8902/M1and 8903/M1Sin/Cos Registration Options

Technical Manual

HA469269U001 Issue 4

Compatible with Version 4.x Software

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Safety Information

Requirements

IMPORTANT: *Please read this information BEFORE installing the equipment.*

Intended Users

This manual is to be made available to all persons who are required to install, configure or service equipment described herein, or any other associated operation.

The information given is intended to highlight safety issues, EMC considerations, and to enable the user to obtain maximum benefit from the equipment.

Complete the following table for future reference detailing how the unit is to be installed and used.

INSTALLATION DETAILS		
Model Number ***(see product label)***		
Where installed ***(for your own information)***		
Unit used as a: ***(refer to Certification for the Inverter)***	O Component	O Relevant Apparatus
Unit fitted:	O Wall-mounted	O Enclosure

Application Area

The equipment described is intended for industrial motor speed control utilising DC motors, AC induction or AC synchronous machines

Personnel

Installation, operation and maintenance of the equipment should be carried out by qualified personnel. A qualified person is someone who is technically competent and familiar with all safety information and established safety practices; with the installation process, operation and maintenance of this equipment; and with all the hazards involved.

Product Warnings

Caution Risk of electric shock	**Caution** Refer to documentation	**Earth/Ground** Protective Conductor Terminal

Safety Information

Hazards

DANGER! - Ignoring the following may result in injury

1. This equipment can endanger life by exposure to rotating machinery and high voltages.
2. The equipment must be permanently earthed due to the high earth leakage current, and the drive motor must be connected to an appropriate safety earth.
3. Ensure all incoming supplies are isolated before working on the equipment. Be aware that there may be more than one supply connection to the drive.
4. There may still be dangerous voltages present at power terminals (motor output, supply input phases, DC bus and the brake, where fitted) when the motor is at standstill or is stopped.
5. For measurements use only a meter to IEC 61010 (CAT III or higher). Always begin using the highest range.
   CAT I and CAT II meters must not be used on this product.
6. Allow at least 5 minutes for the drive's capacitors to discharge to safe voltage levels (<50V). Use the specified meter capable of measuring up to 1000V dc & ac rms to confirm that less than 50V is present between all power terminals and earth.
7. Unless otherwise stated, this product must NOT be dismantled. In the event of a fault the drive must be returned. Refer to "Routine Maintenance and Repair".

WARNING! - Ignoring the following may result in injury or damage to equipment

SAFETY

Where there is conflict between EMC and Safety requirements, personnel safety shall always take precedence.

- Never perform high voltage resistance checks on the wiring without first disconnecting the drive from the circuit being tested.
- Whilst ensuring ventilation is sufficient, provide guarding and /or additional safety systems to prevent injury or damage to equipment.
- When replacing a drive in an application and before returning to use, it is essential that all user defined parameters for the product's operation are correctly installed.
- All control and signal terminals are SELV, i.e. protected by double insulation. Ensure all external wiring is rated for the highest system voltage.
- Thermal sensors contained within the motor must have at least basic insulation.
- All exposed metalwork in the Inverter is protected by basic insulation and bonded to a safety earth.
- RCDs are not recommended for use with this product but, where their use is mandatory, only Type B RCDs should be used.

EMC

- In a domestic environment this product may cause radio interference in which case supplementary mitigation measures may be required.
- This equipment contains electrostatic discharge (ESD) sensitive parts. Observe static control precautions when handling, installing and servicing this product.
- This is a product of the restricted sales distribution class according to IEC 61800-3. It is designated as "professional equipment" as defined in EN61000-3-2. Permission of the supply authority shall be obtained before connection to the low voltage supply.

CAUTION!

APPLICATION RISK

- The specifications, processes and circuitry described herein are for guidance only and may need to be adapted to the user's specific application. We can not guarantee the suitability of the equipment described in this Manual for individual applications.

RISK ASSESSMENT

Under fault conditions, power loss or unintended operating conditions, the drive may not operate as intended.
In particular:

- Stored energy might not discharge to safe levels as quickly as suggested, and can still be present even though the drive appears to be switched off
- The motor's direction of rotation might not be controlled
- The motor speed might not be controlled
- The motor might be energised

A drive is a component within a drive system that may influence its operation or effects under a fault condition.
Consideration must be given to:

- Stored energy
- Supply disconnects
- Sequencing logic
- Unintended operation

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8902/M1 & 8903/M1 OPTIONS

Description

The Sin/Cos Registration Options allow 1V p-p (peak-to-peak) Sin/Cos encoders to be connected directly to the motor controller to provide highly accurate speed feedback measurement and registration.

Features

Two options are available: 8902/M1 and 8903/M1.

Common Features

- Interpolates each encoder line with 11-bit accuracy giving 4 million counts per revolution on a 2048 line encoder
- Optional 1V input from 'Z' index pulse for use with registration
- Captures encoder position on arrival of every edge using up to two registration mark inputs
- Decoding logic to interface the encoder to the drive's microprocessor
- Supplies 5V or 10V to the encoder
- Decodes Heidenhain Endat 2.1 absolute position Encoders

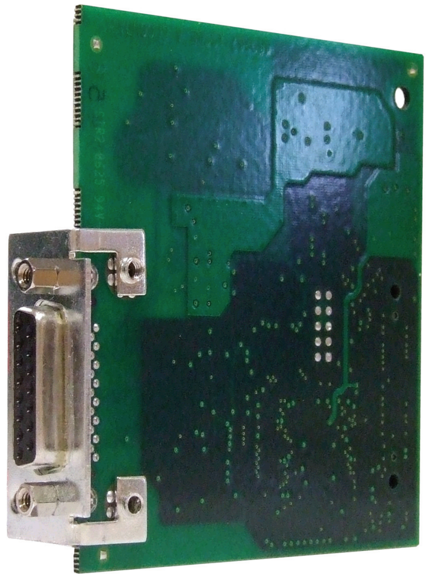

Figure 1 8902/M1 Option

Additional 8903/M1 Features

- Four optically isolated auxiliary digital inputs that can be used either for general purpose inputs, or for inputs from registration mark sensors
- Three non-isolated auxiliary digital outputs that can be used either for general purpose outputs, or for synthesizing an encoder output. These outputs require a supply input. The magnitude of this supply defines the output voltage of these outputs.

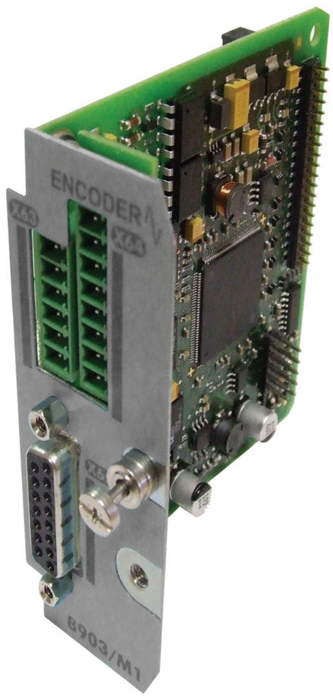

Figure 2 8903/M1 Option

Part Numbers

8902-M1-00-00 Sin/Cos Registration (fitted in the OPTION F position)

8903-M1-00-00 Sin/Cos Registration (fitted in the OPTION A position)

8902-M1-00-**FF** (indicates a factory-fitted option)

8903-M1-00-**FF** (indicates a factory-fitted option)

Used On

These options can be fitted to all 890SD and 890CD drives. The drives have the following product codes:

890SD-..	890SD Standalone Drive
890CD-..	890CD Common Bus Drive

Refer to the 890 Engineering Reference Manual, Appendix E for Product Code details.

Specifications

Encoder Inputs (8902/M1 and 8903/M1)

Maximum Pulse Rate	250kHz
Receiver Impendance	120Ω
Input Format	Two differential 1V p-p signals in quadrature
Encoder Supply	Maximum load: 250mA Voltage adjustable: 5V/10V
Terminal Type	15-way, D-type socket
Maximum cable length	150 metres screened cable
Serial protocol	Endat 2.1

Auxiliary Digital Inputs (8903/M1 only)

Low logic level	0V to 5V relative to X63 pin 5
High logic level	15V to 26V relative to X63 pin 5
Absolute Maximum Input Voltage	30V relative to X63 pin 5
Input current (low logic level)	< 1mA
Input current (high logic level)	> 3mA, < 10mA
Typical Input current at 24V	7mA
Isolation withstand relative to drive chassis	30V
Input safety category	SELV
Terminal Type	6-way pluggable 3.5mm terminal block
Maximum cable length	150 metres. Screened cable is recommended for all lengths, but essential if over 30 metres in order to comply with EMC regulations.

Auxiliary Digital Outputs (8903/M1 only)

Operating Input Supply Voltage (V_S)	5V to 24V
Absolute Maximum Supply Voltage	30V
Maximum Output Current	± 100mA per output
Output Voltage (low logic level)	< 3V at 100mA
Output Voltage (high logic level)	> V_S – 4V at 100mA
Overload and short circuit duration	Indefinite
Maximum Output Frequency	250kHz on each output
Terminal Type	8-way pluggable 3.5mm terminal block
Maximum cable length	150 metres. Screened cable is recommended for all lengths, but essential if over 30 metres in order to comply with EMC regulations.

Hardware / Software Compatibility

There are some incompatibilities between hardware versions of 8903/M1 and 890 drive firmware, as in the following table.

<table>
<tr><th colspan="2" rowspan="2">Drive Firmware Version</th><th colspan="4">8903/M1 Hardware Revision</th></tr>
<tr><th>M01</th><th>M02</th><th>M03</th><th>M04</th></tr>
<tr><td>V1.x</td><td>All</td><td colspan="4">No</td></tr>
<tr><td>V2.x</td><td>All</td><td colspan="4">No</td></tr>
<tr><td rowspan="2">V3.x</td><td>V3.1 to V3.4</td><td colspan="4">No</td></tr>
<tr><td>V3.5 and later</td><td colspan="2">No</td><td colspan="2">Yes[i]</td></tr>
<tr><td rowspan="3">V4.x</td><td>V4.1a to v4.1e</td><td colspan="2">Yes[ii]</td><td colspan="2">No</td></tr>
<tr><td>V4.1f</td><td colspan="4">No</td></tr>
<tr><td>V4.1g and later</td><td colspan="3">No</td><td>Yes</td></tr>
</table>

Notes:

A table entry of ‘No’ indicates this combination of drive firmware and 8903/M1 hardware is not compatible. A suitable version of drive firmware can be downloaded from www.ssddrives.com.

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[i] Synthetic encoder function only. Registration is not supported.

[ii] Synthetic encoder is unstable.

4 Option Configurations

The two Registration Options may be fitted into a drive in the combinations shown below.

8902/M1	8903/M1	Functions
FITTED	not fitted	The 8902/M1 functions as speed feedback for the drive. Registration is available only using the encoder's 1 Volt index pulse.
not fitted	**FITTED**	The 8903/M1 functions as speed feedback for the drive. Auxiliary Digital Inputs and the encoder's index pulse (if supplied by the encoder) are available for registration event inputs. The Auxiliary Digital Inputs are also available for general purpose digital inputs. Auxiliary Digital Outputs are available for a simulated pulse encoder output, or for general purpose digital outputs. In this combination, a reference encoder position would normally be supplied via a Firewire option interface (8903/FA).
FITTED	**FITTED**	The 8902/M1 functions as speed feedback for the drive. The 8903/M1 encoder input is available to provide a reference encoder position. Auxiliary Digital Inputs and the index pulse (if supplied by the encoders) from both encoders are available for registration event inputs. The Auxiliary Digital Inputs are also available for general purpose digital inputs. Auxiliary Digital Outputs are available for a simulated pulse encoder output, or for general purpose digital outputs.

Installation

WARNING!
Before installing, ensure that the drive wiring is electrically isolated and cannot be made "live" unintentionally by other personnel.
Wait 5 minutes after disconnecting power before working on any part of the system or removing the covers from the drives.

To Remove the Control Board

1. Remove the blank covers that fit over the TechCard holes (1). Each cover is secured by a single screw,.
2. Loosen the top and bottom screws in the handles (2) of the Control Board.
3. Pull gently on the handles (2) and slide the Control Board out of the drive.

Note: *Save the blank cover and screw for future use. The drive should not be operated without a TechCard or blank cover. When fitted, these maintain the drive's IP20 rating.*

Figure 2. 890 showing Control Board withdrawn with various Options fitted

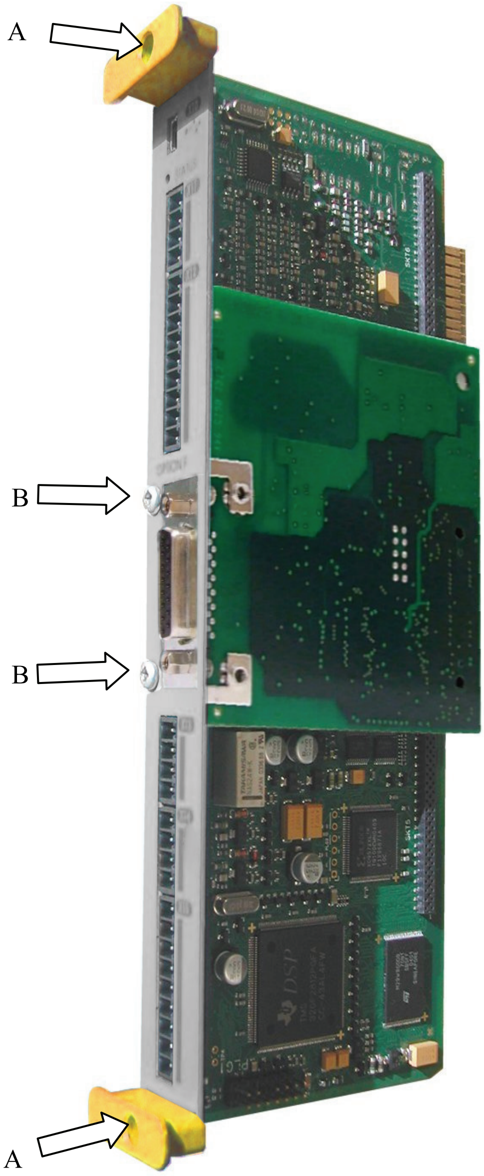
Figure 3. Front of 890 drive showing Control Board fitted

Fitting the 8902/M1 Option

The 8902/M1 fits on to the Control Board in the OPTION F position.

When also fitting the 8903/M1 Option, it is easier to fit the 8902/M1 Option first.

If the Option is not factory-fitted, follow the procedure given below.



WARNING!
Disconnect all sources of power before attempting installation.

Caution
This Option contains ESD (Electrostatic Discharge) sensitive parts. Observe static control precautions when handling, installing and servicing this Option.

1. Undo the two screws (B) and remove the blanking plate.
2. Offer up the Sin/Cos Option through the "OPTION F" cut-out as shown opposite.
3. Fit the two locating pegs of the large connector on the rear edge of the option board into the locating holes on the control board, as shown below.
4. Fit the two screws (C) at the rear edge of the Option.

   DO NOT OVERTIGHTEN

   Tightening torque: 0.2Nm (28 oz-in)
5. Secure with the two screws (B) to the front of the control board.

   The front panel screws (B) are self-tapping and can be quite hard to turn. This turning torque must not be transferred through the option board to the control board connector. To avoid this hold the option board with one hand, while tightening the front panel screws with the other. DO NOT hold the control board whilt tightening these screws.
6. Replace the control board (with attached Options) into the drive.
7. Tighten the Option A and Option B screws; or importantly, fit the blank covers and secure with the screws.

Figure 4 Rear of Control Board

Fitting the 8903/M1 Option

The TechCard fits onto the Control Board in the OPTION A (TOP) position.

1. Insert the connector into the TechCard as shown. The legs of the connector will protrude through into the connector on the other side of the TechCard.
2. Press the assembly into the **TOP** connector (adjacent to terminals X10, and X12) on the Control Board. Ensure that the front panel of the TechCard overlaps the front of the Control Board. Ease the connector at the TechCard so that the two PCB's are parallel when viewed on edge.

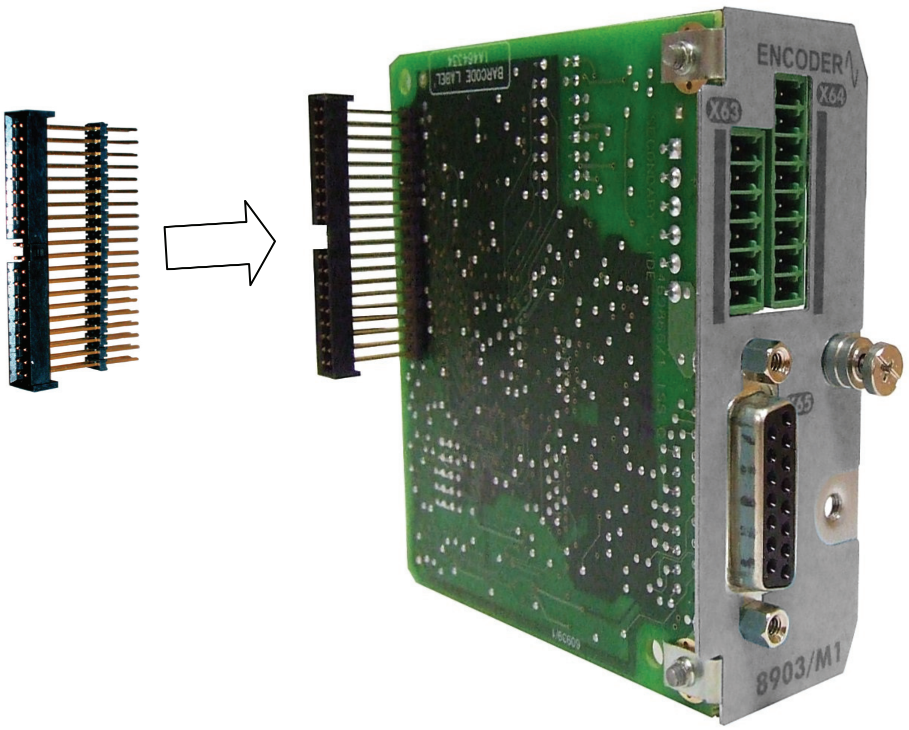


Figure 5. Fitting the connector to the TechCard

Wiring the System

WARNING!
Disconnect all sources of power before attempting installation.

Caution
This Option contains ESD (Electrostatic Discharge) sensitive parts. Observe static control precautions when handling, installing and servicing this Option.

D-Type Connections - 8902/M1 & 8903/M1

Take special care wiring the encoders to the TechCards due to the low level of the signals.

- Use twisted-pair, screened cable with an overall screen and a screen over each individual pair. The signal pairs should have characteristic impedance of 120Ω.
- At the 890x/M1 end of the encoder cable, use a D-type connector with conductive shell to ensure a good electrical connection between cable screen and the front panel metalwork of the 890x/M1.
- To ensure compliance with the EMC Directive connect the overall cable screen to the encoder body and to the cable clamp.
- Use the encoder manufacturer's recommended cable.
- The maximum cable length is 150 metres.

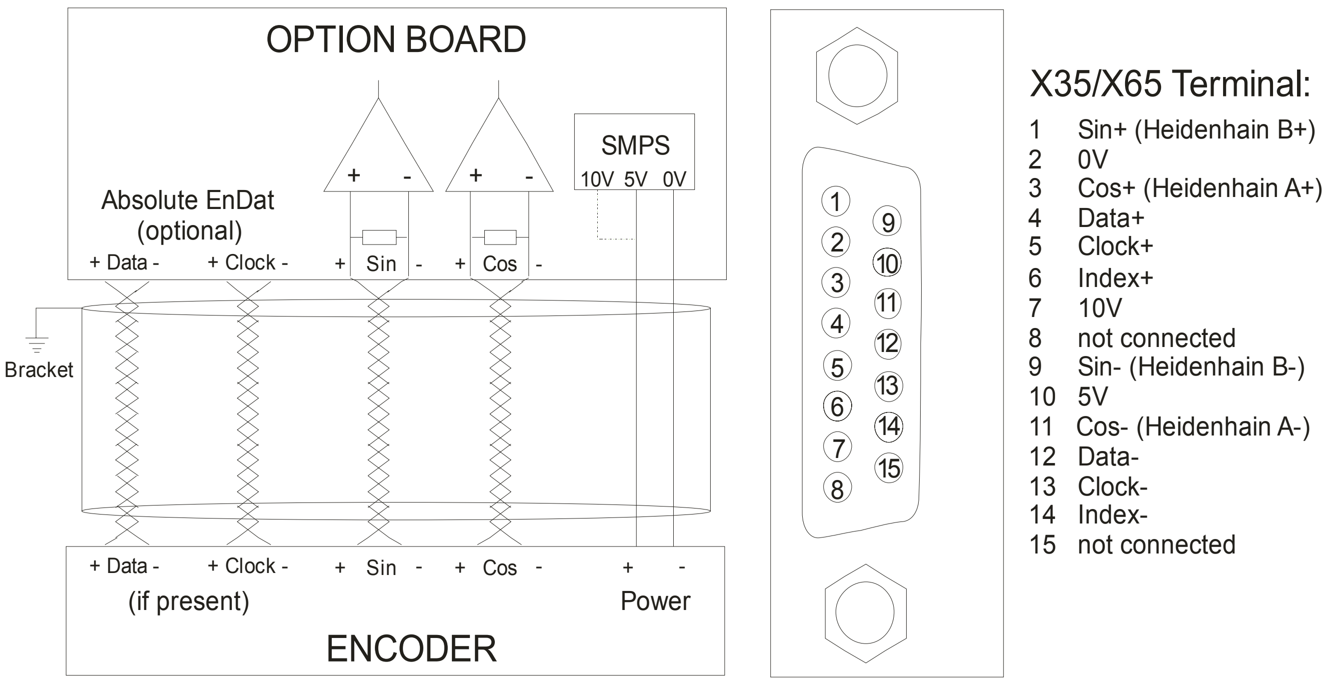
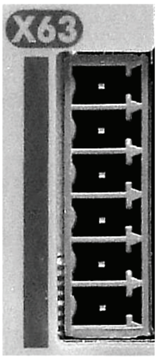


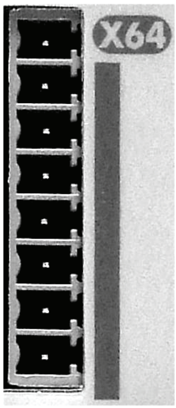
Figure 6 Wiring Diagram

Auxiliary Digital Inputs - 8903/M1



Pin Number	Description
1	Auxiliary Digital Input 1
2	Auxiliary Digital Input 2
3	Auxiliary Digital Input 3
4	Auxiliary Digital Input 4
5	Common 0V for Auxiliary Digital Inputs. This pin is electrically isolated from the drive electronics.
6	Cable shield (if fitted). Connects to drive chassis.

Auxiliary Digital Outputs - 8903/M1



Pin Number	Description
1	Auxiliary Digital Output 1
2	Inverse of Auxiliary Digital Output 1
3	Auxiliary Digital Output 2
4	Inverse of Auxiliary Digital Output 2
5	Auxiliary Digital Output 3
6	Inverse of Auxiliary Digital Output 3
7	Positive Supply for Auxiliary Digital Outputs
8	Negative Supply for Auxiliary Digital Outputs. It is connected internally to drive 0V

Parker SSD Drives Approved Encoders

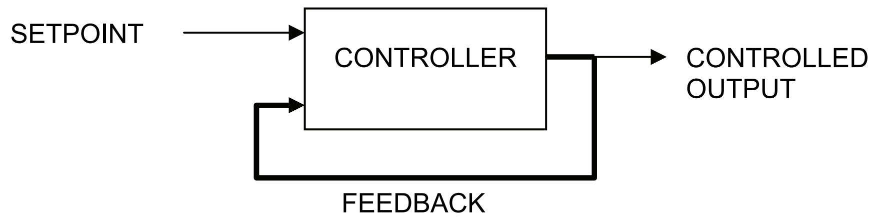
Parker SSD Drives recommend the use of the following encoders:

	1V p-p	EnDat 2.1	Single Turn ABS	Multi-turn ABS
Heidenhain:				
EQN425	✓	✓		✓
ECN413	✓	✓	✓	
ERN480	✓			
Stegmann:				
HG660 AKR(xxxx)S	✓			
HG660 DKR(xxxx)S	✓			
Hengstler:				
RIS58-H	✓			

Operating Principles

Closed-Loop Control System

The 8903/M1 and 8902/M1 provide a closed-loop control system. The diagram below shows a generalised closed-loop control system:

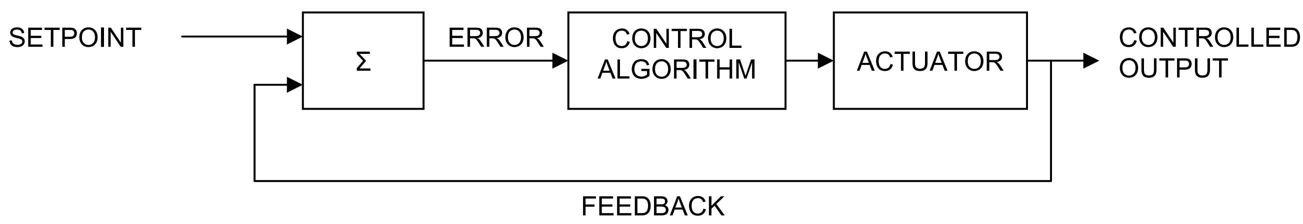


The bold line shows the loop, from controller output back to its input, which gives the closed-loop control system its name.

The control loop controls the position of an output (the controlled output) under instruction from a setpoint. Examples of control loops are:

- **Temperature-controlled oven**. An input, for example from a potentiometer, instructs the control algorithm what temperature to set the oven. A thermocouple measures the actual oven temperature. The control algorithm compares the temperature setpoint with feedback from the thermocouple and decides whether to turn on a heating element or not in order to maintain the desired temperature.
- **Motor speed controller.** An input instructs the controller how fast to turn a motor. A sensor attached to the motor shaft provides speed feedback to the controller. The controller compares setpoint with speed feedback and decides whether to speed up the motor or to slow it down to maintain the desired speed.

Expanding the diagram above:



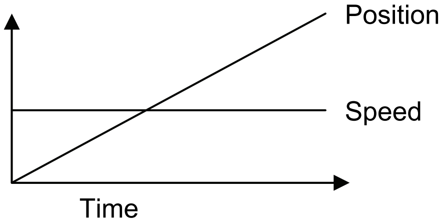
A summing junction, indicated by the Σ symbol, compares setpoint with feedback from the controlled output, and generates an error value. The control algorithm controls an actuator, for example a heating element or an electric motor, in such a way as to make the error as close as possible to zero.

Closed-Loop Position Controller

A closed-loop position controller is an example of a closed-loop control system. A setpoint, the **reference**, tells the control system where to position the output, for example a print shaft. **Feedback**, for example from a rotary encoder, tells the control system where the print shaft actually is.

In the example of a printing process, the **reference** is a continually changing value because the position is required to continually change, usually at a constant rate. That is, the print shaft is required to turn at a constant speed, and therefore its position is required to change at a constant rate. An encoder provides **feedback** to tell the control system the instantaneous position of the motor shaft.

In the printing process example, the position controller causes the print cylinder to follow the print web position, so that the surface speed of the print cylinder is equal to the linear speed of the print web.

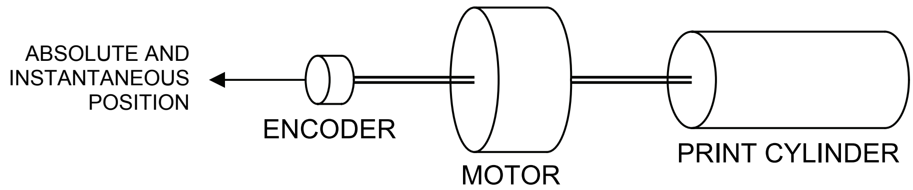


This describes a **relative** position controller. The position of the print cylinder is relative to some arbitrary starting position, i.e. the position when the system was turned on.

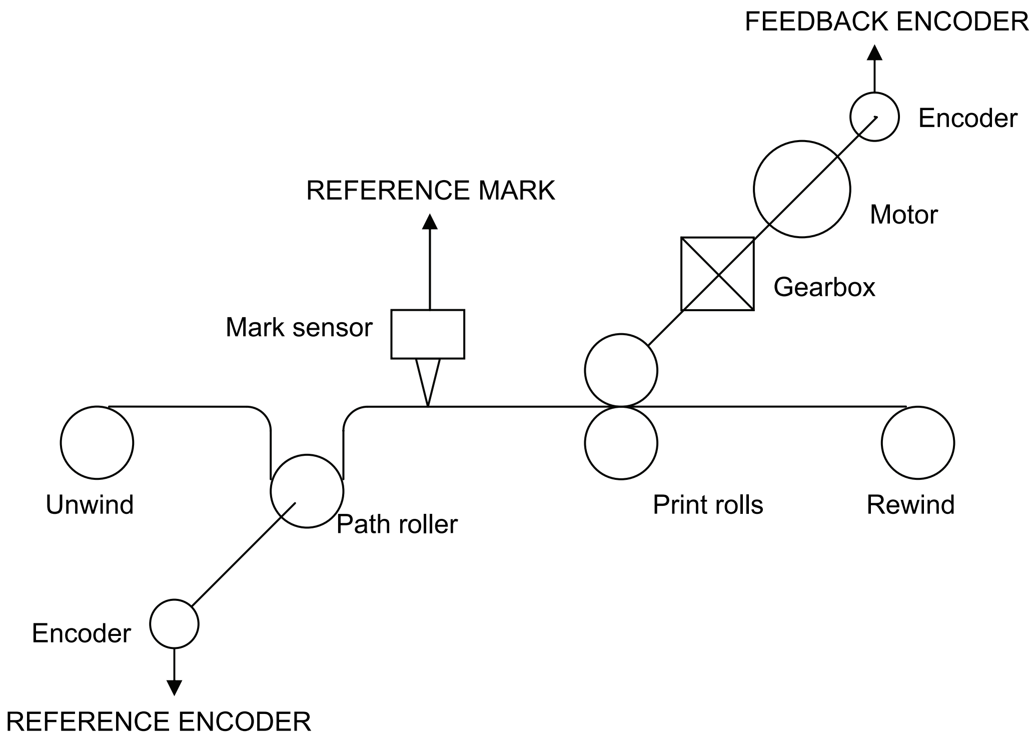
In general, this is not sufficient for a printing process. The print cylinder must usually be synchronised to pre-printed marks on the print web. This requires an **absolute** position controller. Absolute reference and absolute feedback are required.

Absolute reference position is usually provided by pre-printed marks on the web, which are detected by an optical sensor.

Absolute feedback position is provided in a variety of ways depending on the mechanical configuration. For example if the motor is connected directly to the print cylinder, a single encoder attached to the motor shaft can provide both instantaneous position for speed feedback and absolute position for registration.



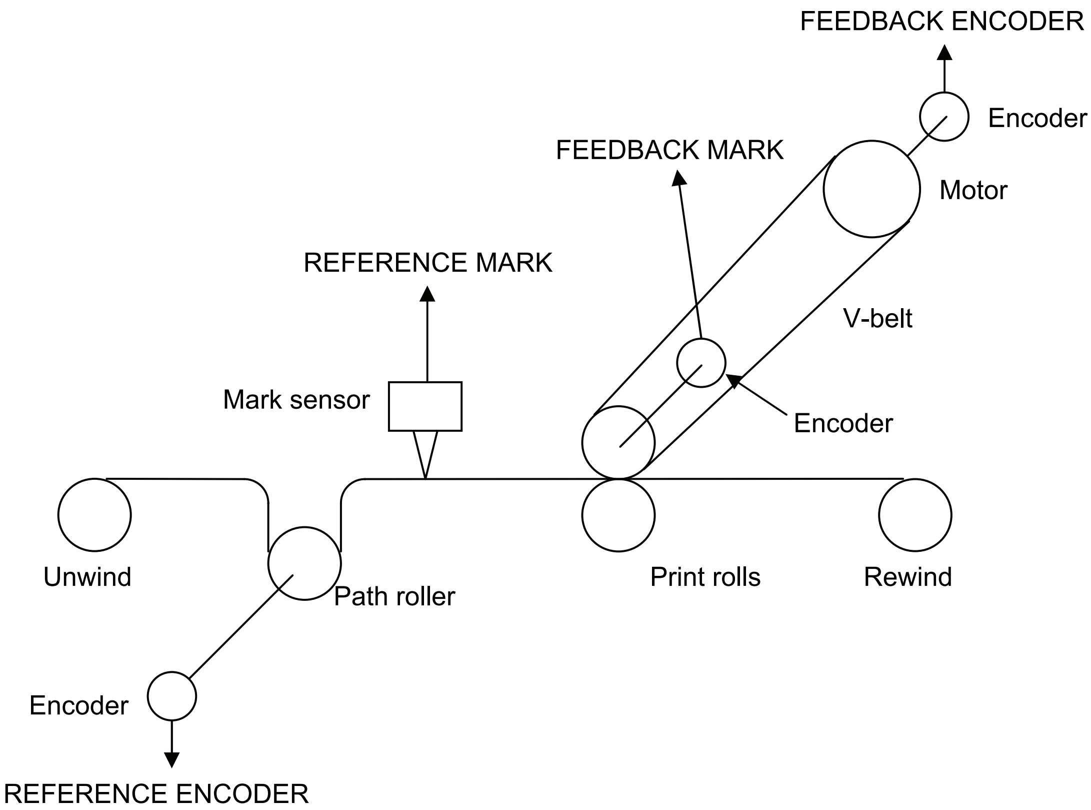
Absolute multi-turn encoders are available that provide instantaneous relative position by means of two quadrature pulse trains or sine wave outputs, and also a slower absolute position over a serial link. The absolute position is typically used to preset the instantaeous position at power-up. This process is known as calibration. It turns the otherwise relative instantaneous position into an absolute one.



Other systems may have a gearbox or other mechanical linkage between the motor shaft and print cylinder.

If the speed ratio between motor shaft and print cylinder is fixed, for example a direct drive, a gearbox or a toothed belt, then the absolute position of the print cylinder can be deduced from the absolute position of the motor shaft. The motor shaft will usually have an encoder fitted to it that provides absolute position feedback as well as feedback for closing the drive's speed loop. This is an example of **one-mark registration**. Because the absolute feedback encoder position is known at all times, it is unnecessary to provide a feedback mark in order to derive an absolute position.

If the speed ratio between motor shaft and print cylinder is not absolutely fixed, for example a V-belt, then an absolute feedback position sensor must be fitted to the print cylinder. This is typically an encoder fitted to the print cylinder that provides a once-per-revolution index pulse. This is an example of **two-mark registration**.

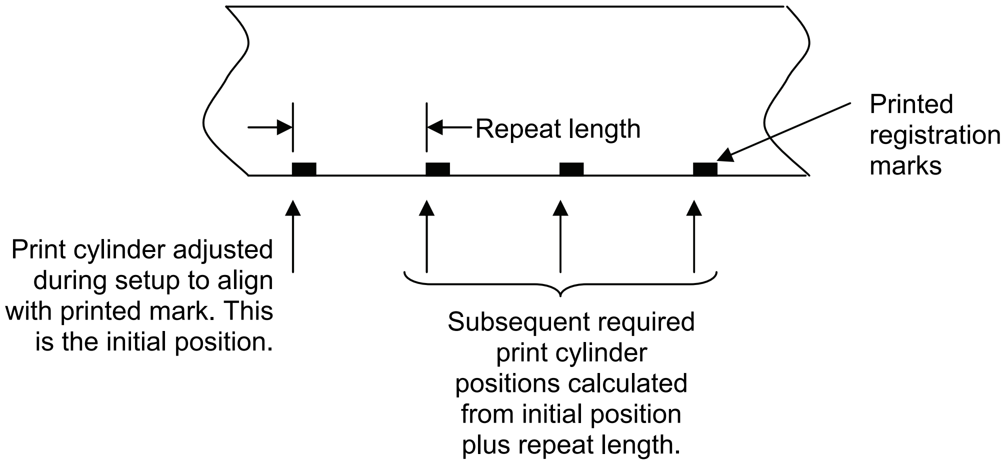


Calculating the Error in a 1-Mark Registration System

It was shown earlier that an error calculator is a key element in any closed-loop control system. It compares a reference value with a feedback value and calculates the difference between the two.

In the case of a 1-mark registration system, the absolute reference position is derived from a sensor which detects registration marks on the process material. It causes the instantaneous position of the feedback encoder to be latched when registration marks occur. This is the absolute reference position.

The required absolute feedback position is calculated by adding one repeat length to the absolute position of the previous repeat. This clearly requires an initial absolute position to be defined. This is part of the commissioning procedure for each print job. Once defined, the absolute feedback position can be calculated for every repeat thereafter.

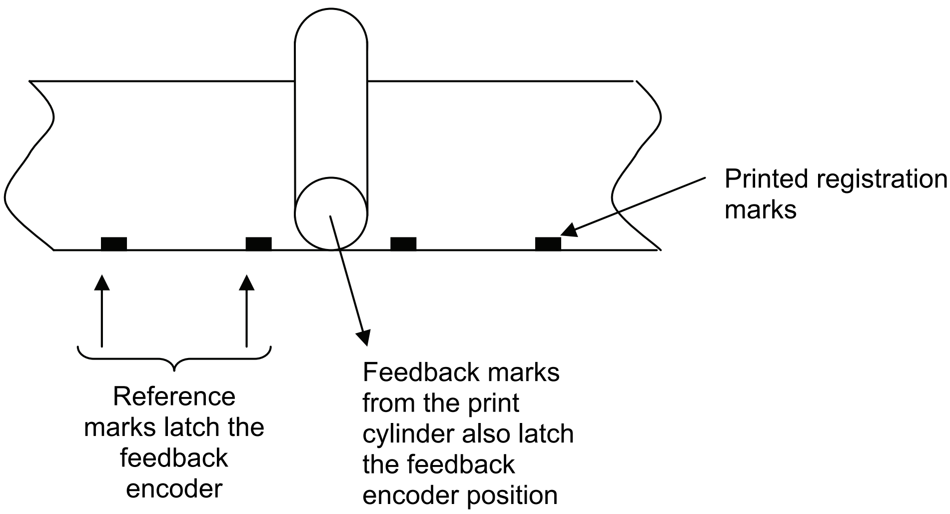


Registration Error = (Feedback Encoder Position when Reference Mark was detected) minus

(Feedback Encoder Position calculated from previous repeat)

Calculating the Error in a 2-Mark Registration System

Whereas the feedback position is the result of calculation in a 1-mark system, in a 2-mark system the feedback position is created by latching the feedback encoder position when a feedback mark occurs.



Registration Error = (Feedback Encoder Position when Reference Mark was detected) minus

(Feedback Encoder Position when Feedback Mark was detected)

14

Using the 8903/M1 and 8902/M1 to Implement Registration Control

There are many different applications for registration, each having a unique set of requirements.

The 8903/M1 and 8902/M1 are very flexible, allowing a wide variety of applications with a high degree of configurability by the user.

The following sections explain how these option boards can be used and configured to solve most registration applications.

Initial Set-Up

Configuring the 890 Drive

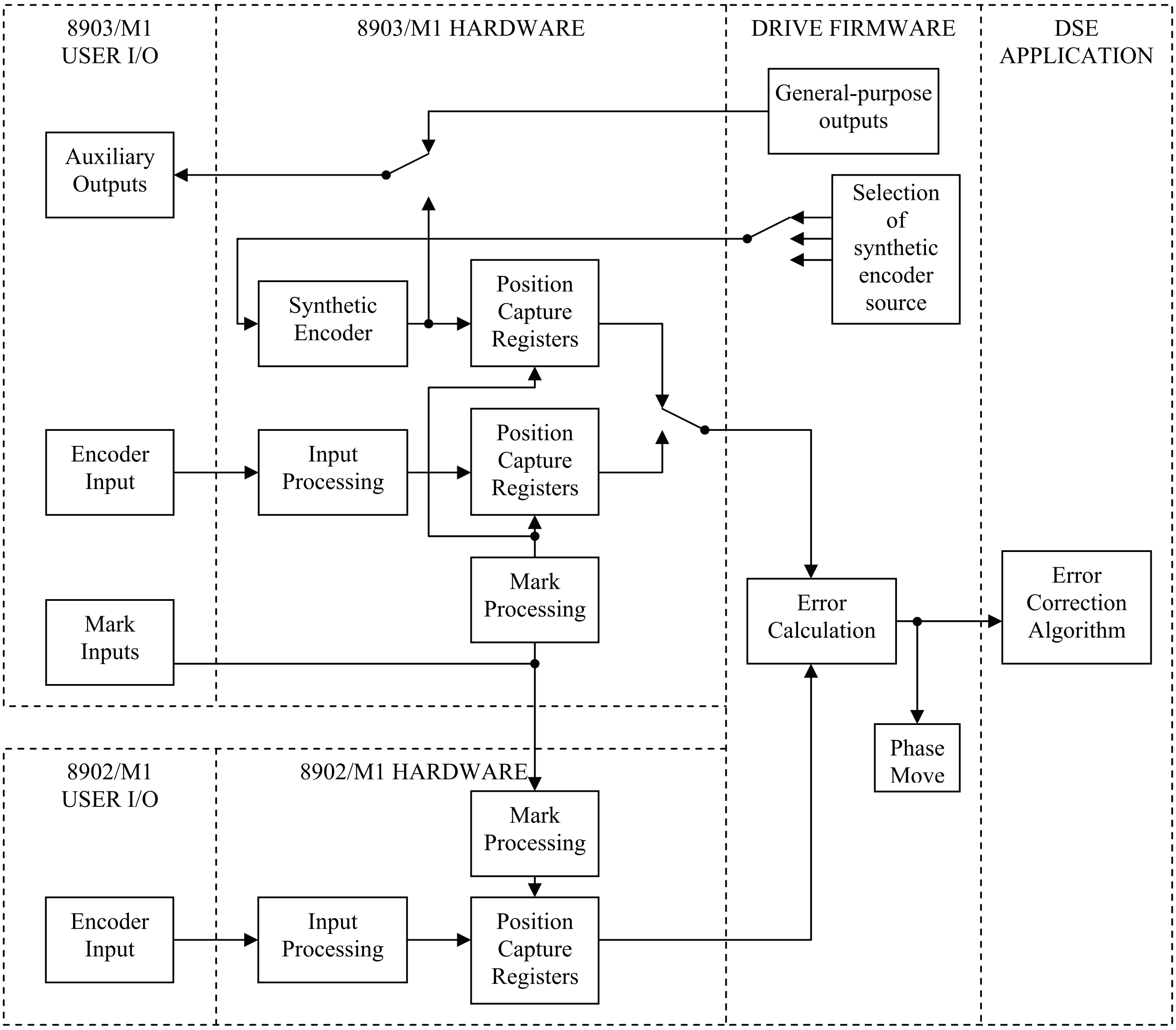
A registration application is configured in three stages:

1. Decide on the system configuration. This involves looking at the application and deciding which option boards should be fitted into which drives.
2. Use the DSE 890 Configuration Tool or HMI to configure the function blocks associated with registration.
3. Create a LINK application that determines how the registration error is processed to eliminate the error.

NOTE The three stage approach provides maximum flexibility. Many applications require different methods of correction. For example, a flying cut application may require the error to be corrected completely within one repeat length, whereas a print registration may require correction over several repeats.

STAGE 1: Configuring the System Hardware

The diagram below shows a simplified block diagram of the 8903/M1 and 8902/M1 option boards:



8903/M1 USER I/O

AUXILIARY OUTPUTS

There are three auxiliary digital outputs. Each output consists of a differential pair, but can be used single-ended if required by connecting a load between one of the pair and 0V, i.e. X64 pin 8.

A supply input is required for these outputs, the voltage of which determines the signal level of the auxiliary digital outputs. For example, 5V supply provides RS422/485 signal levels, while 24V provides levels compatible with IEC61131-2.

The outputs are selectable as either synthetic encoder outputs (A, B and Z) or general purpose outputs.

ENCODER INPUT

This is the sine/cosine encoder input. If an 8902/M1 option is also fitted in the same drive, this input is used as the registration reference encoder input. If the 8902/M1 option is not fitted, this encoder input is used for drive feedback and may also be used as the registration reference, depending on the application.

MARK INPUTS
There are four mark inputs. Any may be selected as mark inputs required for registration. Inputs unused by registration are available as general-purpose inputs via the AUX IO OPTION A menu.

8903/M1 HARDWARE

INPUT PROCESSING
This block processes the sine/cosine encoder inputs, under control of the CONFIG OPTION A menu.

MARK PROCESSING
This block processes the mark inputs under control of the CONFIG OPTION A, OPTION A MARK 1/2 menus. Parameters are available to configure:

Selection of mark inputs from available sources
Noise filtering
Inversion to allow for active-low marks
Windowing
Mark pulse width discrimination

The selected marks are known in the remainder of this manual as Mark 1 and Mark 2.

POSITION CAPTURE REGISTERS
There are four such registers in the 8903/M1. They capture:

The synthetic encoder position on rising and falling edges of Mark 1.
The synthetic encoder position on rising and falling edges of Mark 2.
The physical encoder position on rising and falling edges of Mark 1.
The physical encoder position on rising and falling edges of Mark 2.

SYNTHETIC ENCODER
This block emulates a quadrature pulse encoder. Its frequency is controlled by a phase-locked loop (PLL), the input to which is selectable from several sources. It can be used for example to re-create a reference encoder from a virtual master transmitted to the drive over Firewire.

8902/M1 USER I/O

ENCODER INPUT
This is the sine/cosine encoder input. This input is used as the registration feedback encoder input and as the drive's speed feedback.

8902/M1 HARDWARE

INPUT PROCESSING
This block processes the sine/cosine encoder inputs, under control of the CONFIG OPTION F menu.

MARK PROCESSING
This block processes the mark inputs under control of the CONFIG OPTION F, OPTION F MARK 1/2 menus. Parameters are available to configure:

Selection of mark inputs from available sources
Noise filtering
Inversion to allow for active-low marks
Windowing
Mark pulse width discrimination

The selected marks are known in the remainder of this manual as Mark 1 and Mark 2.

POSITION CAPTURE REGISTERS
There are two such registers in the 8902/M1. They capture:

The physical encoder position on rising and falling edges of Mark 1.
The physical encoder position on rising and falling edges of Mark 2.

DRIVE FIRMWARE

GENERAL PURPOSE OUTPUTS

This block is used to generate general-purpose outputs that can be routed through the 8903/M1 hardware to the auxiliary digital outputs.

SELECTION OF SYNTHETIC ENCODER SOURCE

This block selects the source for synthetic encoder. The synthetic encoder can either be phase-locked onto the 8902/M1 or 8903/M1 encoder input or a virtual master transmitted to the drive via a 8903/FA or 8903/FB Firewire option board, or it can simulate an encoder under total firmware control.

ERROR CALCULATION

This block takes encoder positions captured by Mark 1 and Mark 2. The drive firmware calculates the difference between the two positions to produce a measure of registration error.

There are parameters to select which encoder positions are used in the calculation: synthetic encoder, 8903/M1 encoder input or 8902/M1 encoder input.

PHASE MOVE

This block, which can be disabled by a parameter setting, corrects the registration error.

In addition to a parameter to enable or disable this function, there are parameters to control the rate of correction. For example, the correction can be made within one repeat, or it can be made over several repeats.

A phase move correction should not be enabled at the same time as a DSE error correction algorithm.

DSE APPLICATION

ERROR CORRECTION ALGORITHM

This function should be used only if the phase move correction (see above) is inadequate. It provides greater flexibility, but due to the nature of DSE, the execution times are not as well controlled, so response times may be longer.

Unlike the hardware and drive firmware which are configured by parameters, the error correction algorithm is programmable by linking together function blocks in a DSE application.

There are many different registration applications, and the correction algorithm is likely to vary from one application to another. For example, the action to be taken when a mark is missed: in some applications retrying on the next repeat might be adequate, whereas on other applications it may be necessary to stop the drive. Assigning the correction algorithm to a DSE application provides complete freedom to configure the drive according to the application.

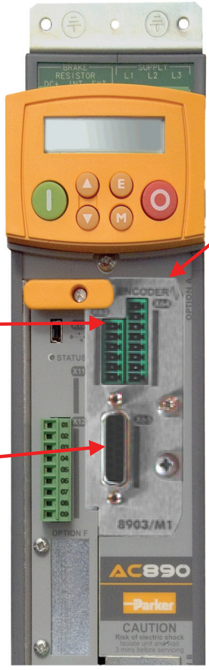
Drive Configuration

There are several ways to configure 890 drives with 8903/M1 and 8902/M1 options. This section provides some example configurations.

Examples: Configuration 1

MARK 1
(REFERENCE)
INPUT

FEEDBACK
ENCODER



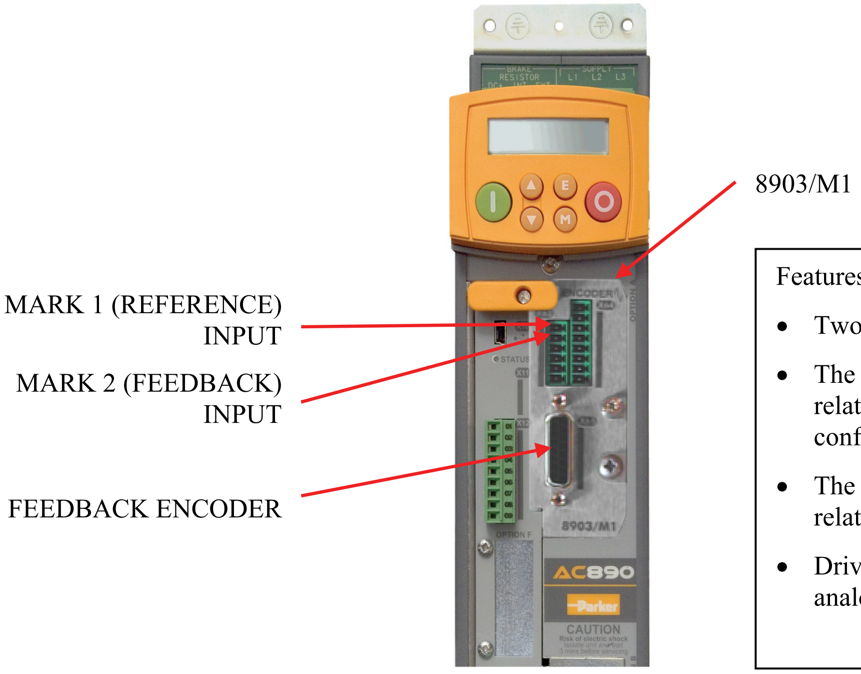
8903/M1

Features:

- One mark system.
- A feedback mark is unnecessary if the feedback encoder provides absolute position (e.g. Endat 2.1), and there is no possibility of slippage between the encoder and the controlled shaft.
- The reference mark can be windowed relative to the synthetic encoder with this configuration.
- Drive setpoint can be from Firewire or analogue input.

Note: If only an 8903/M1 option is fitted, it also provides speed feedback for the drive.

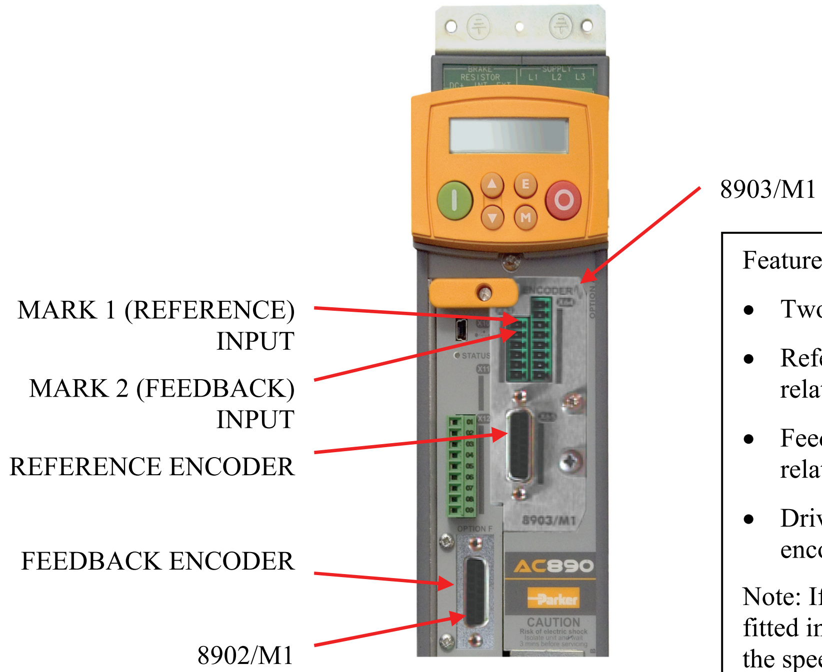
Examples: Configuration 2



Features:

- Two mark system.
- The reference mark cannot be windowed relative to the physical encoder with this configuration.
- The feedback mark can be windowed relative to the feedback encoder.
- Drive setpoint can be from Firewire or analogue input.

Examples: Configuration 3

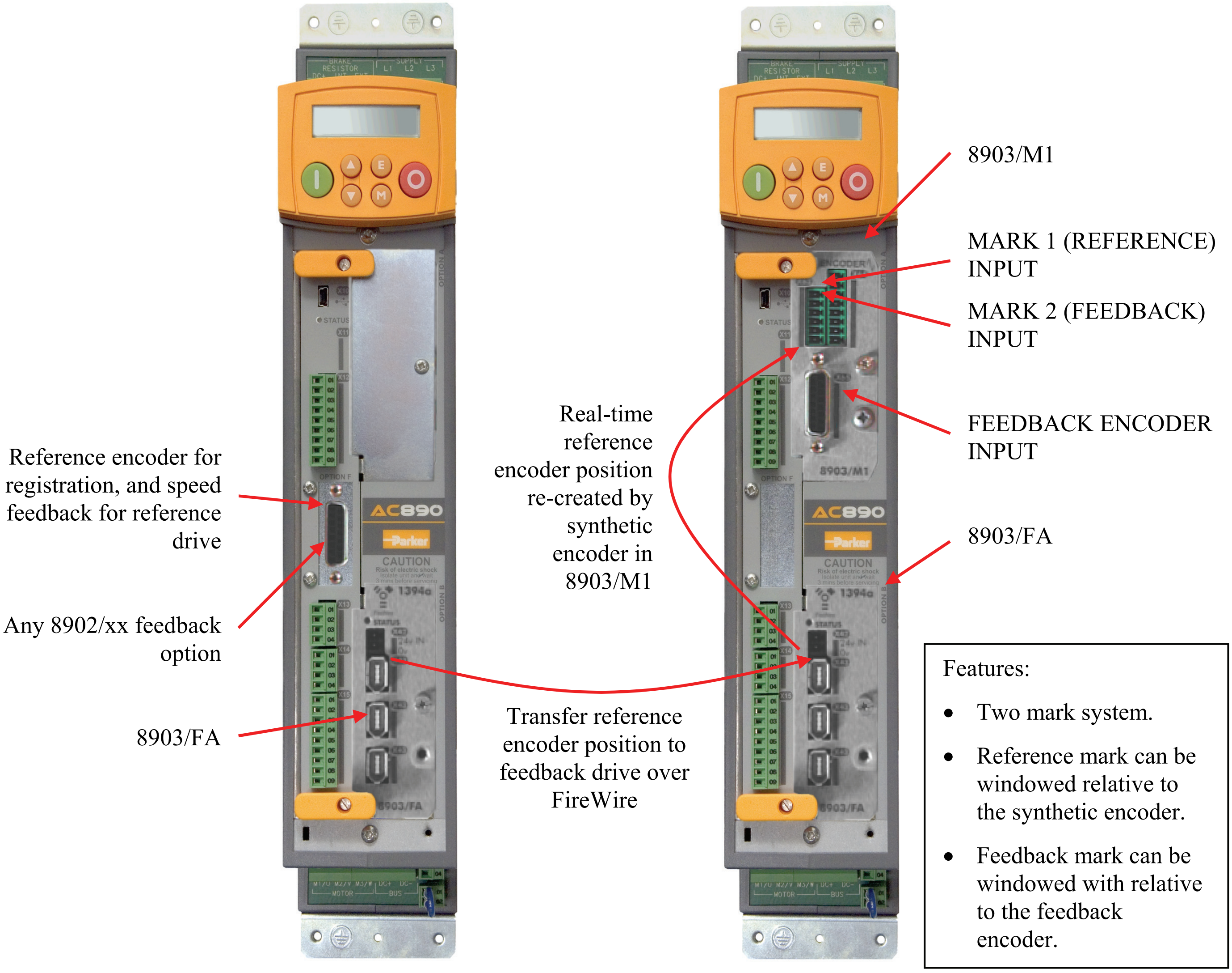


Features:

- Two mark system.
- Reference mark can be windowed relative to the reference encoder.
- Feedback mark can be windowed relative to the feedback encoder.
- Drive setpoint can be from reference encoder, Firewire or analogue input.

Note: If an 8902/M1 and 8903/M1 are both fitted in one drive, the 8902/M1 is always the speed feedback for the drive.

Examples: Configuration 4



Features:

- Two mark system.
- Reference mark can be windowed relative to the synthetic encoder.
- Feedback mark can be windowed with relative to the feedback encoder.

Important Notes

If only one registration board is fitted, either 8902/M1 or 8903/M1, it also provides speed feedback for the drive, and will be configured via the SETUP::MOTOR CONTROL::ENCODER menu.

If both 8902/M1 and 8903/M1 are fitted in one drive, the 8902/M1 always provides speed feedback, and is also always the registration feedback option. It will be configured via the SETUP::MOTOR CONTROL::ENCODER menu. The 8903/M1 in this case is always the registration reference, and the encoder input is configured via the SETUP:: PHASE CONTROL::REFERNCE ENCODER menu.

Reference marks are usually windowed relative to the reference encoder or synthetic encoder, and feedback marks are usually windowed relative to the feedback encoder.

STAGE 2: Configuring the Function Blocks

Set-up the following function blocks to configure a registration application. Use either the DSE 890 Configuration Tool supplied with the drive, or the Keypad.

Refer to Appendix A for details of how to set up each parameter in the function blocks.

Options Fitted			Function Blocks to Configure
8902	8903	8902 & 8903	
	●	●	**AUX IO OPTION A** SETUP::REGISTRATION::AUX IO OPTION A Configures the auxiliary inputs and outputs of the 8903/M1 fitted in option A. These parameters are not required for registration applications, only when these inputs and outputs are used for general purpose.
	●	●	**CONFIG OPTION A** SETUP::REGISTRATION::CONFIG OPTION A Configures the registration hardware for option A
	●	●	**OPTION A MARK1** SETUP::REGISTRATION::OPTION A MARK1 Configures parameters to process Mark 1 on option A
	●	●	**OPTION A MARK2** SETUP::REGISTRATION:OPTION A MARK2 Configures parameters to process Mark 2. on option A
●		●	**CONFIG OPTION F** SETUP::REGISTRATION::CONFIG OPTION F Configures the registration hardware for option F
●		●	**OPTION F MARK1** SETUP::REGISTRATION::OPTION F MARK1 Configures parameters to process Mark 1 on option F
●		●	**OPTION F MARK2** SETUP::REGISTRATION::OPTION F MARK2 Configures parameters to process Mark 2 on option F
●	●	●	**REGISTER MOVE** SETUP::REGISTRATION::REGISTER MOVE Configures parameters that determine how a registration error is calculated, and if enabled, performs a Phase Move to correct the error.
●	●	●	**ENCODER** SETUP:: MOTOR CONTROL::ENCODER Configures the hardware interface to the feedback encoder: either 8902/M1 or 8903/M1
		●	**REFERNCE ENCODER** SETUP:: PHASE CONTROL::REFERNCE ENCODER Configures the hardware interface to the 8903/M1 if an 8902/M1 is fitted in the OPTION F position
	●	●	**V MASTER SIMLATR** SETUP::PHASE CONTROL::V MASTER SIMLATR Configures the synthetic encoder

NOTE *The REGISTER MOVE function block is disabled by default. To enable the block, the MOVE ENABLE parameter must be set to TRUE.*

The function blocks above contain parameters allowing you to configure to your particular application. However, certain parameters must be enabled for all applications.

These are:

Option	Function Block	Parameters to Set	
8903/M1	OPTION A MARK 1	MARK METHOD ENABLE METHOD	Select the method used to configure MARK 1 Enable the registration method selected by the MARK METHOD parameter
8903/M1	OPTION A MARK 2 (required only if ERROR METHOD in the REGISTER MOVE function block is set to OPT A, MA1 MA2)	MARK METHOD ENABLE METHOD	Select the method used to configure MARK 2 (if used) Enable the registration method selected by the MARK METHOD parameter (if used)
8902/M1 and/or 8903/M1	REGISTER MOVE	ERROR METHOD ENABLE METHOD MOVE ENABLE	Select the method used to calculate the registration error Enable error calculation Enable or disable the firmware-based phase move. If disabled, a DSE-based error correction algorithm must be enabled.

Configure Registration Hardware

In function block CONFIG OPTION A, set the following minimum set of parameters:

SEL MARK 1 INPUT : Select the source for mark 1. The default is Auxiliary Digital Input 1, which is pin 1 on terminal block X64.

SEL MARK 2 INPUT (if used) : Select the source for mark 2. The default is Auxiliary Digital Input 2, which is pin 2 on terminal block X64.

INVERT MARK 1 : Set this to TRUE if the mark 1 sensor is active low, i.e. it produces a low output voltage level when a mark is detected.

INVERT MARK 2 : Set this to TRUE if the mark 2 sensor is active low, i.e. it produces a low output voltage level when a mark is detected.

SCALE A and **SCALE B :** These parameters define the user units used in all registration function blocks. As a guide, SCALE A can be the repeat length in user units, for example millimetres, and SCALE B can be the repeat length in encoder units. If you know the values required, you can enter them. Otherwise leave both values at default, and the user units will then be the same as the encoder units, i.e. the number of encoder lines per mechanical revolution multiplied by 2048. For example a 2048 line encoder will give 4194304 counts per revolution.

COUNT DIRECTION : Feed a mark past the sensor in the same direction as required by the application. Note the value in MARK 1 (or 2) LATCH. Feed a second mark past the sensor, and note the new value in MARK 1 (or 2) LATCH. If the two values are of different sign, i.e. one is positive and the other negative, repeat this exercise. Then if the difference between the two values (i.e. second value – first value) is negative, change COUNT DIRECTION to NEGATIVE (assuming it was initially POSITIVE).

LATCH SOURCE : Change this to SYNTHETIC ENC if using the synthetic encoder for registration. Otherwise leave it as the default REAL ENCODER.

Machine Parameters

The MARK METHOD parameter (found in function blocks OPTION A MARK 1 & 2 and OPTION F MARK 1 & 2) is used to select the method of configuring a mark.

It's worthy of a special mention as it contains the selection for TEACH IN. When the TEACH IN mode is selected, a set of parameter values are automatically entered as you perform the TEACH IN function.

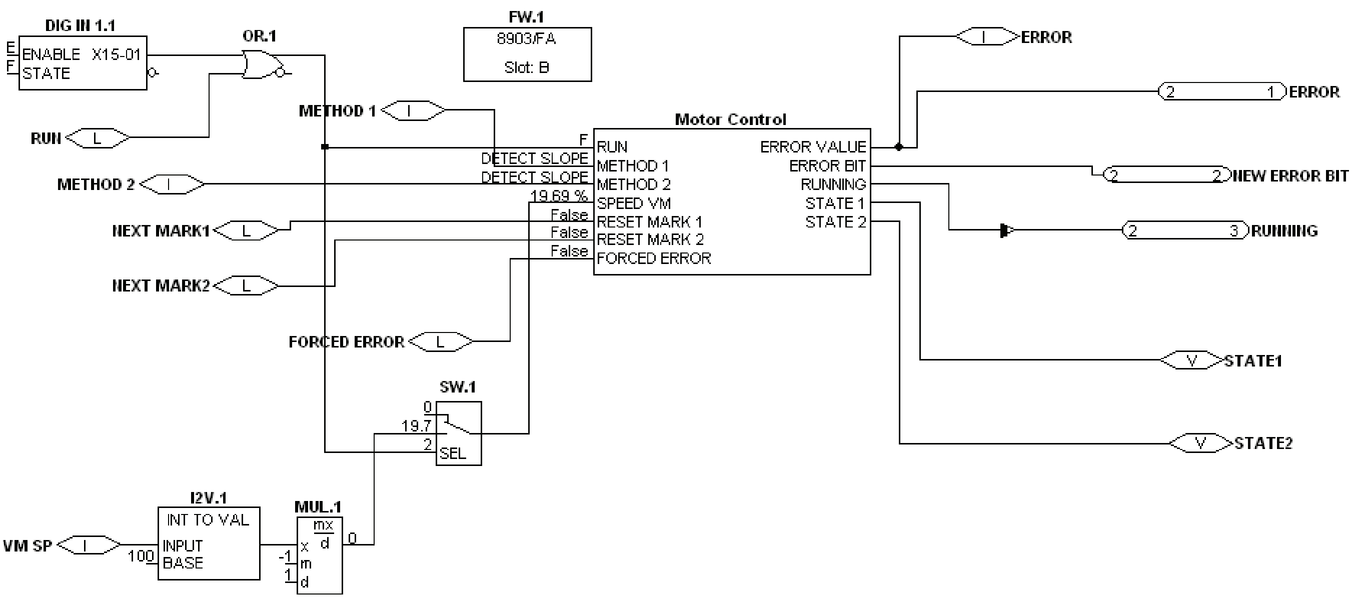
NOTE When configuring a registration application you must always perform the TEACH IN function or enter several parameter values manually.

Perform the TEACH IN function on OPTION A MARK 1, and also on OPTION A MARK 2 if ERROR METHOD is set to OPT A MA1 MA2, or similarly for OPTION F if the application uses the 8902/M1 encoder for registration.

STAGE 3: Creating a LINK Application

Now that the Option(s) are installed and working correctly with the encoder(s), you must create a LINK application using the DSE 890 Configuration Tool supplied with the drive. A default configuration is supplied with DSE for V4.1 software.

Below is an example LINK application.



Save the Application

Remember to save your new configuration in DSE 890 and install it into the drive. In DSE 890, select "Command→Install At Selected" to install the currently opened configuration into a drive.

Refer to Appendix C for an example registration application.

Disposal

This product contains materials which are consignable waste under the Special Waste Regulations 1996 which complies with the EC Hazardous Waste Directive - Directive 91/689/EEC.

We recommend you dispose of the appropriate materials in accordance with the valid environmental control laws. The following table shows which materials can be recycled and which have to be disposed of in a special way.

Material	Recycle	Disposal
metal	yes	No
plastics material	yes	No
printed circuit board	no	yes

The printed circuit board should be disposed of in one of two ways:

1. High temperature incineration (minimum temperature 1200°C) by an incinerator authorised under parts A or B of the Environmental Protection Act
2. Disposal in an engineered land fill site that is licensed to take aluminium electrolytic capacitors. Do not dispose of in a land fill site set aside for domestic waste.

Packaging

During transport our products are protected by suitable packaging. This is entirely environmentally compatible and should be taken for central disposal as secondary raw material.

Appendix A : Function Blocks

AUX IO OPTION A

SETUP::REGISTRATION::AUX IO OPTION A

Configures the auxiliary inputs and outputs of the 8903/M1 Option fitted in option A.

Parameter Descriptions

FUNCTION OUT 1	*PREF: 170.08*	*Default: 3*	*Range: see below*

This parameter determines the function peformed by auxiliary digital output 1.

Enumerated Value : *Method*

0 : ENC SIM TRACK A	Quadrature output A from the synthetic encoder.
1 : ENC OPT A TRK A	Quadrature output A from the encoder connected to the 8903/M1
2 : ENC OPT F TRK A	Quadrature output A from the encoder connected to the 8902/M1 (if fitted).
3 : GENERAL PURPOSE	Auxiliary digital outputs are general purpose, and are controlled using the AUX OUTPUT 1 parameter.
4 : WIN MARK1 OPT A	Mark 1 input to option A, qualified by windowing. If the window is open, the selected mark 1 input is repeated out on this terminal. When the window is closed, selected marks are not repeated out on this terminal.
5 : WIN MARK2 OPT A	Mark 2 input to option A, qualified by windowing. If the window is open, the selected mark 2 input is repeated out on this terminal. When the window is closed, the output remains in the inactive state.

FUNCTION OUT 2	*PREF: 170.09*	*Default: 3*	*Range: see below*

This parameter determines the function peformed by auxiliary digital output 2.

Enumerated Value : *Method*

0 : ENC SIM TRACK B	Quadrature output B from the synthetic encoder.
1 : ENC OPT A TRK B	Quadrature output B from the encoder connected to the 8903/M1
2 : ENC OPT F TRK B	Quadrature output B from the encoder connected to the 8902/M1 (if fitted).
3 : GENERAL PURPOSE	Auxiliary digital outputs are general purpose, and are controlled using the AUX OUTPUT 2 parameter.
4 : WIN MARK1 OPT A	Mark 1 input to option A, qualified by windowing. If the window is open, the selected mark 1 input is repeated out on this terminal. When the window is closed, selected marks are not repeated out on this terminal.
5 : WIN MARK2 OPT A	Mark 2 input to option A, qualified by windowing. If the window is open, the selected mark 2 input is repeated out on this terminal. When the window is closed, the output remains in the inactive state.

FUNCTION OUT 3	*PREF: 170.10*	*Default: 3*	*Range:see below*

This parameter determines the function peformed by auxiliary digital output 3.

Enumerated Value : *Method*

0 : ENC SIM TRACK Z	Zero index pulse Z from the synthetic encoder.
1 : ENC OPT A TRK Z	Zero index pulse Z from the encoder connected to the 8903/M1
2 : ENC OPT F TRK Z	Zero index pulse Z from the encoder connected to the 8902/M1 (if fitted).
3 : GENERAL PURPOSE	Auxiliary digital outputs are general purpose, and are controlled using the AUX OUTPUT 3 parameter.
4 : WIN MARK1 OPT A	Mark 1 input to option A, qualified by windowing. If the window is open, the selected mark 1 input is repeated out on this terminal. When the window is closed, selected marks are not repeated out on this terminal.
5 : WIN MARK2 OPT A	Mark 2 input to option A, qualified by windowing. If the window is open, the selected mark 2 input is repeated out on this terminal. When the window is closed, the output remains in the inactive s tate.

AUX INPUT 1/2/3/4	*PREF: 170.01, 170.02, 170.03, 170.04*	*Default: —*	*Range: FALSE / TRUE*

These four diagnostics indicate the logic values of the auxiliary digital inputs on terminal block X63.

AUX OUTPUT 1/2/3	*PREF: 170.05, 170.06, 170.07*	*Default: FALSE*	*Range:FALSE / TRUE*

When the FUNCTION OUT 1/2/3 parameter is set to GENERAL PURPOSE, these three parameters control the logic state of the auxiliary digital outputs on terminal block X64. When TRUE, the corresponding digital output is high, and the corresponding inverse output is low.

(When FUNCTION OUT 1/2/3 parameter is set to any other value, AUX OUTPUT 1/2/3 is not used.

OPTION A MARK 1, OPTION A MARK 2, OPTION F MARK 1, OPTION F MARK 2

SETUP::REGISTRATION::OPTION A MARK 1, SETUP::REGISTRATION::OPTION A MARK 2
SETUP::REGISTRATION::OPTION F MARK 1, SETUP::REGISTRATION::OPTION F MARK 2

These menus configure the registration hardware parameters for Mark 1 and Mark 2 of the respective option card. When enabled, the function block loads a set of parameters with information about the application dependent upon the setting of the MARK METHOD parameter.

Parameter Descriptions

MARK METHOD *PREF: 167.01, 168.01, 175.01, 176.01* *Default: 0* *Range: see below*

This parameter selects how incoming marks are validated

Before editing the MARK METHOD parameter, set the ENABLE METHOD parameter to FALSE.

Enumerated Value : *Method*

0 : METHOD DISABLED	Registration is disabled. marks are not detected. Parameter values can be entered manually. Method Disabled resets the internal state machine of the respective OPTION A/F MARK 1/2 function block. LATCH POSITION will be reset to (encoder position – NOMINAL REPEAT +SENSOR POSITION). This gives the ability to start registration on the right mark inside the specified window. The values for NOMINAL REPEAT and SENSOR POSITION must be entered correctly before a registration method with windowing is enabled.
1 : TEACH IN	Sets up registration parameters by a teaching process. The marks are passed under the sensor, the mark width and repeat length are measured, and the results are entered automatically into the appropriate parameters. After Teach In, set MARK METHOD to value 2, 3 or 4 for automated mark detection.
2 : DETECT EDGE	Continuous registration: detecting all leading edges. This method can be combined with windowing.
3 : NUMBER OF PULSES	Continuous registration: detects a preset number of pulses set by this parameter. This method can be combined with windowing.
4 : PULSE WIDTH	Continuous registration: detecting marks with a preset width. Set the PULSEWIDTH MAX and PULSEWIDTH MIN parameters. This method can be combined with windowing.

See description of the STATE parameter for more details of the MARK METHOD

SENSOR POSITION *PREF: 167.02, 168.02, 175.02, 176.02* *Default: 0* *Range: 0 to 2147483647*

When MARK METHOD = TEACH IN, the parameter is entered automatically.
When MARK METHOD = METHOD DISABLED, this parameter can be entered manually.

The parameter records the distance from the sensor to the first mark position. This is used to ensure that the system registers to the first correct mark and not to spurious marks.

When MARK METHOD is switched from METHOD DISABLED to one of the automatic registration modes (2, 3, or 4) and METHOD ENABLE becomes true the following calculations take place (note: these are internal calculations, and are not visible to the user) :

Expect_next_mark = actual encoder position + SENSOR POSITION.

This is the expected encoder position when the first valid mark arrives, and is used if windowing is enabled.

Window_open_position = Expect_next mark - WINDOW OPEN

This is the encoder position when the window will open, and is used if windowing is enabled.

Window_close_position = Expect_next mark + WINDOW CLOSE

This is the encoder position when the window will close if no mark is seen, and is used if windowing is enabled.

After the first repeat the *Expect_next_mark* value is calculated as described under ACTUAL REPEAT.

Parameter Descriptions

NOMINAL REPEAT *PREF: 167.03, 168.03, 175.03, 176.03* *Default: 0* *Range: 0 to 2147483647*

When MARK METHOD = TEACH IN, this parameter is entered automatically.
When MARK METHOD = METHOD DISABLED, this parameter can be entered manually.

This parameter defines the expected repeat length in user units. See SCALE A and SCALE B parameters.

It is necessary for the system to know the NOMINAL REPEAT value so that the window open and window close positions can be calculated correctly on the first repeat, and also in the case of missed marks.

Also when the ERROR METHOD parameter in the REGISTER MOVE block selects a 1 mark method (ERROR METHOD = OPT A MARK1 or OPT F MARK1), NOMINAL REPEAT is used for calculating the registration setpoint.

WINDOW OPEN *PREF: 167.04, 168.04, 175.04, 176.04* *Default: 0* *Range: 0 to 2147483647*

Windowing can be used to discriminate genuine marks from spurious and other marks. A window is opened shortly before an expected mark occurs, and closes shortly after it. This parameter defines the point at which the window opens. It is measured in user units. The value represents the distance from window opening to the position of the expected mark. NOMINAL REPEAT must be set correctly.

If *Expect next mark* is the encoder position when the next mark is expected, the window open position is calculated:

Window_open_position = Expect_next mark - WINDOW OPEN

WINDOW CLOSE *PREF: 167.05, 168.05, 175.05, 176.05* *Default: 0* *Range: 0 to 2147483647*

Windowing can be used to discriminate genuine marks from spurious and other marks. A window is opened shortly before an expected mark occurs, and closes shortly after it. This parameter defines the point at which the window closes. It is measured in user units. The value represents the distance from the expected mark to window closing. The window closes immediately a mark is detected when the window is open. NOMINAL REPEAT must be set correctly.

If *Expect next mark* is the encoder position when the next mark is expected, the window close position is calculated:

Window_close_position = Expect_next mark + WINDOW CLOSE

PULSEWIDTH MIN *PREF: 167.06, 168.06, 175.06, 176.06* *Default: 0* *Range: 0 to 2147483647*

This parameter sets the minimum allowed width of a mark, in user units. It is used when MARK METHOD = PULSE WIDTH.

The width of a mark can be used to discriminate between genuine marks and spurious or other marks. The measured mark width is compared with minimum and maximum values. Any marks inside those limits are used; values outside the limits are ignored.

PULSEWIDTH MAX *PREF: 167.07, 168.07, 175.07, 176.07* *Default: 0* *Range: 0 to 2147483647*

This parameter sets the maximum allowed width of a mark in load position units. It is used when MARK METHOD = PULSE WIDTH.

The width of a mark can be used to discriminate between genuine marks and spurious or other marks. The measured mark width is compared with minimum and maximum values. Any marks inside those limits are used; values outside the limits are ignored.

NO OF EDGES *PREF: 167.08, 168.08, 175.08, 176.08* *Default: 1* *Range: 1 to 64*

This parameter sets how many edges must be detected before calculating a new error. For example, a value of 6 results in every 6^{th} edge being registered. It is used when MARK METHOD = NUMBER OF PULSES.

Sometimes it is necessary to register on every n'th mark. This occurs for example if the repeat length of the load is a multiple or sub-multiple of the repeat length between reference marks. Note that each mark has two edges: a leading edge and a trailing edge.

If Windowing is enabled:

> When NUMBER OF EDGES is set to an odd value, the system will register to a leading edge.
> When NUMBER OF EDGES is set to an even value, the system will register to a trailing edge.
>
> The edge count is reset to zero each time the window closes. It increments on every edge found after the window re-opens.

If Windowing is disabled, an odd value of NUMBER OF EDGES is rounded up internally to the next even number.

ENABLE METHOD *PREF: 167.09, 168.09, 175.09, 176.09* *Default: FALSE* *Range: FALSE / TRUE*

This parameter enables the registration method selected by the MARK METHOD parameter.

This parameter should be set to FALSE when editing the MARK METHOD parameter.

Parameter Descriptions

ENABLE WINDOW	*PREF: 167.28, 168.28, 175.28, 176.28*	*Default: FALSE*	*Range: FALSE / TRUE*

This parameter enables or disables the Windowing feature. Refer to the WINDOW OPEN and WINDOW CLOSE parameters.

USE NEXT MARK	*PREF: 167.10, 168.10, 175.10, 176.10*	*Default: FALSE*	*Range: FALSE / TRUE*

This parameter can be used when MARK METHOD = TEACH IN. Changing from False to True instructs the system that a mark is approaching the sensor and thus should be registered by the system. This is a method for bypassing unwanted marks that would otherwise cause Teach In to record the unwanted marks. Changing from True to False has no effect.

When MARK METHOD = DETECT EDGE, NUMBER OF EDGES or PULSE WIDTH, changing this parameter from False to True can be used to skip to the next mark. For example, if every 6^{th} mark is registering but a spurious mark results in the wrong marks now being read, this parameter can be used to skip forward one mark at a time until the system re-registers to the correct mark. Changing from True to False has no effect.

RESET	*PREF: 167.11, 168.11, 175.11, 176.11*	*Default: FALSE*	*Range: FALSE / TRUE*

When TRUE, this parameter resets the VALID MARK and INVALID MARK counters associated with this function block.

ACTUAL REPEAT	*PREF: 167.12, 168.12, 175.12, 176.12*	*Default: 0*	*Range: 0 to 2147483647*

This diagnostic reports the measured repeat length in user units. ACTUAL REPEAT is used internally for calculating the point where the next mark is expected. This is important for windowing.

When a valid mark is captured (this is the LATCH POSITION), the following calculations takes place:

ACTUAL REPEAT = LATCH POSITION – LATCH POSITION from last cycle

Expect_next mark = LATCH POSITION + ACTUAL REPEAT .

If a mark is missed, the expected position for the next mark is calculated in a different way:

LATCH POSITION = LATCH POSITION + NOMINAL REPEAT

Expect_next mark = LATCH POSITION + NOMINAL REPEAT

LATCH POSITION	*PREF: 167.13, 168.13, 175.13, 176.13*	*Default: —*	*Range: 0 to 2147483647*

This diagnostic is the position of the most recent validated mark, in user units. The value depends on the setting of the MARK METHOD parameter.

Method	*Latch Position*
DISABLED	Actual position of the encoder + SENSOR POSITION - NOMINAL REPEAT.
TEACH IN	MARK 1 or MARK2 position when the most recent leading mark edge occurred.
DETECT EDGE	MARK1 or MARK2 position when the most recent leading mark edge occurred.
NUMBER OF PULSES	MARK1 or MARK2 position after the defined number of edges has occurred.
PULSE WIDTH	MARK1 or MARK2 position when the most recent leading mark edge occurred, and the mark width was within the pulsewidth limits.

When initialising the first automatic registration cycle (i.e. MARK METHOD = METHOD DISABLED)

LATCH POSITION = actual encoder position + SENSOR POSITION - NOMINAL REPEAT.

Assuming the first capture occurs at “actual encoder position at start” + SENSOR POSITION and following the formulas for ACTUAL REPEAT, the resulting ACTUAL REPEAT becomes equal to NOMINAL REPEAT.

PULSEWIDTH MEAS	*PREF: 167.14, 168.14, 175.14, 176.14*	*Default: —*	*Range: 0 to 2147483647*

This diagnostic value reports the width of the most recent validated mark, in user units.

VALID MARKS	*PREF: 167.15, 168.15, 175.15, 176.15*	*Default: —*	*Range: 0 to 2147483647*

This diagnostic increments each time a valid mark is detected.

LATCH OK	*PREF: 167.16, 168.16, 175.16, 176.16*	*Default: —*	*Range: FALSE / TRUE*

This diagnostic indicates that a valid mark has been detected. It is true for one block diagram cycle on detecting a valid mark, and then automatically resets. This can then be used to trigger events in the DSE application. Because it is true for a very short time, it is unlikely to register a TRUE value on an HMI.

MARK NOT SEEN *PREF: 167.17, 168.17, 175.17, 176.17* *Default: —* *Range: FALSE / TRUE*

This diagnostic indicates that a valid mark was not detected inside the mark window. It stays True until a valid mark is seen inside the window. ENABLE WINDOW must be True.

MISSED MARKS *PREF: 167.18, 168.18, 175.18, 176.18* *Default: —* *Range: 0 to 2147483647*

The value of this diagnostic increments when no mark is detected when the window is open (if windowing is enabled).

WINDOW STATE *PREF: 167.19, 168.19, 175.19, 176.19* *Default: —* *Range: CLOSED/OPEN*

This diagnostic indicates the state of the window.

STATE *PREF: 167.20, 168.20, 175.20, 176.20* *Default: —* *Range: see below*

This diagnostic displays the state of the function block state machine.

Mark Method	***State***	***Comment***
METHOD DISABLED	INPUT PARAMETER	Registration on the respective input is disabled. The Parameters for configuring the method can be entered without the risk of inconsistent data.
TEACH IN	WAIT 1 RES VALID	First state of teach in method. The system waits for a positive edge on USE NEXT MARK to enable the registration input.
	WAIT 1 MARK	Second state of teach in. Mark capture is enabled, and the system waits for a positive edge on the mark input
	WAIT 2 RES VALID	Third state of teach in method. The first valid mark was captured and registration is disabled on this input. The system waits for a positive edge on USE NEXT MARK to re-enable the registration input.
	WAIT 2 MARK	Fourth state of teach in method. Mark capture is enabled again, and the system waits for the second mark. When the mark is captured, NOMINAL REPEAT, ACTUAL REPEAT and SENSOR POSTION are calculated. If one of the automatic registration methods is selected before the next mark and METHOD DISABLED is not first selected, the window opens and closes around the next valid mark.
DETECT EDGE	WAIT ENABLE	The state machine for the DETECT EDGE task is waiting for ENABLE METHOD to go TRUE.
	EDGE NO WINDOW	Windowing is disabled, and the system is waiting for a positive edge on the registration input.
	EDGE WINDOW	The system enables registration when the encoder position is between WINDOW OPEN and WINDOW CLOSE positions (see ACTUAL REPEAT), and waits for a positive edge on the mark input.
	INIT WINDOW	A positive edge on USE NEXT MARK was detected. The system will take the next positive edge on the registration input as the next valid mark and calculate from its position the next window open and window close positions. (See ACTUAL REPEAT). Then the state machine goes to EDGE WINDOW.

Parameter Descriptions

STATE *PREF: 167.20, 168.20, 175.20, 176.20* *Default: —* *Range: continued below*

This diagnostic displays the state of the function block state machine.

Mark Method	*State*	*Comment*
NO OF PULSES	WAIT ENABLE	The state machine for the NO OF EDGES task is waiting for ENABLE METHOD to go TRUE.
	NO EDGES NO WIN	Windowing is disabled and the system is waiting until the specified NO OF EDGES have been captured at the registration input. LATCH POSITION is the captured encoder position of the defined edge. After the NO OF EDGES are detected by the system, the following edge is the first edge of the next repeat.
	NO EDGES WINDOW	The system enables registration when the encoder position is between WINDOW OPEN and WINDOW CLOSE positions (See ACTUAL REPEAT) and waits until the defined NO OF EDGES have been captured at the registration input. LATCH POSITION is the captured encoder position of the specified edge. The internal edge count resets to zero when the window is opened next time.
	INIT WINDOW	A positive edge on USE NEXT MARK was detected. The system will take the next captured positive edge on the registration input as the first valid mark and use it to calculate the next WINDOW OPEN and WINDOW CLOSE positions (See ACTUAL REPEAT). After this edge the state machine goes to NO EDGES WINDOW.
PULSE WIDTH	WAIT ENABLE	The state machine for the PULSE WIDTH task is waiting for ENABLE METHOD to go TRUE.
	PULSWIDTH NO WIN	The system waits until a mark is detected with width (difference between trailing and leading edge) between PULSEWIDTH MIN and PULSEWIDTH MAX. LATCH POSTION is then the captured encoder position of the leading edge. Windowing is disabled.
	PULSWIDTH WINDOW	The system enables registration when the encoder position is between WINDOW OPEN and WINDOW CLOSE positions (see ACTUAL REPEAT), and waits until a mark is detected with width (difference between trailing and leading edge), between PULSEWIDTH MIN and PULSEWIDTH MAX. LATCH POSTION is then the captured encoder position of the leading edge.
	INIT WINDOW	A positive edge on USE NEXT MARK was detected. The system will take the next captured positive edge on the registration input as the first valid mark and use it to calculate the next WINDOW OPEN and WINDOW CLOSE positions. (See ACTUAL REPEAT). After that the state machine goes to PULSWIDTH WINDOW.

INVALID MARKS *PREF: 167.31, 168.31, 175.31, 176.11* *Default: —* *Range: 0 to 2147483647*

The value of this diagnostic increments when a mark is detected when the window is closed (if windowing is enabled).

Functional Description

Mark Methods

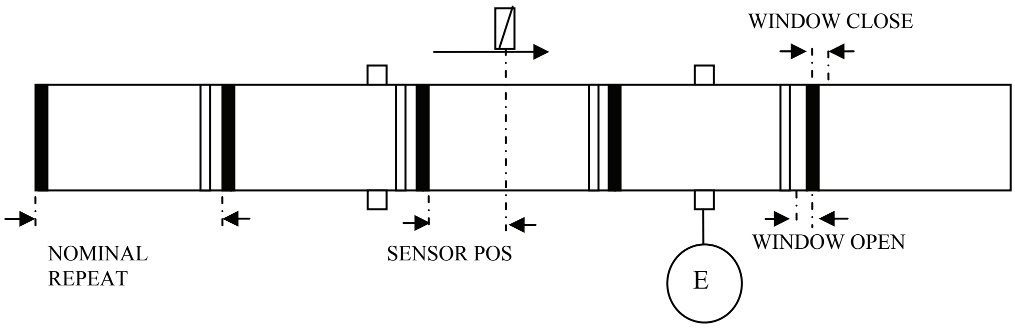
There are many registration applications, each requiring a different registration method of processing marks .Therefore Mark Methods DETECT EDGE, NO OF EDGES and PULSE WIDTH are available. For setting up these automatic registration methods, the METHOD DISABLED and TEACH IN settings can be used.

MARK METHOD = METHOD DISABLED

When METHOD is disabled the intial values for starting up one of the automatic methods DETECT EDGE, NO OF EDGES, PULSE WITH can be entered manually. METHOD DISABLED resets the internal state machine of the respective OPTION A/F,1/2 MARK function block. All incoming marks are ignored when MARK METHOD = METHOD DISABLED. This method is designed for entering parameter values to the system. LATCH POSITION will be reset to

encoder position – NOMINAL REPEAT + SENSOR POSITION.

This enables registration to start on the right mark inside the specified window, assuming that correct values for NOMINAL REPEAT and SENSOR POSITION have been entered before a registration method with windowing is enabled.



1. Feed the paper into the machine, either manually or in jog mode.

2. Switch the MARK METHOD to METHOD DISABLED.

3. At standstill measure the parameters as shown in the diagram above.

4. Enter the parameters in user units at the HMI or in the DSE configuration (Note: SCALE A and SCALE B must be configured first to specify user units).

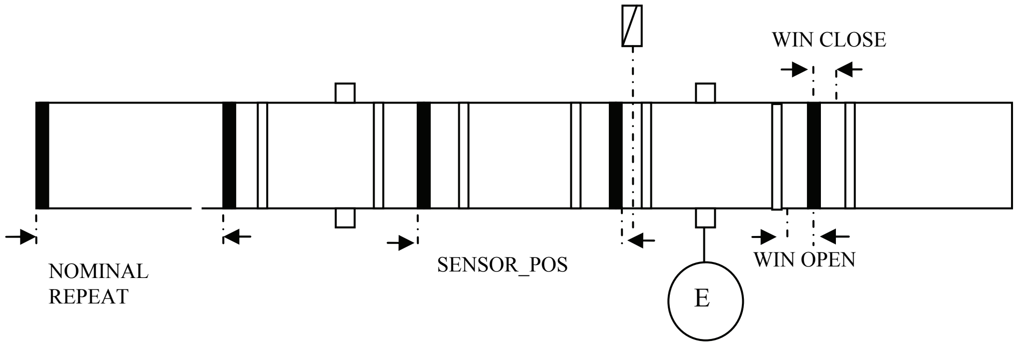
5. Switch the MARK METHOD to DETECT EDGE, NO OF EDGES or PULSE WITH.

6. Start the paper feed.

7. Parameters LATCH POSITION, PULSEWIDTH MEAS, ACTUAL REPEAT will now be updated every repeat, and can be monitored on the HMI or via DSE's monitoring facilities.

MARK METHOD = TEACH IN

This Method is designed determine the intial values for starting up one of the automatic methods DETECT EDGE, NO OF EDGES and PULSE WITH.



1. Switch the MARK METHOD to TEACH IN.

2. Feed the paper into the machine, either manually or in jog mode until the mark is near the sensor. Make sure that there is only plain paper between mark and sensor, as shown in the diagram above.

3. Toggle USE NEXT MARK from FALSE to TRUE and back to FALSE. STATE will now change from WAIT 1 RES VALID to WAIT 1 MARK.

4. Feed the first mark past the sensor. LATCH POSITION and PULSEWIDTH MEAS will now be updated and REG STATE changes to WAIT 2 RES VALID.

5. Feed the paper forward, until the next mark is approaching the sensor, and there is only plain paper between mark and sensor, as in step 2.

6. Toggle USE NEXT MARK from FALSE to TRUE and back to FALSE. STATE will now change from WAIT 2 RES VALID to WAIT 2 MARK.

7. Feed the second mark past the sensor. SENSOR POSITION, NOMINAL REPEAT, ACTUAL REPEAT, LATCH POSITION and PULSEWIDTH MEAS will now be updated and STATE changes to WAIT 1 RES VALID.

8. Switch ENABLE METHOD to FALSE, and then MARK METHOD to DETECT EDGE, NO OF EDGES or PULSE WIDTH.

9. TEACH IN is now complete. Switch ENABLE METHOD to TRUE, and then the paper feed may be started.

10. The Parameters LATCH POSITION, PULSEWIDTH MEAS, ACTUAL REPEAT will now be updated every cycle and can be monitored on the HMI or via DSE's monitoring facilities.

NOTE During this Set-up Operation, the parameters for "Window Open" and "Window Close" will be ignored.

MARK METHOD = DETECT EDGE

The DETECT EDGE method captures the encoder position on every leading and trailing edge of the registration inputs.

- LATCH POSITION is updated on every leading mark edge.
- PULSEWIDTH is calculated from the difference between trailing and leading mark edges.
- NOMINAL REPEAT is calculated from the difference between consecutive LATCH POSITION values.

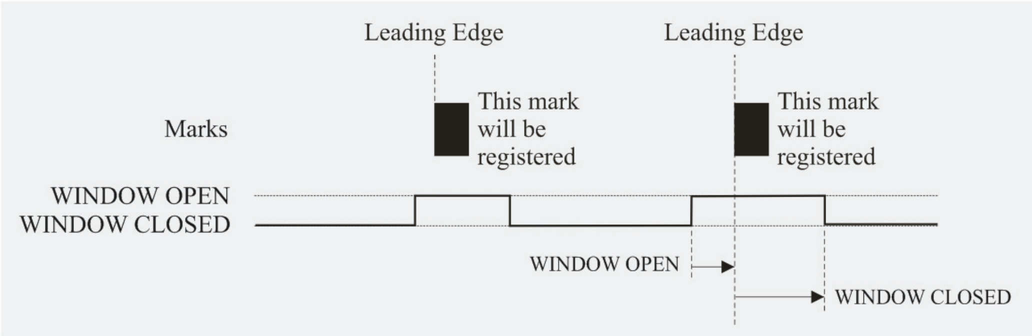
A common problem with mark registration is that poor quality of marks, spurious marks, or EMC problems can cause the system to attempt to register to the wrong mark. However this function block can be made to reject unwanted marks, and only act on valid marks. This can be achieved by selecting the appropriate MARK METHOD, optionally in combination with windowing.

WINDOW ENABLE, WINDOW OPEN and WINDOW CLOSE

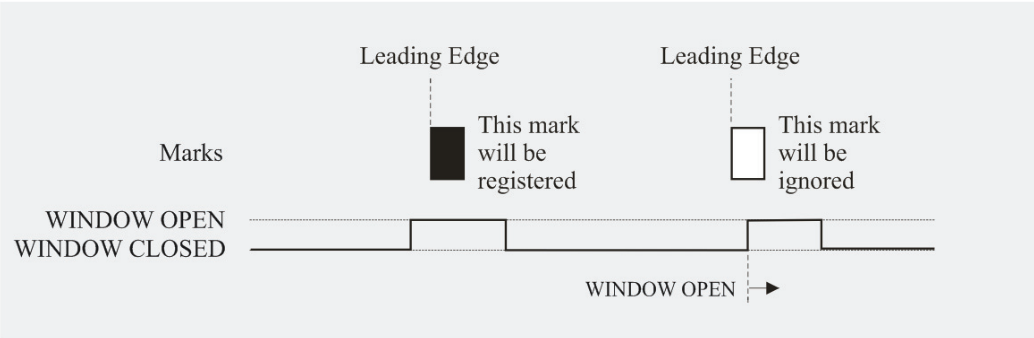
Windowing can be used to discriminate between wanted and unwanted marks. A window can be either open or closed. When it is open, marks are allowing through into the registration system. When it is closed, marks are not allowed through, and so are ignored.

These parameters define whether windowing is enabled or disabled, and when the mark window opens and closes. From a known good mark position, the expected position of the next good mark is calculated, and WINDOW OPEN and WINDOW CLOSE positions are calculated from the expected good mark position. (See description of function block parameters)

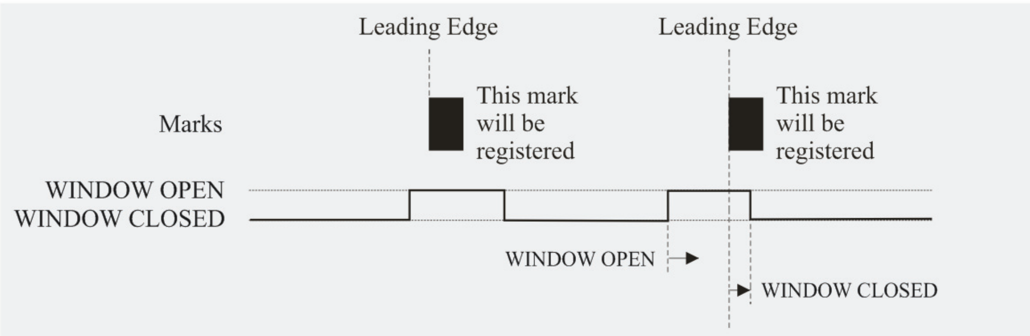
The example below shows a window referenced to the leading edge of marks.



The example below shows the window opening after the leading edge of the mark. The mark is ignored. The window must be open at the leading edge of a mark for the mark to be registered by the system.



The example below shows the window closing while the mark is present. This mark is still registered by the system.



MARK METHOD = NO OF PULSES

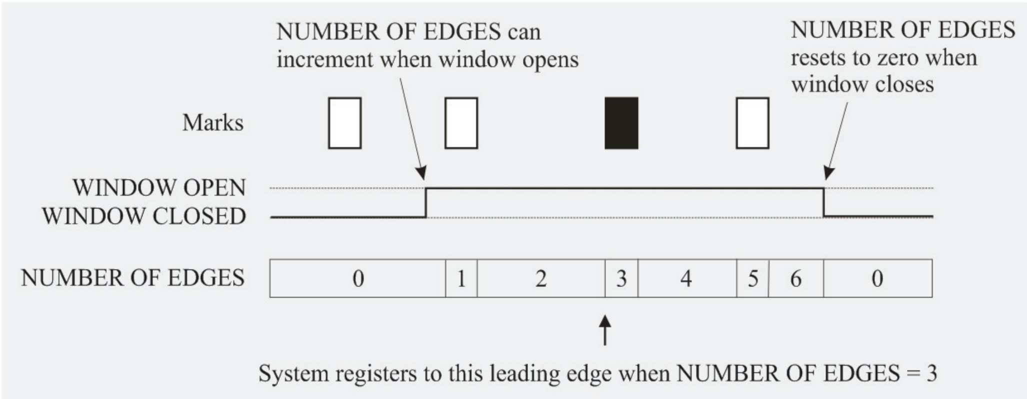
The most important parameter for NO OF PULSES method is the NUMBER OF EDGES input.

This parameter determines the number of marks that must occur before a new valid mark is generated. Its function depends on whether Windowing is enabled or not.

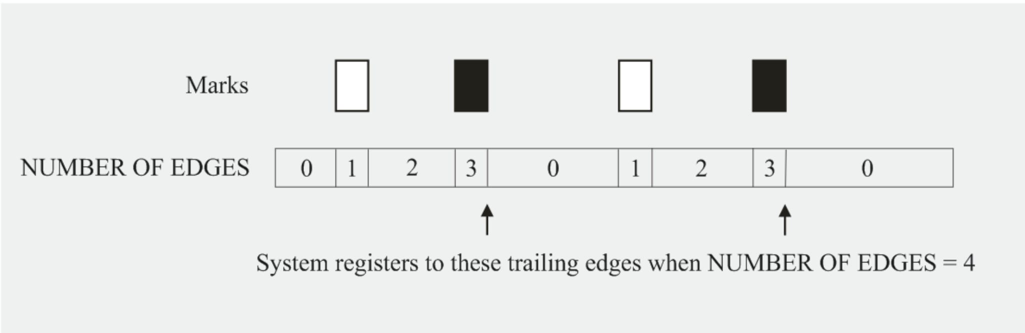
If Windowing is enabled and NUMBER OF EDGES is odd, the reference is a mark's leading edge. If NUMBER OF EDGES is even, the reference is a mark's trailing edge.

If Windowing is disabled and the NUMBER OF EDGES is even the value is internally rounded up to the next odd number.

Windowing enabled – Example NO OF EDGES = 3



Windowing disabled – Example NO OF EDGES = 4



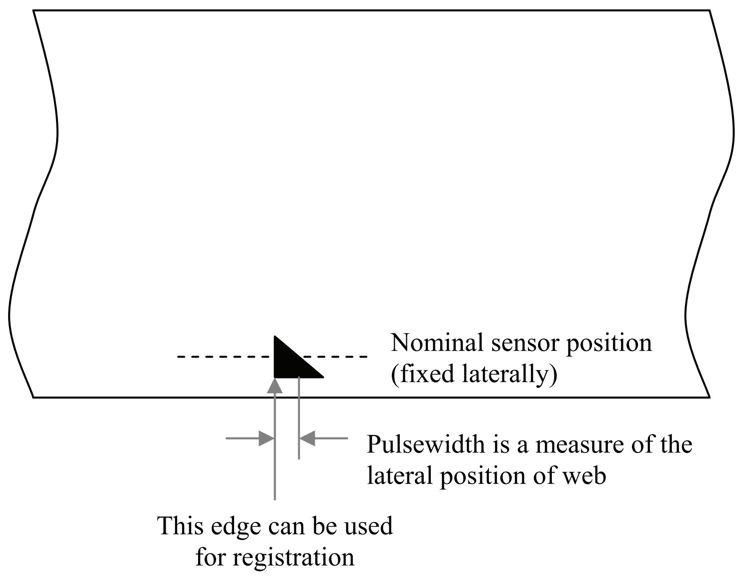
MARK METHOD = PULSE WIDTH

This mark method compares the measured pulsewidth with PULSEWIDTH MAX and PULSEWIDTH MIN values. It is a useful means of detecting valid marks amongst invalid marks.

Pulsewidth is the distance between trailing and leading edges of a mark. Pulses which fit within the limits are detected as valid marks. The LATCH POSITION will become the captured encoder position at the leading edge.

Pulsewidth discrimination can be combined with windowing. The calculation for WINDOW OPEN and WINDOW CLOSE are the same as for the other mark methods

The PULSEWIDTH MEAS diagnostic can also be used in a link block diagram to monitor and drive a control unit that controls the lateral position of the web material. This is possible if the mark is triangular, as shown below.



CONFIG OPTION A

SETUP::REGISTRATION::CONFIGURE OPTION A

This function block provides the facility to configure basic set-up for the mark inputs and encoder input of a registration board plugged into option A, i.e. the top option in the 890 drive. The function block also provides some diagnostics for the hardware and wiring of the sensors.

Parameter Descriptions

SEL MARK 1 INPUT *PREF: 166.01* *Default: 2* *Range: see below*

This parameter selects the source for MARK 1.

Enumerated Value : *Method*

0 : Z-PULSE OPT A	Index pulse from the 8903/M1 encoder
1: WIN MA1 OPT F	Windowed Mark1 from option F (i.e. the windowed Z-pulse)
2 : AUX INPUT 1	Auxiliary digital input 1 on X63 pin 1
3 : AUX INPUT 2	Auxiliary digital input 2 on X63 pin 2
4 : AUX INPUT 3	Auxiliary digital input 3 on X63 pin 3
5 : AUX INPUT 4	Auxiliary digital input 4 on X63 pin 4
6: TOGGLE IN 1 2	Auxiliary digital inputs 1 and 2 on X63 pin 1,2 used as differential input
7: TOGGLE IN 3 4	Auxiliary digital inputs 3 and 4 on X63 pin 3,4 used as differential input

SEL MARK 2 INPUT *PREF: 166.02* *Default: 3* *Range: see below*

This parameter selects the source for MARK 2.

Enumerated Value : *Method*

0 : Z-PULSE OPT A	Index pulse from the 8903/M1 encoder
1: WIN MA2 OPT F	Windowed Mark2 from option F
2 : AUX INPUT 1	Auxiliary digital input 1 on X63 pin 1
3 : AUX INPUT 2	Auxiliary digital input 2 on X63 pin 2
4 : AUX INPUT 3	Auxiliary digital input 3 on X63 pin 3
5 : AUX INPUT 4	Auxiliary digital input 4 on X63 pin 4
6: TOGGLE IN 1 2	Auxiliary digital inputs 1 and 2 on X63 pin 1,2 used as differential input
7: TOGGLE IN 3 4	Auxiliary digital inputs 3 and 4 on X63 pin 3,4 used as differential input

FILTER MARK 1 *PREF: 166.03* *Default: 2* *Range: see below*

This parameter selects the duration of a filter on the selected MARK 1 input. This is intended to reject noise. Note that the filter does not incur a delay in mark processing. All mark edges are recognised by the registration hardware, but any which fail to satisfy the filter requirement are rejected. Any change of state on the selected MARK 1 input must remain unchanged for the duration of the filter time before it will be used.

Enumerated Value : *Method*

0 : MINIMUM

1 : 1 µs

2 : 5 µs

3 : 12 µs

FILTER MARK 2	*PREF: 166.04*	*Default: 2*	*Range: see below*

This parameter selects the duration of a filter on the selected MARK 2 input. This is intended to reject noise. Note that the filter does not incur a delay in mark processing. All mark edges are recognised by the registration hardware, but any which fail to satisfy the filter requirement are rejected. Any change of state on the selected MARK 2 input must remain unchanged for the duration of the filter before it will be used.

Enumerated Value : *Method*

0 : MINIMUM

1 : 1 µs

2 : 5 µs

3 : 12 µs

INVERT MARK 1	*PREF: 166.05*	*Default: FALSE*	*Range: FALSE / TRUE*

When FALSE, the mark input is active high, i.e. it presents a positive signal when the mark is present. If one of the auxiliary digital inputs is selected, this will be +24V.

When TRUE, the mark input is active low, i.e. it presents a 0v signal when the mark is present.

INVERT MARK 2	*PREF: 166.06*	*Default: FALSE*	*Range: FALSE / TRUE*

When FALSE, the mark input is active high, i.e. it presents a positive signal when the mark is present. If one of the auxiliary digital inputs is selected, this will be +24V.

When TRUE, the mark input is active low, i.e. it presents a 0v signal when the mark is present.

TEST MARK 1	*PREF: 166.07*	*Default: FALSE*	*Range: FALSE / TRUE*

This parameter is used to make a very basic test of the Mark Input 1. MARK METHOD must be set to METHOD DISABLED in the OPTION A MARK1 function block. When TEST MARK 1 is TRUE, every edge occurring at Mark Input 1 will be latched. MARK INDEX 1 will increment on every edge, and MARK 1 LATCH will show the most recent latched encoder position.

When FALSE, the control of the Mark 1 Input is passed to function block OPTION A MARK1 for registration to take place.

TEST MARK 2	*PREF: 166.08*	*Default: FALSE*	*Range: FALSE / TRUE*

This parameter is used to make a very basic test of the Mark Input 2. MARK METHOD must be set to METHOD DISABLED in the OPTION A MARK2 function block. When TEST MARK 2 is TRUE, every edge occurring at Mark Input 2 will be latched. MARK INDEX 2 will increment on every edge, and MARK 2 LATCH will show the most recent latched encoder position.

When FALSE, the control of the Mark 2 Input is passed to function block OPTION A MARK2 for registration to take place.

SCALE A	*PREF: 166.09*	*Default: 1000*	*Range: 0 to 2147483647*

Together with SCALE B, this parameter is used to convert encoder position to user position using the following formula. User position can be output directly as user units, for example, millimetres.

$$Load\ Position = Encoder\ Position \times \frac{SCALE\ A}{SCALE\ B}$$

Note: encoder resolution is equal to 2^{11} x the number of encoder lines = 2048 x the number of encoder lines per mechanical revolution of the encoder. For example, a 2048 line encoder provides 2048 x 2048 = 4194304 increments per mechanical revolution.

SCALE B	*PREF: 166.10*	*Default: 1000*	*Range: 0 to 2147483647*

Together with SCALE A, this parameter is used to convert encoder position to user position using the following formula. User position can be output directly as user units, for example, millimetres.

$$Load\ Position = Encoder\ Position \times \frac{SCALE\ A}{SCALE\ B}$$

Note: encoder resolution is equal to 2^{11} x the number of encoder lines = 2048 x the number of encoder lines per mechanical revolution of the encoder. For example, a 2048 line encoder provides 2048 x 2048 = 4194304 increments per mechanical revolution.

Parameter Descriptions

COUNT DIRECTION	*PREF: 166.11*	*Default: POSITIVE*	*Range: POSITIVE/NEGATIVE*

When this parameter is POSITIVE, the encoder position increments when the encoder turns clockwise.

When NEGATIVE, the encoder position increments when the encoder turns counter-clockwise.

This parameter must be adjusted so that the encoder position increments in the normal direction of movement in the application. This can be verified by examining successive values of MARK 1 LATCH or MARK 2 LATCH.

MODULO	*PREF: 166.24*	*Default: 0*	*Range 0 to 2147483647*

This parameter is used in calculating the encoder position. It represents the repeat length between reference or feedback marks, in load position units. It defines the maximum value of the following parameters :

MARK 1 LATCH

MARK 2 LATCH

OPTION A MARK1: LATCH POSITION

OPTION A MARK2: LATCH POSITION

When the value is zero, Modulo calculation is disabled.

RESET POSITION	*PREF: 166.25*	*Default: FALSE*	*Range: FALSE / TRUE*

When TRUE, this parameter resets the encoder position, user position, and latch positions to zero.

ENCODER POSITION	*PREF: 166.16*	*Default: FALSE*	*Range: FALSE / TRUE*

Absolute position of the encoder shaft, in units of encoder lines x 2^{11}.

MARK INDEX 1	*PREF: 166.18*	*Default: —*	*Range: 0 to 127*

When a mark event occurs, i.e. a leading or trailing edge, the encoder position is captured into a circular buffer. This diagnostic indicates where the next entry for Mark 1 will be inserted into the circular buffer. It can be used to verify correct detection of marks.

MARK INDEX 2	*PREF: 166.19*	*Default: —*	*Range: 0 to 127*

When a mark event occurs, i.e. a leading or trailing edge, the encoder position is captured into a circular buffer. This diagnostic indicates where the next entry for Mark 2 will be inserted into the circular buffer. It can be used to verify correct detection of marks.

MARK 1 LATCH	*PREF: 166.20*	*Default: —*	*Range: 0 to 2147483647*

This diagnostic reports the encoder position in user units of the most recent event on mark 1.

MARK 2 LATCH	*PREF: 166.21*	*Default: —*	*Range: 0 to 2147483647*

This diagnostic reports the encoder position in user units of the most recent event on mark 2.

BOARD STATUS	*PREF: 166.22*	*Default: —*	*Range: - see below*

This diagnostic reports the status of the registration board and encoder in option A.

Enumerated Value : *Board Status*

0 : NO ENCODER BRD

1 : INITIALISING

2 : HEALTHY

3 : FAULT

OPTION A FITTED	*PREF: 166.23*	*Default: —*	*Range: - see below*

This diagnostic reports which type of board is fitted in option A.

Enumerated Value : *Board Status*

0 : NO ENCODER BRD

1 : HTTL ENCODER

2 : RS485 ENCODER

3 : SINCOS ENCODER

4: SINCOS ENC REG

5: HTTL ENC REG

6: RS485 ENC REG

This diagnostic should report value 4: SINCOS ENC REG if an 8903/M1 option is fitted.

LATCH SOURCE	*PREF: 166.26*	*Default: —*	*Range: - see below*

This parameter selects which latched encoder position will be used in calculating register move.

Enumerated Value : *Latch Source*

0 : REAL ENCODER. This is the physical encoder connected to X65.

1 : SYNTHETIC ENC. This is not a physical encoder, but a simulated encoder generated within the 8903/M1. Refer to function block PHASE CONTROL::V MASTER SIMLATR

REG ZERO OFFSET	*PREF: 166.28*	*Default: 0*	*Range: 0 ± 2147483647*

Reserved for future use.

Functional Description

Scaling

It is frequently useful to work in user units instead of the native scaling inside the 8903/M1 option. For example, it is easier to think in terms of physical units such as millimeters rather than a number of encoder increments.

To convert between native units and user units, parameters SCALE A and SCALE B are used.

$$User\ units = Encoder\ increments \times \frac{SCALE\ A}{SCALE\ B}$$

The number of encoder increments per mechanical revolution is equal to 2048 multiplied by the number of encoder lines per revolution.

Example

Suppose the system contains an 512 line encoder that rotates 3.5 complete revolutions per repeat.

There will be 3.5 x 2048 x 512 = 3670016 encoder increments per repeat.

If the physical repeat is 825mm, and we want the user units to be in tenths of a millimeter, i.e. 8250 user units per repeat, then one user unit is 8250 / 3670016 encoder increments.

To make this conversion, set SCALE A = 8250, and SCALE B = 3670016.

CONFIG OPTION F

SETUP::REGISTRATION::CONFIGURE OPTION F

This function block provides the facility to configure basic set-up for the the mark inputs and encoder input of a registration board plugged into option F, i.e. the feedback option in the 890 drive. The function block also provides some diagnostics for the hardware and wiring of the sensors.

Parameter Descriptions

SEL MARK 1 INPUT *PREF, 165.01* *Default: 2* *Range: see below*

This parameter selects the source for MARK 1. When appropriate, marks are transferred from the 8903/M1 to the 8902/M1 automatically, no external wiring is required.

Enumerated Value : *Method*

0 : Z-PULSE OPTION A	Index pulse from the 8903/M1 encoder
1 : Z-PULSE OPTION F	Index pulse from the 8902/M1 encoder
2 : AUX INPUT 1	Auxiliary digital input 1 on X63 pin 1
3 : AUX INPUT 2	Auxiliary digital input 2 on X63 pin 2
4 : AUX INPUT 3	Auxiliary digital input 3 on X63 pin 3
5 : AUX INPUT 4	Auxiliary digital input 4 on X63 pin 4
6: TOGGLE IN 1 2	Auxiliary digital inputs 1 and 2 on X63 pin 1,2 used as differential input
7: TOGGLE IN 3 4	Auxiliary digital inputs 3 and 4 on X63 pin 3,4 used as differential input
8: WIN MA1 OPT A	Windowed Mark1 from option A

SEL MARK 2 INPUT *PREF: 165.02* *Default: 3* *Range: see below*

This parameter selects the source for MARK 2. When appropriate, marks are transferred from the 8903/M1 to the 8902/M1 automatically, no external wiring is required.

Enumerated Value : *Method*

0 : Z-PULSE OPTION A	Index pulse from the 8903/M1 encoder
1 : Z-PULSE OPTION F	Index pulse from the 8902/M1 encoder
2 : AUX INPUT 1	Auxiliary digital input 1 on X63 pin 1
3 : AUX INPUT 2	Auxiliary digital input 2 on X63 pin 2
4 : AUX INPUT 3	Auxiliary digital input 3 on X63 pin 3
5 : AUX INPUT 4	Auxiliary digital input 4 on X63 pin 4
6: TOGGLE IN 1 2	Auxiliary digital inputs 1 and 2 on X63 pin 1,2 used as differential input
7: TOGGLE IN 3 4	Auxiliary digital inputs 3 and 4 on X63 pin 3,4 used as differential input
8: WIN MA2 OPT A	Windowed Mark2 from option A

FILTER MARK 1 *PREF: 165.03* *Default: 2* *Range: see below*

This parameter selects the duration of a filter on the selected MARK 1 input. This is intended to reject noise. Note that the filter does not incur a delay in mark processing. All mark edges are recognised by the registration hardware, but any which fail to satisfy the filter requirement are rejected. Any change of state on the selected MARK 1 input must remain unchanged for the duration of the filter time before it will be used.

Enumerated Value : *Method*

0 : MINIMUM

1 : 1 µs

2 : 5 µs

3 : 12 µs

FILTER MARK 2 *PREF: 165.04* *Default: 2* *Range: see below*

This parameter selects the duration of a filter on the selected MARK 2 input. This is intended to reject noise. Note that the filter does not incur a delay in mark processing. All mark edges are recognised by the registration hardware, but any which fail to satisfy the filter requirement are rejected. Any change of state on the selected MARK 2 input must remain unchanged for the duration of the filter before it will be used.

Enumerated Value : *Method*

0 : MINIMUM

1 : 1 µs

2 : 5 µs

3 : 12 µs

INVERT MARK 1 *PREF: 165.05* *Default: FALSE* *Range: FALSE / TRUE*

When FALSE, the mark input is active high, i.e. it presents a positive signal when the mark is present. If one of the auxiliary digital inputs is selected, this will be +24V.

When TRUE, the mark input is active low, i.e. it presents a 0v signal when the mark is present.

INVERT MARK 2 *PREF: 165.06* *Default: FALSE* *Range: FALSE / TRUE*

When FALSE, the mark input is active high, i.e. it presents a positive signal when the mark is present. If one of the auxiliary digital inputs is selected, this will be +24V.

When TRUE, the mark input is active low, i.e. it presents a 0v signal when the mark is present.

TEST MARK 1 *PREF: 165.07* *Default: FALSE* *Range: FALSE / TRUE*

This parameter is used to make a very basic test of the Mark Input 1. MARK METHOD must be set to METHOD DISABLED in the OPTION A MARK1 function block. When TEST MARK 1 is TRUE, every edge occurring at Mark Input 1 will be latched. MARK INDEX 1 will increment on every edge, and MARK 1 LATCH will show the most recent latched encoder position.

When FALSE, the control of the Mark 1 Input is passed to function block OPTION A MARK1 for registration to take place.

TEST MARK 2 *PREF: 165.08* *Default: FALSE* *Range: FALSE / TRUE*

This parameter is used to make a very basic test of the Mark Input 2. MARK METHOD must be set to METHOD DISABLED in the OPTION A MARK2 function block. When TEST MARK 2 is TRUE, every edge occurring at Mark Input 2 will be latched. MARK INDEX 2 will increment on every edge, and MARK 2 LATCH will show the most recent latched encoder position.

When FALSE, the control of the Mark 2 Input is passed to function block OPTION A MARK2 for registration to take place.

SCALE A *PREF: 165.09* *Default: 1000* *Range: 0 to 2147483647*

Together with SCALE B, this parameter is used to convert encoder position to user position using the following formula. User position can be output directly as user units, for example, millimetres.

$$Load\ Position = Encoder\ Position \times \frac{SCALE\ A}{SCALE\ B}$$

Note: encoder resolution is equal to 2^{11} x the number of encoder lines = 2048 x the number of encoder lines per mechanical revolution of the encoder. For example, a 2048 line encoder provides 2048 x 2048 = 4194304 increments per mechanical revolution.

SCALE B *PREF: 165.10* *Default: 1000* *Range: 0 to 2147483647*

Together with SCALE A, this parameter is used to convert encoder position to user position using the following formula. User position can be output directly as user units, for example, millimetres.

$$Load\ Position = Encoder\ Position \times \frac{SCALE\ A}{SCALE\ B}$$

Note: encoder resolution is equal to 2^{11} x the number of encoder lines = 2048 x the number of encoder lines per mechanical revolution of the encoder. For example, a 2048 line encoder provides 2048 x 2048 = 4194304 increments per mechanical revolution.

Parameter Descriptions

COUNT DIRECTION *PREF: 165.11* *Default:POSITIVE* *Range:POSITIVE/NEGATIVE*

When this parameter is POSITIVE, the encoder position increments when the encoder turns clockwise.

When NEGATIVE, the encoder position increments when the encoder turns counter-clockwise.

This parameter must be adjusted so that the encoder position increments in the normal direction of movement in the application. This can be verified by examining successive values of MARK 1 LATCH or MARK 2 LATCH.

MODULO *PREF: 165.24* *Default: 0* *Range 0 to 2147483647*

This parameter is used in calculating the encoder position. It represents the repeat length of the reference or feedback encoder, in load position units. It defines the maximum value of the following parameters :

MARK 1 LATCH
MARK 2 LATCH
OPTION F MARK1: LATCH POSITION
OPTION F MARK2: LATCH POSITION

When the value is zero, Modulo calculation is disabled.

RESET POSITION *PREF: 165.25* *Default: FALSE* *Range: FALSE / TRUE*

When TRUE, this parameter resets the encoder position, user position, and latch positions to zero.

ENCODER POSITION *PREF: 165.16* *Default: FALSE* *Range: FALSE / TRUE*

Absolute position of the encoder shaft, in units of encoder lines x 2^{11}.

MARK INDEX 1 *PREF: 165.18* *Default: —* *Range: 0 to 127*

When a mark event occurs, i.e. a leading or trailing edge, the encoder position is captured into a circular buffer. This diagnostic indicates where the next entry for Mark 1 will be inserted into the circular buffer. It can be used to verify correct detection of marks.

MARK INDEX 2 *PREF: 165.19* *Default: —* *Range: 0 to 127*

When a mark event occurs, i.e. a leading or trailing edge, the encoder position is captured into a circular buffer. This diagnostic indicates where the next entry for Mark 2 will be inserted into the circular buffer. It can be used to verify correct detection of marks.

MARK 1 LATCH *PREF: 165.20* *Default: —* *Range: 0 to 2147483647*

This diagnostic reports the encoder position, in user units, of the most recent event on mark 1.

MARK 2 LATCH *PREF: 165.21* *Default: —* *Range: 0 to 2147483647*

This diagnostic reports the encoder position, in user units, of the most recent event on mark 2.

BOARD STATUS *PREF: 165.22* *Default: —* *Range: see below*

This diagnostic reports the status of the registration board and encoder in option F.

Enumerated Value : *Board Status*

0 : NO ENCODER BRD
1 : INITIALISING
2 : HEALTHY
3 : FAULT

OPTION F FITTED *PREF: 165.23* *Default: —* *Range: see below*

This diagnostic reports the type of registration board in option F.

Enumerated Value : *Board Status*

0 : NO ENCODER BRD
1 : HTTL ENCODER
2 : RS485 ENCODER
3 : SINCOS ENCODER
4: SINCOS ENC REG
5: HTTL ENC REG
6: RS485 ENC REG

This diagnostic should report value 4: SINCOS ENC REG if an 8902/M1 option is fitted.

LATCH SOURCE *PREF: 166.26* *Default: —* *Range: -*

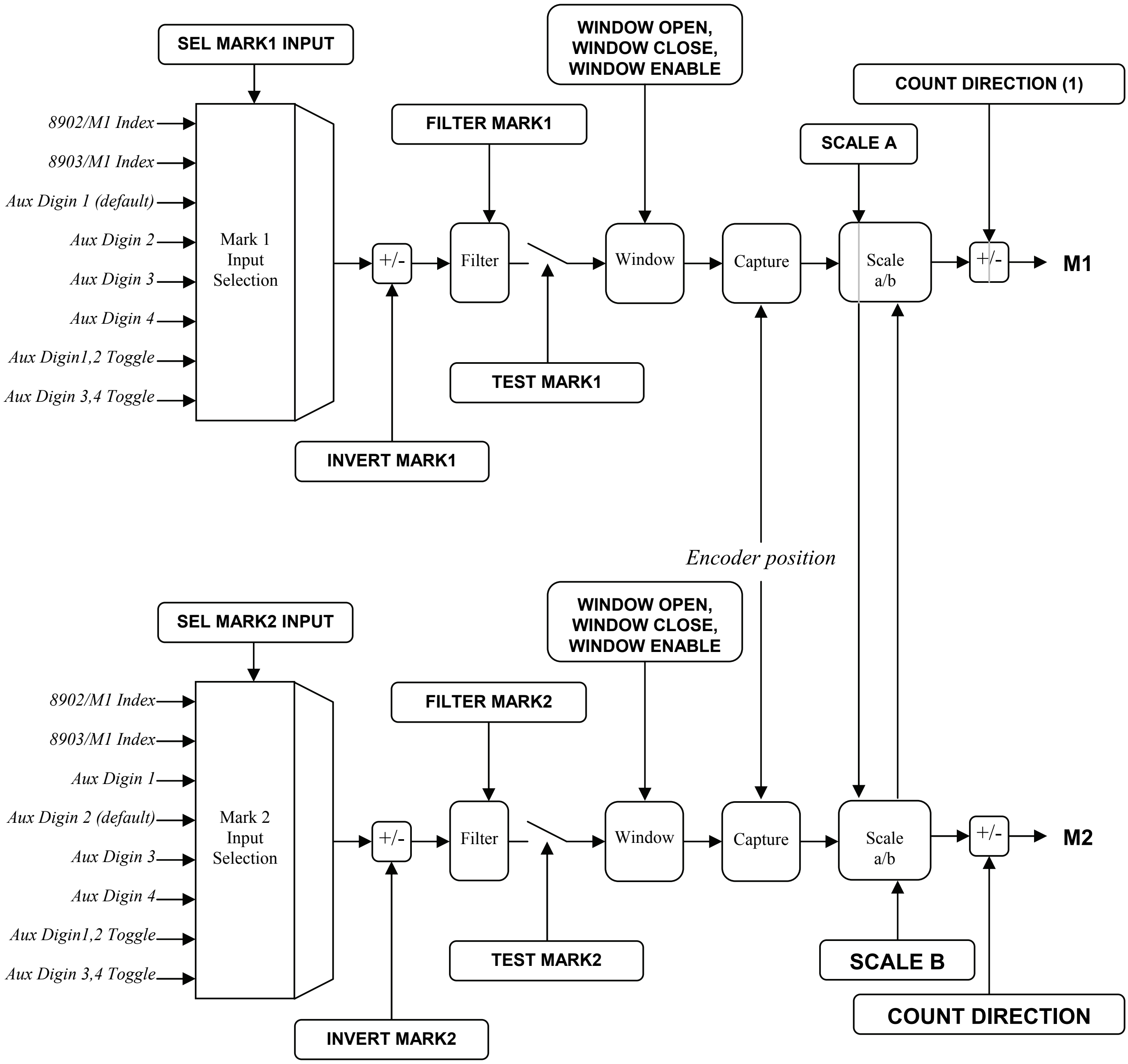
Reserved for future use.

REG ZERO OFFSET *PREF: 165.28* *Default: 0* *Range: 0 ± 2147483647*

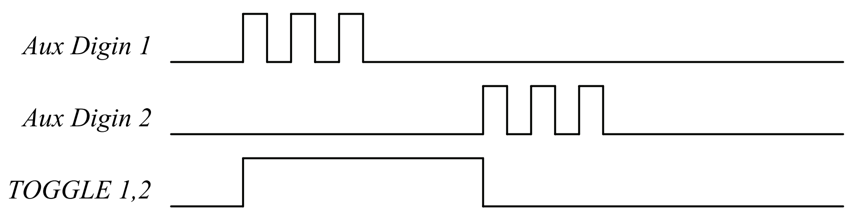
Reserved for future use.

Functional Description

The registration system provides four auxiliary digital inputs, any two of which may be used for registration. A number of parameters allow the selected input(s) to be configured. The following diagram shows how the mark inputs are configured and processed.



The two Aux Digin Toggle inputs each require two inputs to function, as explained in the following diagram, which shows waveforms for Aux Digin 1,2 Toggle. It is useful if the marks are generated from contacts which may bounce. The waveforms for Aux Digin 3,4 are similar, and produce an output TOGGLE 3,4.

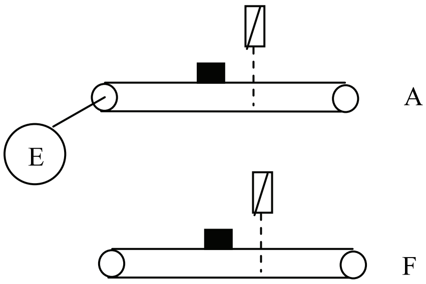


Mark Transfer between OPTION A and OPTION F

Due the fact that the feedback encoder registration board has only the z-pulse input available to become a registration input, it is necessary to pass the inputs from the option A registration board to the option F board for capturing the feedback encoder. This is done inside the drive; no wiring is necessary. Likewise it is possible to transfer the Z-pulse on option F to the board in option A.

Windowing both marks with one encoder is only possible if the drives are synchronized correctly. If the process needs both marks to be windowed, the best solution is to set up the windowing function on the reference encoder for mark 1 and on the feedback encoder for mark2. Otherwise, if one encoder can be used as reference for windowing both marks, then either the option F or option A encoder can be used.

Registration System with capture and windowing on one encoder

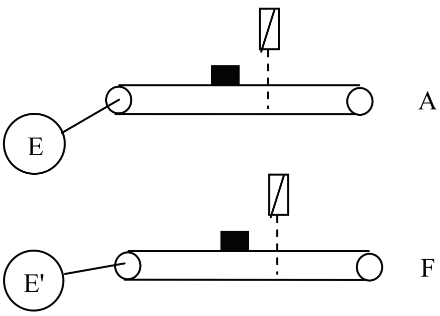


System A can be windowed for every possible movement, because it is mechanically linked with the encoder.

For system F, windowing is only possible if the link to the encoder is established by gearing with no slip.

The registration error is the difference between the encoder position (E) when A has reached its mark and the encoder position (E) when F has reached its mark.

Registration System with capture on one encoder and windowing on two encoders



System A can be windowed for every possible movement, because it is mechanically linked with the encoder E.

For system F universal windowing is possible when the window open and close positions are derived from encoder E' .

The registration error is the difference between the encoder position E or E' when F has reached its mark minus the encoder position E or E' when F has reached its mark.

So in this example the Mark Sensor for feedback encoder E' will be connected to Aux Input 2 and the Mark Sensor for the reference encoder E will be connected to Aux Input 1. Encoder E' is connected to OPTION F and the encoder E is connected to OPTION A.

- To select Aux Input 2 as Mark Input 2 on the option F board set
  CONFIG OPTION F:SEL MARK 2 INPUT = AUX INPUT 2

  Set up windowing for Mark 2 on option F as described before in the OPTION F MARK2 block.
- To select Aux Input 1 as Mark Input 1 on the option A board set
  CONFIG OPTION A:SEL MARK 1 INPUT = AUX INPUT 1

  Set up windowing for Mark 1 on option A as described before in the OPTION A MARK1 block

Now select the windowed Mark2 from option F as Mark 2 input for option A. Note on option A, the reference encoder E will be captured.

- CONFIG OPTION A:SEL MARK 2 INPUT = WIN MA2 OPTION F
- Ideally run the OPTION A MARK2 block without windowing enabled.
- The registration error can now be derived from the REGISTER MOVE block using ERROR METHOD = OPT F MA1 MA2.

REGISTER MOVE

SETUP::REGISTRATION::REGISTER MOVE

This block configures and monitors parameters associated with the calculation of registration error and, if enabled, does a Phase Move to correct the error.

Parameter Descriptions

OFFSET	*PREF: 169.01*	*Default: 0*	*Range: ± 2147483647*

This parameter sets the required offset between marks M1 and M2, measured in user units.

MODULO	*PREF: 169.02*	*Default: 0*	*Range: 0 to 2147483647*

Modulo for the registration error. The measured registration error is divided by this number, and the remainder is used to calculate a registration error. This is used, for example, to ensure that any correction made to null the registration error is within ± ½ a repeat length. The value is in user units.

RESET	*PREF: 169.07*	*Default:FALSE*	*Range: FALSE / TRUE*

When this parameter is True, ERROR COUNT is reset to 0.

ENABLE METHOD	*PREF: 169.08*	*Default: FALSE*	*Range: FALSE / TRUE*

This parameter enables or disables error calculation. When False, ERROR and ERROR/CYCLE diagnostics are zero.

ERROR METHOD	*PREF: 169.09*	*Default: 0*	*Range: - see below*

This parameter defines the method used to calculate the registration error.

Enum Value : Error Method

0 SETUP PARAMETER — Calculation of new errors does not take place. This value is used while other parameter values in this block are being entered or edited.

1 OPT A MARK1 — Only MARK 1 from option A is used. The position of the feedback encoder is captured as defined in the OPTION A MARK1 function block. When a mark occurs the registration error is calculated as:

OFFSET
+ n * OPTION A MARK1::NOMINAL REPEAT
- OPTION A MARK1::LATCH POSITION

n = Number of registration cycles = 1 after 1st repeat, 2 after 2nd repeat etc.

That is, the error is based on encoder positions captured in Option A. This method requires NOMINAL REPEAT, SCALE A and SCALE B to be exact. SCALE A and SCALE B are in the CONFIG OPTION A menu.

Note this setting is incompatible with LATCH SOURCE – SYNTHETIC ENC.

2 OPT A MA1 MA2 — Two marks are used to calculate the registration error. One mark is used as a reference, and one for feedback.

The formula for calculating regstration error is:

OFFSET
+ OPTION A MARK1::LATCH POSITION
- OPTION A MARK2::LATCH POSITION

That is, the error is based on encoder positions captured in Option A.

3 OPT F MARK 1 — Only MARK 1 from option F is used. The position of the encoder is captured as defined in the OPTION F MARK1 function block. When a mark occurs the registration error is calculated as:

OFFSET
+ n * OPTION F MARK1::NOMINAL REPEAT
- OPTION F MARK1::LATCH POSITION

n = Number of registration cycles = 1 after 1st repeat, 2 after 2nd repeat etc.

That is, the error is based on encoder positions captured in Option F. This method requires NOMINAL REPEAT, SCALE A and SCALE B parameters to be exact.

Parameter Descriptions

4	OPT F MA1 MA2	Two marks are used to calculate the registration error. One mark is used as a reference, and one for feedback. The formula for calculating regstration error is: OFFSET + OPTION F MARK1::LATCH POSITION - OPTION F MARK2::LATCH POSITION That is, the error is based on encoder positions captured in Option F.

MAX ERROR *PREF: 169.11* *Default: 0* *Range: 0 to 2147483647*

This parameter clamps the registration error to +/- MAX ERROR. If MAX ERROR= 0 then the clamp is disabled.

MOVE ENABLE *PREF: 169.13* *Default:FALSE* *Range: FALSE / TRUE*

This parameter enables or disables a Phase Move to correct the calculated error. See functional description below.

Note: Position Loop must be enabled for correction to take place. (SETUP :: MOTOR CONTROL :: POSITION LOOP :: ENABLE must be TRUE)

DIRECTION *PREF: 169.14* *Default:POSITIVE* *Range: NEGATIVE / POSITIVE*

This parameter determines the direction of the Phase Move if **MOVE ENABLE** is True.

GAIN *PREF: 169.15* *Default: 100 %* *Range: 0.01 to 100.00 %*

Determines percentage of error corrected in one move if **MOVE ENABLE** is True. See functional description below.

LIMIT *PREF: 169.16* *Default: 100 %* *Range: 0.01 to 100.00 %*

Limits the maximum distance of one move if **MOVE ENABLE** is True. See functional description below.

VELOCITY *PREF: 169.17* *Default: 1.00 %* *Range: 0.10 to 200.00 %*

The maximum velocity at which the distance is added to the phase loop, set in units per second.

ACCELERATION *PREF: 169.18* *Default: 1.00 %* *Range: 0.01 to 500.00 %*

The acceleration at which the distance is added to the phase loop, set in units per second^2.

ERROR *PREF: 169.03* *Default: —* *Range: ± 2147483647*

This diagnostic is the measured registration error, in user units. ENABLE METHOD must be True.

ERROR/CYCLE *PREF: 169.04* *Default: —* *Range: ± 2147483647*

This diagnostic is the difference between the new “Error” and the “Error” from the last cycle, in user units.

NEW ERROR *PREF: 169.05* *Default: —* *Range: FALSE / TRUE*

When True, this diagnostic indicates that a new registration error has been calculated. It remains True for one tick of the application block diagram, and is therefore unlikely to be seen True on an HMI.

ERROR COUNT *PREF: 169.06* *Default: —* *Range: 0 to 2147483647*

This diagnostic increments every time a new registration error failed to be calculated. For example, if ERROR METHOD = OPT A MA1 MA2, this value will increment if one of the marks fails to arrive.

STATE *PREF: 169.10* *Default: —* *Range: - see below*

This diagnostic indicates the state of a state machine that checks the two mark inputs, when ERROR METHOD = OPT A, MA1 MA2 or OPT F MA1 MA2.

Error Method	*State*	*Comment*
SETUP PARAMETER	INPUT PARAMETER	The REGISTER MOVE function block is disabled, and all output parameters are frozen.
OPTION A/F MARK1	WAIT VALID MARK	The Error Method for the one sensor mode is enabled. The system is waiting for a valid mark on input 1.
OPT A/F MA1 MA2	WAIT 1 MARK	The state machine is waiting for the first valid mark, either on mark 1 or mark 2.
	MARK 1 SEEN	A valid mark on input 1 has been detected, the state machine is waiting for a valid mark on input 2.
	MARK 2 SEEN	A valid mark on input 2 has been detected, the state machine is waiting for a valid mark on input 1.

BOTH MARKS SEEN	Both marks have been captured. The system calculates a new ERROR, a new ERROR/CYCLE and sets the NEW ERROR flag, for triggering the LINK Application. This diagnostic is only valid for one 5ms tick, so it will normally not been recognized on the HMI.

MOVE ACTIVE *PREF: 169.12* *Default: —* *Range: FALSE / TRUE*

When True, indicates that a Phase Move is active to correct error term. See functional description below.

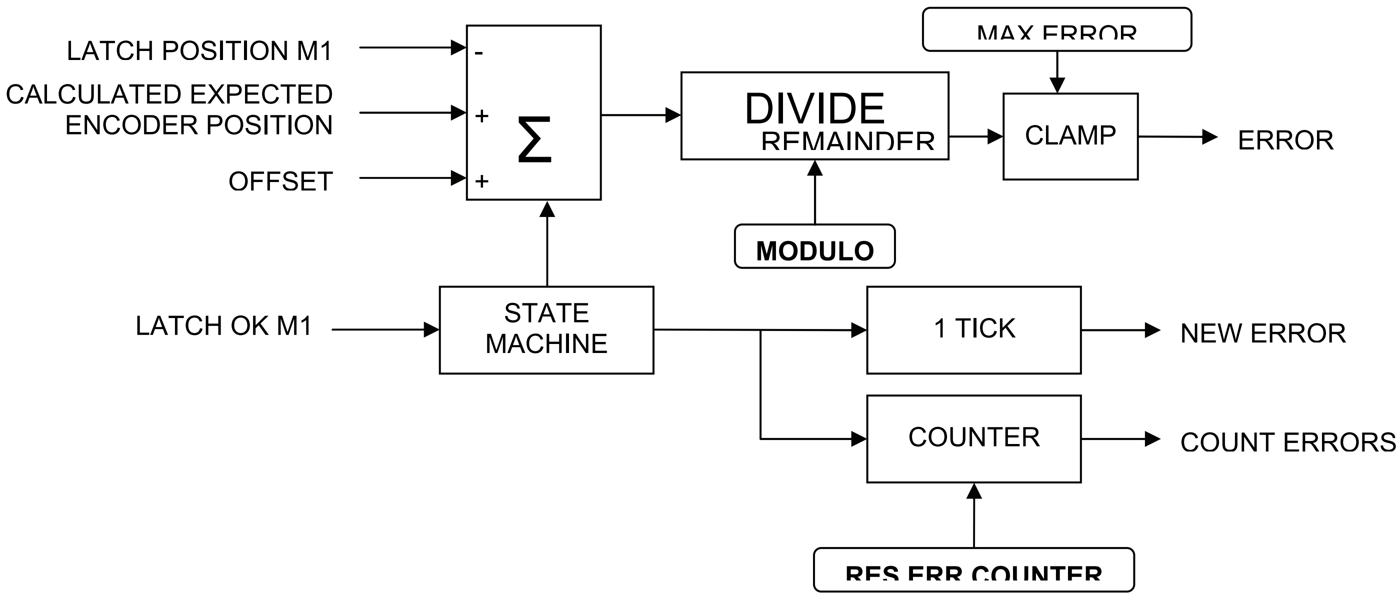
MOVE OFFSET *PREF: 169.19* *Default: —* *Range: 0 – 1.0000*

Current offset of Phase Move if **MOVE ENABLE** is True. (1.0 = 1 load mechanical revolution) . See functional description below.

Functional Description

ONE MARK Mode

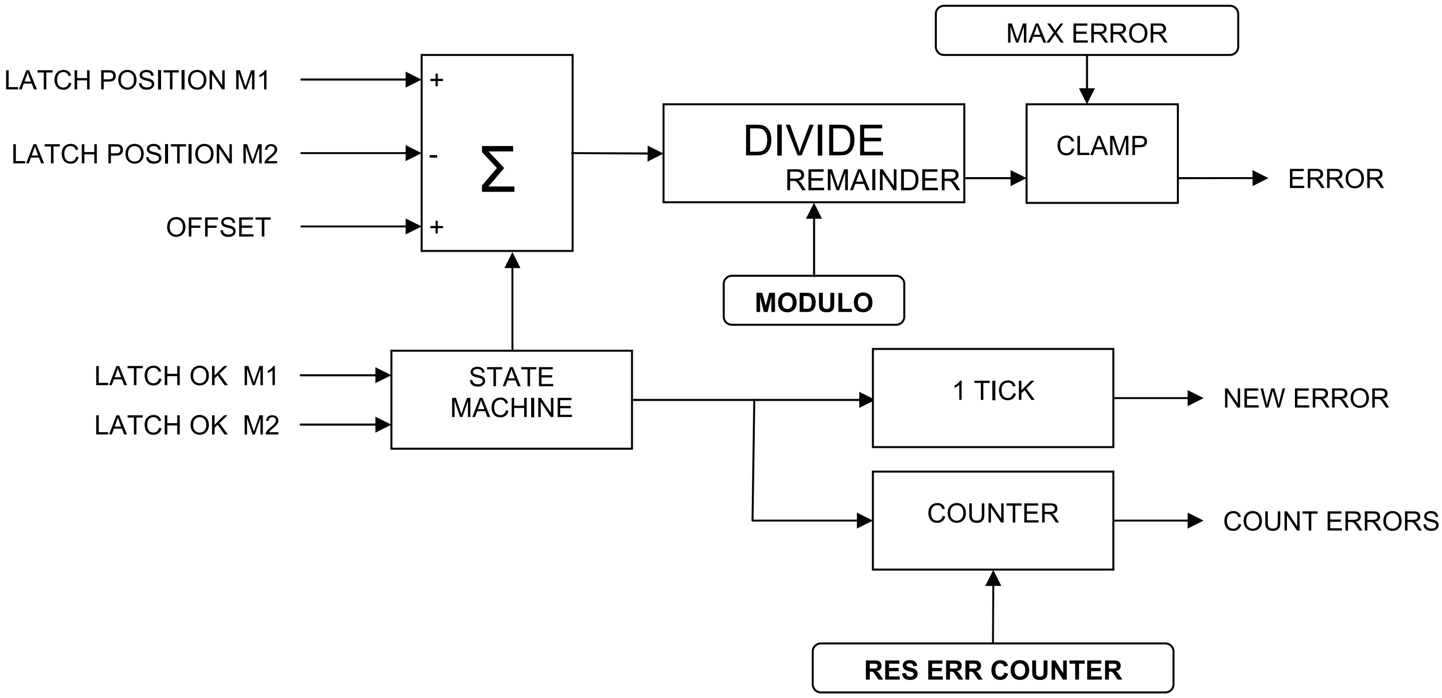
The following diagram shows how the registration error is calculated when the ERROR METHOD parameter is set to OPTION A MARK1 or OPTION F MARK1.



In this mode, the feedback encoder position is calculated by drive software. During the set-up for a new job, the phase relationship of the feedback encoder, i.e. the OFFSET parameter, is adjusted manually to the correct initial position. From this initial position, the firmware calculates the encoder position for when the next mark is expected. It does this by adding exactly one revolution to the initial position. When the mark actually arrives, the firmware can calculate the registration error by subtracting the actual encoder position from the expected position. After this mark has arrived, the firmware adds a further revolution to the expected position and so on.

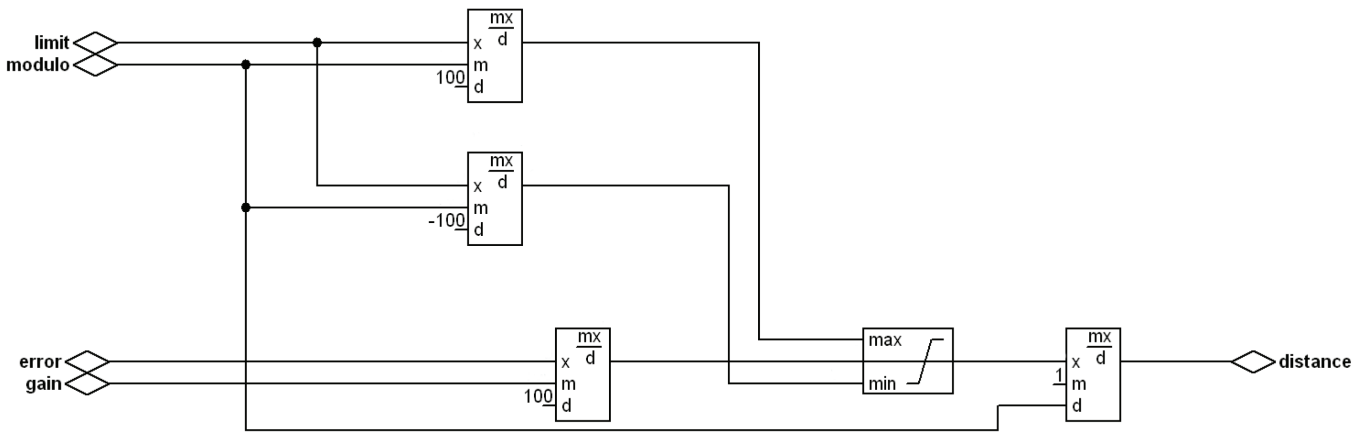
TWO MARKS Mode

The following diagram shows how the registration error is calculated when the ERROR METHOD parameter is set to OPT A MA1 MA2 or OPT F MA1 MA2.



Move Enabled

If MOVE ENABLE is True, a Phase Move is executed (see PHASE MOVE block) where the distance is calculated as follows.



ENCODER

SETUP::MOTOR CONTROL::ENCODER

This block is used to set up the way that speed feedback is obtained via the 8902/M1 or 8903/M1. (If both cards are fitted, refer to REFERNCE ENCODER for setting up the 8903/M1).

Various encoder types may be selected and require different hardware options. If an encoder type is selected which does not match the hardware, an error will be flagged.

Parameter Descriptions

PULSE ENC VOLTS *PREF: 71.01* *Default: 10.0 V* *Range: 10.0 to 20.0 V*

Set this approximately to the supply voltage required by the pulse encoder. This parameter is not relevant for the 8903/M1 or 8902/M1.

SINCOS ENC VOLTS *PREF: 71.22* *Default: 5.0 V* *Range: See below*

Used to set the supply volts required by the sin/cos encoder.

Enumerated Value : SinCos Encoder Volts

0 : 5V
1 : 10V

ENCODER LINES *PREF: 71.02* *Default: 2048* *Range: 250 to 262143*

The number of lines must be set to match the type of encoder being used. Incorrect setting of this parameter will result in an erroneous speed measurement and will cause the motor to become unstable.

ENCODER INVERT *PREF: 71.03* *Default: FALSE* *Range: FALSE/TRUE*

Used to match the encoder direction to the motor direction. The encoder direction is set automatically by the Autotune when running in closed-loop vector mode. It should not be necessary to adjust this parameter. When TRUE, it changes the sign of the measured speed and the direction of the position count.

ENCODER TYPE *PREF: 71.04* *Default: 3* *Range: See below*

This parameter defines the type of encoder being used.

Enumerated Value :	*Type*
0 : QUADRATURE	single-ended pulse encoder
1 : CLOCK/DIR	single-ended pulse encoder
2 : CLOCK	single-ended pulse encoder
3 : QUADRATURE DIFF	differential pulse encoder
4 : CLOCK/DIR DIFF	differential pulse encoder
5 : CLOCK DIFF	differential pulse encoder
6 : SINCOS ENC	sin/cos encoder
7 : ABS ENDAT ST	single turn endat absolute encoder
8 : ABS ENDAT MT	multi-turn endat absolute encoder

Note that if an absolute endat encoder is used, the encoder MUST be wired exactly as specified. If not, it will fail to calibrate the absolute position and an error will result when the drive is started. Its status can be viewed via the parameter CALIBRATN STATUS.

For 8902/M1 and 8903/M1, select value 5, 6 or 7.

ENCODER MECH O/S *PREF: 71.06* *Default: 0.0000 deg* *Range: 0.0000 to 360.0000 deg*

(Encoder mechanical offset). When using an absolute encoder, the SHAFT POSITION diagnostic shows the absolute position of the motor shaft. The zero position can be adjusted by setting ENCODER MECH O/S. Rotate the motor shaft to the position which is required to be zero, and note the value of SHAFT POSITION. Enter this value into ENCODER MECH O/S to zero its position.

SHAFT POSITION *PREF: 71.09* *Default: —.xx deg* *Range: —.xx deg*

This diagnostic provides the motor shaft position (before the gear box).

LOAD POSITION *PREF: 71.10* *Default: —.xx deg* *Range: —.xx deg*

This diagnostic provides the motor load position (after the gear box).

OUTPUT G'BOX IN *PREF: 71.05* *Default: 1* *Range: -2000000000 to +2000000000*

See OUTPUT G'BOX OUT below.

Parameter Descriptions

OUTPUT G'BOX OUT *PREF: 71.26* *Default: 1* *Range: -2000000000 to +2000000000*

These two parameters define the gearbox ratio between the motor and the load. For example, if a 3:2 gearbox is fitted between the motor and the load such that the motor turns through 3 revolutions for every 2 revolutions of the load, then set OUTPUT G'BOX IN to 3, and set OUTPUT G'BOX OUT to 2. The software will then keep track of the load position.

If the power is removed and then reapplied, it is possible for the drive to keep track of the load position even if the shaft has moved since the power was removed. This is only possible if the encoder is an absolute multi-turn. Otherwise, the load position will be set equal to the motor position on power-up.

CALIBRATN STATUS *PREF: 71.13* *Default: 0* *Range: see below*

If a sincos absolute Endat encoder is fitted (single-turn or multi-turn), the software will attempt to match the slow absolute position (Endat) information to the fast analog feedback information, to obtain a fast absolute position feedback. This will normally be done on power-up. If the encoder is wired correctly and working correctly, these should match. The CALIBRATN STATUS diagnostic will then display COMPLETED. If the encoder is not an absolute type, the diagnostic will show NOT REQUIRED. If calibration fails, this diagnostic will indicate where the problem may lie. Refer to CAL FAIL RETRY.

Enumerated Value : Type

0 : NOT REQUIRED
1 : DRIVE NOT STOP'D
2 : MOTOR NOT STOP'D
3 : ENDAT FAULT
4 : CAL IN PROGRESS
5 : ID PSN IN PRGRSS
6 : COMPLETED
7 : CALIBRATION LOST
8 : CALIBRATN FAILED

REV COUNT *PREF: 71.15* *Default: 0* *Range: —.*

This counts the number of turns of the motor shaft. It will normally start from zero on power-up. If a multi-turn Endat encoder is fitted, REV COUNT will be made to match the multi turn encoder rev count. However, it will continue to count beyond the Endat range of 0 to 4095 revs. It will count to the limits of a 32 bit number, but the lower 12 bits will be equal to the Endat rev count.

CAL FAIL RETRY *PREF: 71.24* *Default: FALSE* *Range: FALSE / TRUE*

The software will make a number of attempts to calibrate the absolute position (see CALIBRATN STATUS above) and then go into the CALIBRATN FAILED state. If the problem has been corrected, it is necessary to get it to try again. This can be done either by switching the drive off and on, changing a related parameter, or by setting CAL FAIL RETRY = TRUE. When the calibration is done, it will automatically be reset to FALSE.

ENCODER FEEDBACK *PREF: 71.30* *Default: 0.00* *Range: —.xx RPM*

This parameter shows the mechanical speed of the motor shaft, calculated from the encoder feedback, in RPM.

REFERNCE ENCODER

SETUP::MOTOR CONTROL::REFERNCE ENCODER

This block is used to set up how the reference encoder input is obtained, via the 8903/M1 Option Card. The drive must be capable of using the High Performance blocks found in the DSE 890 Configuration Tool (refer to the drive's Product Code).

Various encoder types may be selected and these require different hardware options. If an encoder type is selected which does not match the hardware, an error will be flagged.

The reference encoder input will normally be used to make the drive precisely follow an external reference. This is done in conjunction with the VIRTUAL MASTER function block. The Firewire mode must first be selected. The parameter VIRTUAL MASTER :: SOURCE should be set to REFERNCE ENCODER. The virtual master output will then be equal to the reference encoder input.

Parameter Descriptions

PULSE ENC VOLTS *PREF: 158.01* *Default: 10.0 V* *Range: 10.0 to 20.0 V*

Set this approximately to the supply voltage required by the pulse encoder. This parameter is not relevant for the 8903/M1 or 8902/M1.

SINCOS ENC VOLTS *PREF: 158.22* *Default: 5.0 V* *Range: See below*

Used to set the supply volts required by the sin/cos encoder.

Enumerated Value : SinCos Encoder Volts

0 : 5V
1 : 10V

ENCODER LINES *PREF: 158.02* *Default: 2048* *Range: 250 to 262143*

The number of lines must be set to match the type of encoder being used. Incorrect setting of this parameter will result in an erroneous speed measurement.

ENCODER INVERT *PREF: 158.03* *Default: FALSE* *Range: FALSE/TRUE*

This parameter is used to switch the direction of the input encoder, forward or reverse.

ENCODER TYPE *PREF: 158.04* *Default: 0* *Range: See below*

This parameter defines the type of encoder being used.

Enumerated Value :	*Type*
0 : QUADRATURE	single-ended pulse encoder
1 : CLOCK/DIR	single-ended pulse encoder
2 : CLOCK	single-ended pulse encoder
3 : QUADRATURE DIFF	differential pulse encoder
4 : CLOCK/DIR DIFF	differential pulse encoder
5 : CLOCK DIFF	differential pulse encoder
6 : SINCOS INC	sin/cos encoder
7 : ABS ENDAT ST	single turn endat absolute encoder
8 : ABS ENDAT MT	multi-turn endat absolute encoder

Note that if an absolute endat encoder is used, the encoder MUST be wired exactly as specified. If not, it will fail to calibrate the absolute position and an error will result when the drive is started. This status can be viewed via the parameter CALIBRATN STATUS.

For 8902/M1 and 8903/M1, select value 5, 6 or 7.

ENCODER MECH O/S *PREF: 158.06* *Default: 0.0000 deg* *Range: 0.0000 to 360.0000 deg*

(Encoder mechanical offset). When using an absolute encoder, the SHAFT POSITION diagnostic shows the absolute position of the input encoder. The zero position can be adjusted by setting ENCODER MECH O/S. Locate the position which is required to be zero, and note the value of SHAFT POSITION. Enter this value into ENCODER MECH O/S to zero its position.

ENCODER FBK % *PREF: 158.08* *Default: —.xx %* *Range: —.xx %*

This parameter shows the speed of the input encoder, as a percentage of the MAX SPEED parameter in the REFERENCE function block.

Parameter Descriptions

SHAFT POSITION	*PREF: 158.09*	*Default: —.xx deg*	*Range: —.xx deg*

This diagnostic provides the motor shaft position (before the gear box).

*** LOAD POSITION**	*PREF: 158.10*	*Default: —.xx deg*	*Range: —.xx deg*

This diagnostic provides the motor load position (after the gear box).

*** OUTPUT G'BOX IN**	*PREF: 158.05*	*Default: 1*	*Range: -2000000000 to +2000000000*

See OUTPUT G'BOX OUT below.

***OUTPUT G'BOX OUT**	*PREF: 158.26*	*Default: 1*	*Range: -2000000000 to +2000000000*

These two parameters define the gearbox ratio between the motor and the load. For example, if a 3:2 gearbox is fitted between the motor and the load such that the motor turns through 3 revolutions for every 2 revolutions of the load, then set OUTPUT G'BOX IN to 3, and set OUTPUT G'BOX OUT to 2. The software will then keep track of the load position.

If the power is removed and then reapplied, it is possible for the drive to keep track of the load position even if the shaft has moved since the power was removed. This is only possible if the encoder is an absolute multi-turn. Otherwise, the load position will be set equal to the motor position on power-up.

** The output gearbox functions LOAD POSITION, OUTPUT G'BOX IN and OUTPUT G'BOX OUT are intended to apply to the feedback encoder, to allow the user to keep track of the speed and position of a load attached to the motor via a gearbox. It will not normally be applicable to the reference encoder. However, the parameters are included here because it is possible that the reference encoder may be derived from a motor with a gearbox. In this case it may be desirable to use the load position as the reference. These parameters will make it possible to do this.*

CALIBRATN STATUS	*PREF: 158.13*	*Default: 0*	*Range: see below*

If a sincos absolute Endat encoder is fitted (single-turn or multi-turn), the software will attempt to match the slow absolute position (Endat) information to the fast analog feedback information, to obtain a fast absolute position feedback. This will normally be done on power-up. If the encoder is wired correctly and working correctly, these should match. The CALIBRATN STATUS diagnostic will then display COMPLETED. If the encoder is not an absolute type, the diagnostic will show NOT REQUIRED. If calibration fails, this diagnostic will indicate where the problem may lie. Refer to CAL FAIL RETRY.

Enumerated Value : Type

0 : NOT REQUIRED
1 : DRIVE NOT STOP'D
2 : MOTOR NOT STOP'D
3 : ENDAT FAULT
4 : CAL IN PROGRESS
5 : ID PSN IN PRGRSS
6 : COMPLETED
7 : CALIBRATION LOST
8 : CALIBRATN FAILED

REV COUNT	*PREF: 158.15*	*Default: 0*	*Range: —.*

This counts the number of turns of the encoder input. It will normally start from zero on power-up. If a multi-turn Endat encoder is fitted, REV COUNT will be made to match the multi-turn encoder rev count. However, it will continue to count beyond the Endat range of 0 to 4095 revs. It will count to the limits of a 32 bit number, but the lower 12 bits will be equal to the endat rev count.

CAL FAIL RETRY	*PREF: 158.24*	*Default: FALSE*	*Range: FALSE / TRUE*

The software will make a number of attempts to calibrate the absolute position (see CALIBRATN STATUS above) and then go into the CALIBRATN FAILED state. If the problem has been corrected, it is necessary to get it to try again. This can be done either by switching the drive on and off, changing a related parameter, or by setting CAL FAIL RETRY = TRUE. When the calibration is done, CAL FAIL RETRY will automatically be reset to FALSE.

ENCODER FEEDBACK	*PREF: 158.30*	*Default: 0.00*	*Range: —.xx RPM*

This parameter shows the mechanical speed of the motor shaft, calculated from the encoder feedback, in RPM.

SYNTHETIC ENCODER

SETUP::PHASE CONTROL::SYNTHETIC ENCODER

(Virtual Master Simulator) This function is used in conjunction with the 8903/M1 that is fitted in Option A position. It generates A, B, and Z pulses, equivalent to an encoder, and internally an encoder position value. This is typically used to interface with external registration equipment, such as in shaftless printing.

Parameter Descriptions

RUN SIMULATOR *PREF: 160.1 Default: FALSE Range: FALSE / TRUE*

Enables or disables the simulator function.

SOURCE *PREF: 160.9 Default: V MASTER POS'N Range: see below*

This selects the input to the synthetic encoder. Selecting V MASTER POSN will cause the synthetic encoder to directly follow the virtual master. It can also be set to follow the feedback or reference encoders. Both the feedback and the reference encoders have a software gearbox function, which continuously calculates the position of a load on the other side of a gearbox connected to the motor shaft or reference shaft. It is possible to select the synthetic encoder to follow the encoder shaft directly, or to follow the position of the load on the other side of the gearbox.
For example, to follow the feedback encoder directly, select FBK ENCR SHAFT, and to follow the load on the other side of the gearbox, select FBK ENCR LOAD.

Enumerated Value : Type

0 : V MASTER POS'N
1: FBK ENCDR SHAFT
2: FBK ENCDR LOAD
3: REF ENCDR SHAFT
4: REF ENCDR LOAD

ENCODER LINES *PREF: 160.2 Default: 1024 Range: 4 to 65536*

Sets the number of lines per effective revolution of the synthetic encoder.

DIRECTION *PREF: 160.3 Default: SAME AS SOURCE Range: See below*

Allows inverting the synthetic encoder direction relative to the source direction.

Enumerated Value : Type

0 : SAME AS SOURCE
1: REVERSE OF SRCE

Z PULSE OFFSET *PREF: 160.5 Default: 0.0000 Range: 0.0000 to 360.0000º*

This parameter sets the position in degrees at which the marker pulse (Z pulse) occurs.

GEAR IN *PREF: 160.13 Default: 1 Range: 0 to 2000000000*

See GEAR OUT

GEAR OUT *PREF: 160.14 Default: 1 Range: 0 to 2000000000*

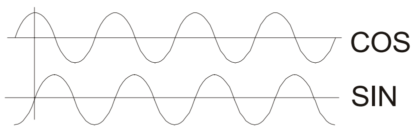
Together with GEAR IN, sets the ratio between the synthetic encoder speed and its source.

$$SyntheticEncoderSpeed = SourceSpeed \times \frac{GEAR\ OUT}{GEAR\ IN}$$

In order to obtain maximum resolution, GEAR IN and GEAR OUT should be chosen to make SyntheticEncoderSpeed as high as possible, but without exceeding the maximum 250kHz.

Appendix B : SIN/COS Encoder Overview

A Sin/Cos encoder generates two output signals, SIN and COS, which by definition are offset by a quarter of a cycle (90°).



Direction is obtained by looking to see if SIN is leading or lagging the COS signal.

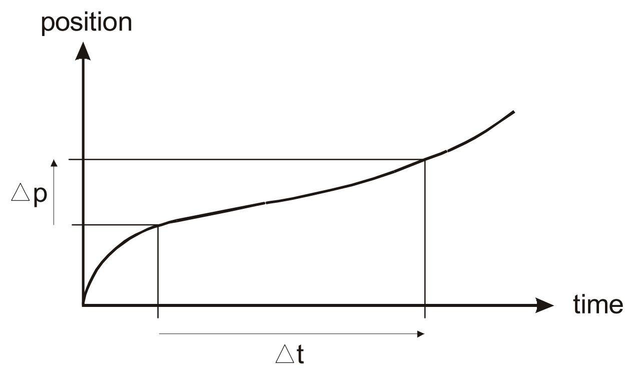
A coarse position is obtained by incrementing or decrementing a counter when the polarity of the SIN signal changes with the COS signal high. This gives one count per encoder line.

The SIN and COS inputs are further sampled by an ADC (analog to digital converter) so that encoder positon can be interpolated by a factor of 2^{11} within one line count, eg. for a 2048 line encoder this gives:

2048 x 2^{11} counts per revolution = 4,194,304 counts per revolution

High resolution speed can now be calculated from this high resolution position:

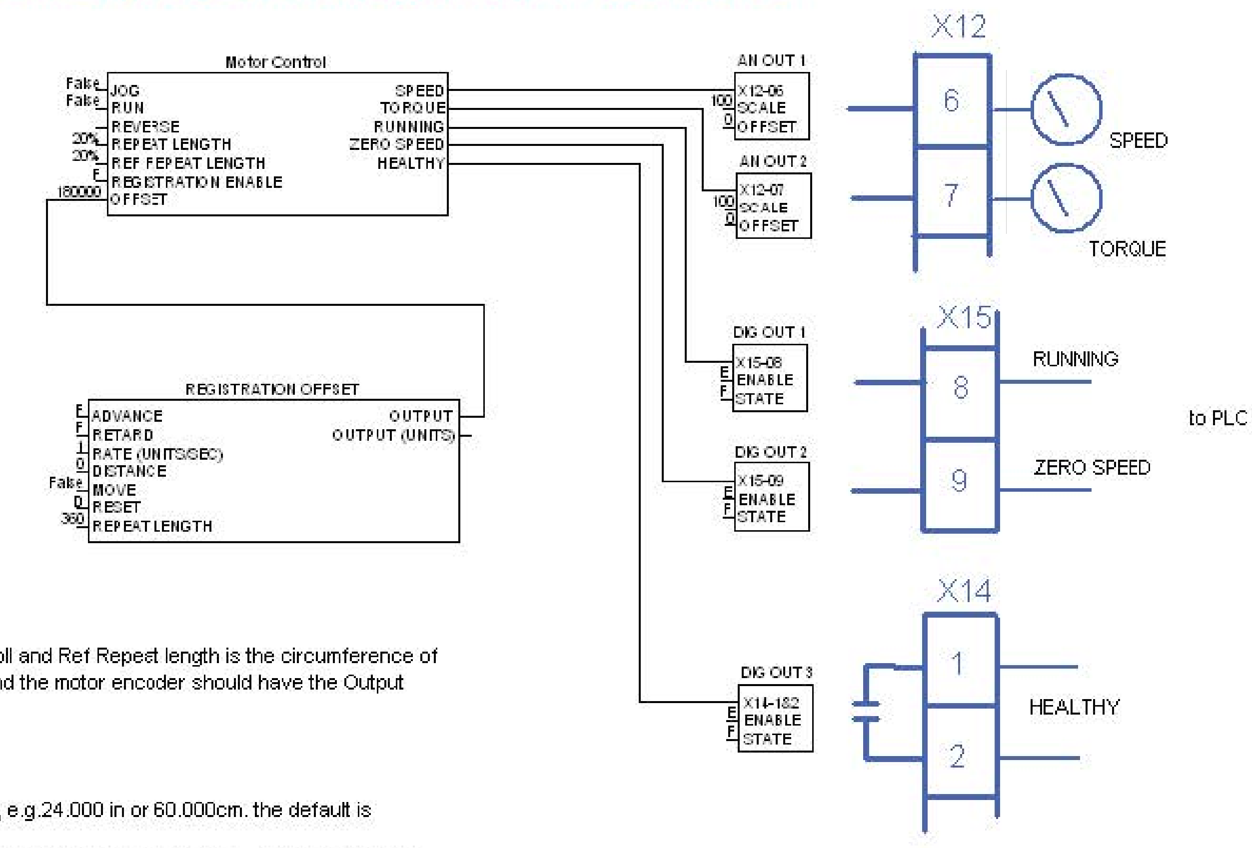
$$\text{speed} = \frac{\triangle \text{position}}{\triangle \text{time}}$$



This configuration will be available to download from the Parker SSD Drives website. Refer to www.ssddrives.com.

Top Level Block Diagram

REGISTRATION TEMPLATE FOR 1 SENSOR FOLLOWING A VIRTUAL MASTER



REGISTRATION

Repeat length is the circumference of the driven roll and Ref Repeat length is the circumference of the reference roll. Both the Reference encoder and the motor encoder should have the Output Gbox In and Output Gbox Out set for the Load.

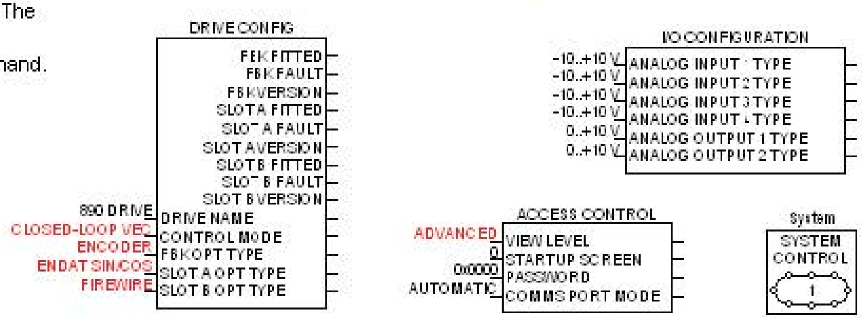
REGISTRATION OFFSET

REPEAT LENGTH is the driven load circumference, e.g.24.000 in or 60.000cm. the default is 360.000deg,

RATE is the rate of Advance or Retard in Repeat units per second, e.g. 0.001 = 1/1000in/sec.The default is 1 = 1deg/sec.

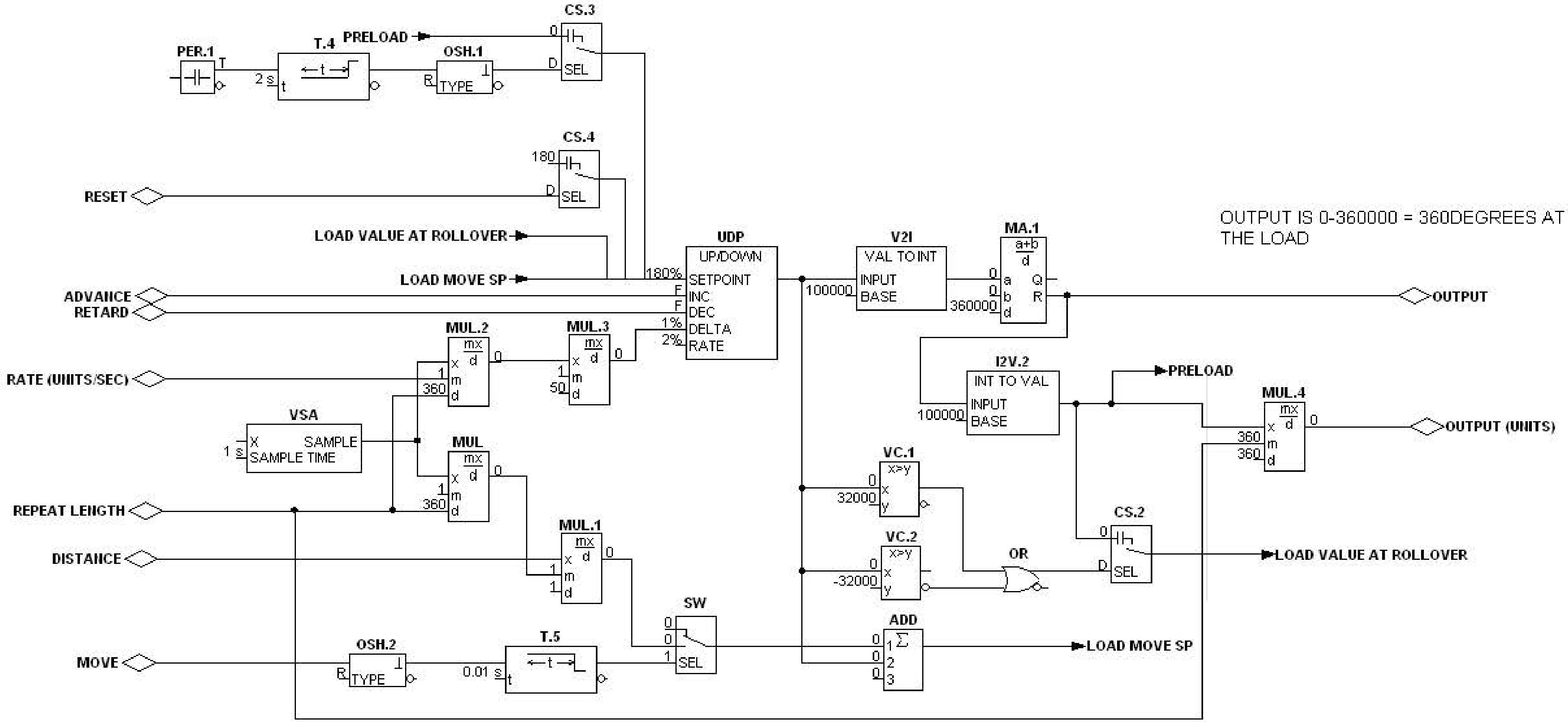
DISTANCE is the distance in the Repeat units that the Offset will change with the MOVE command. Distance is signed where positive is Advance.

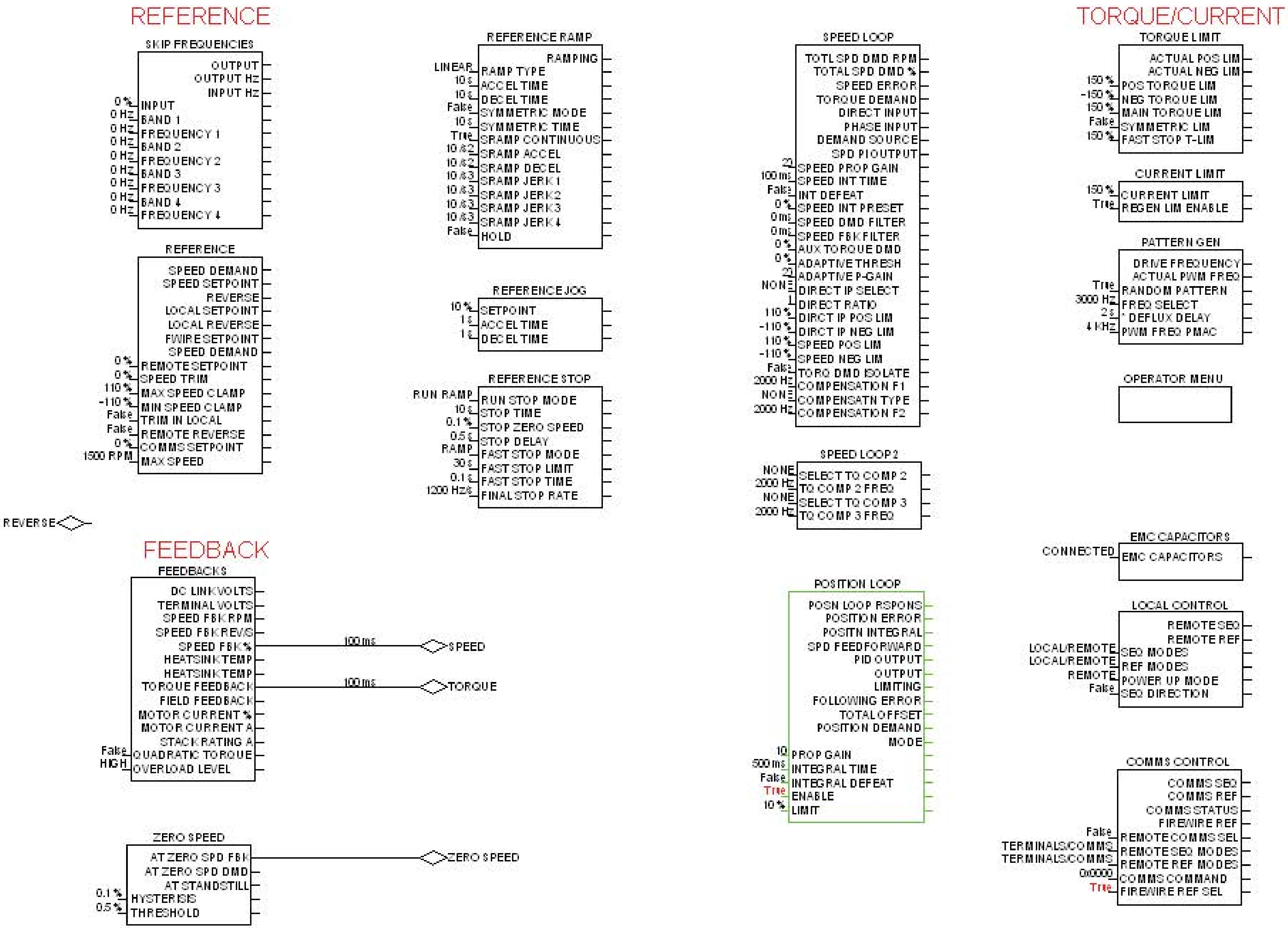
The Offset OUTPUT is persistent, i.e. the value at power down is reloaded at power up.



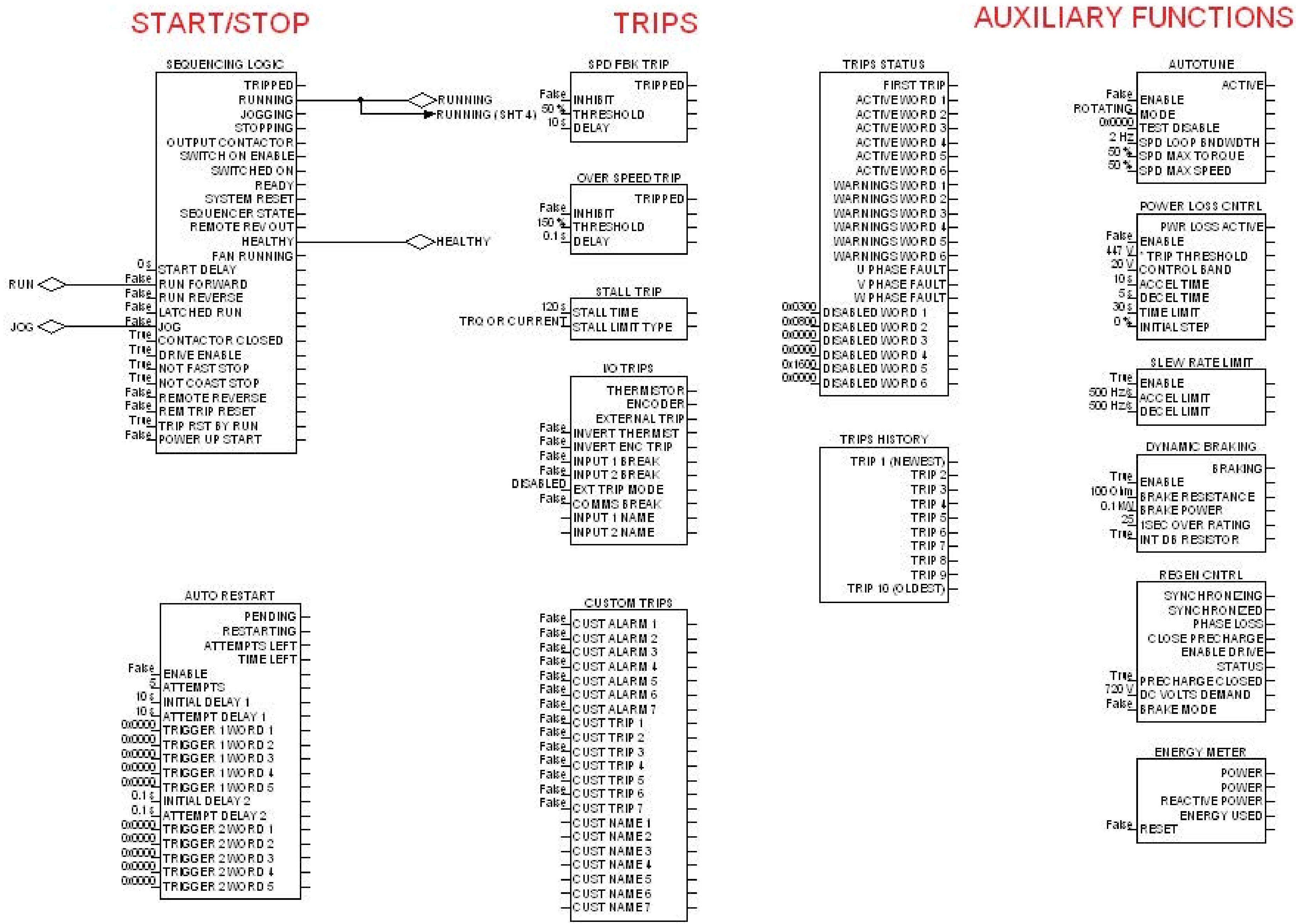
V4.1 TEMPLATE

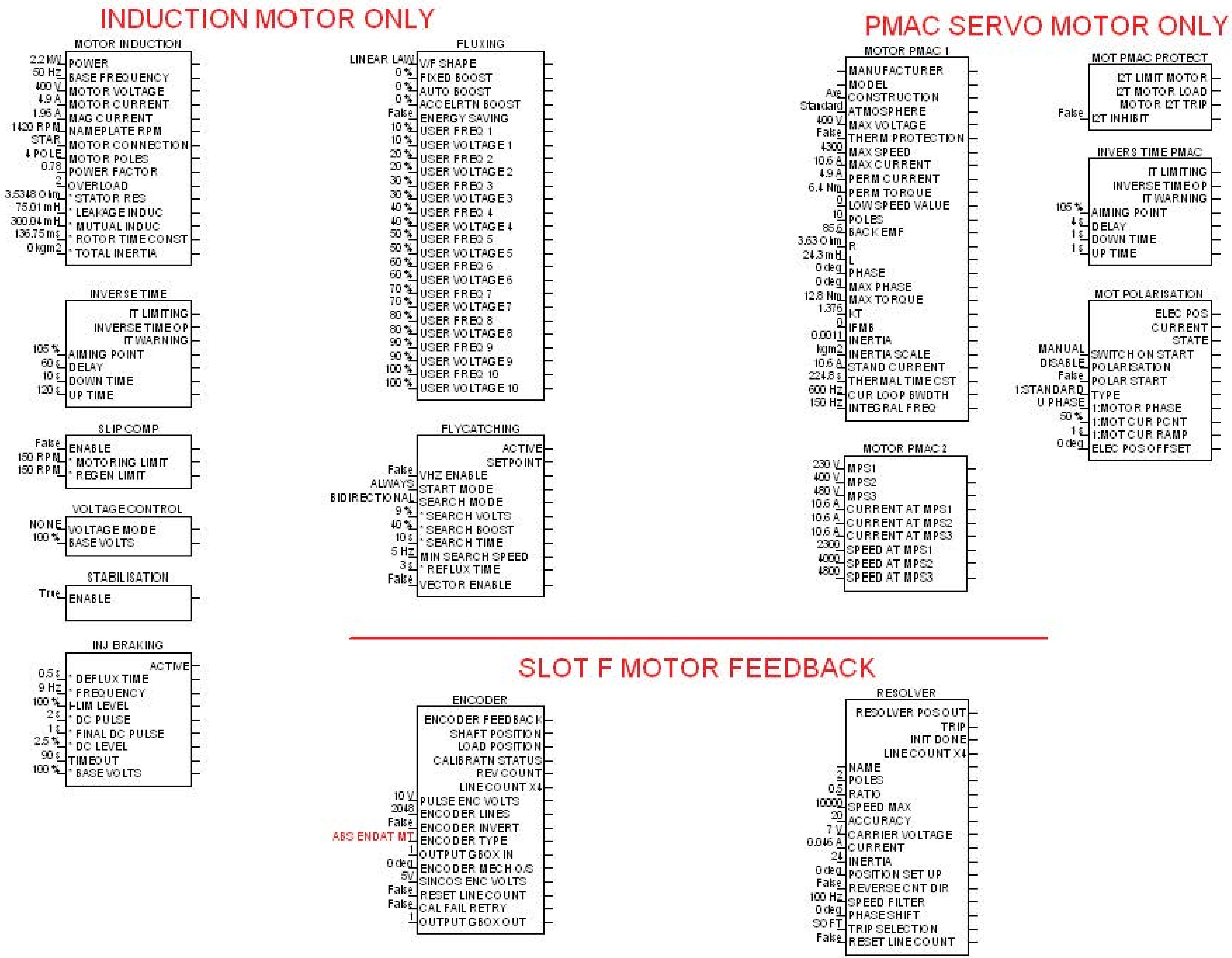
REGISTRATION OFFSET Function Block



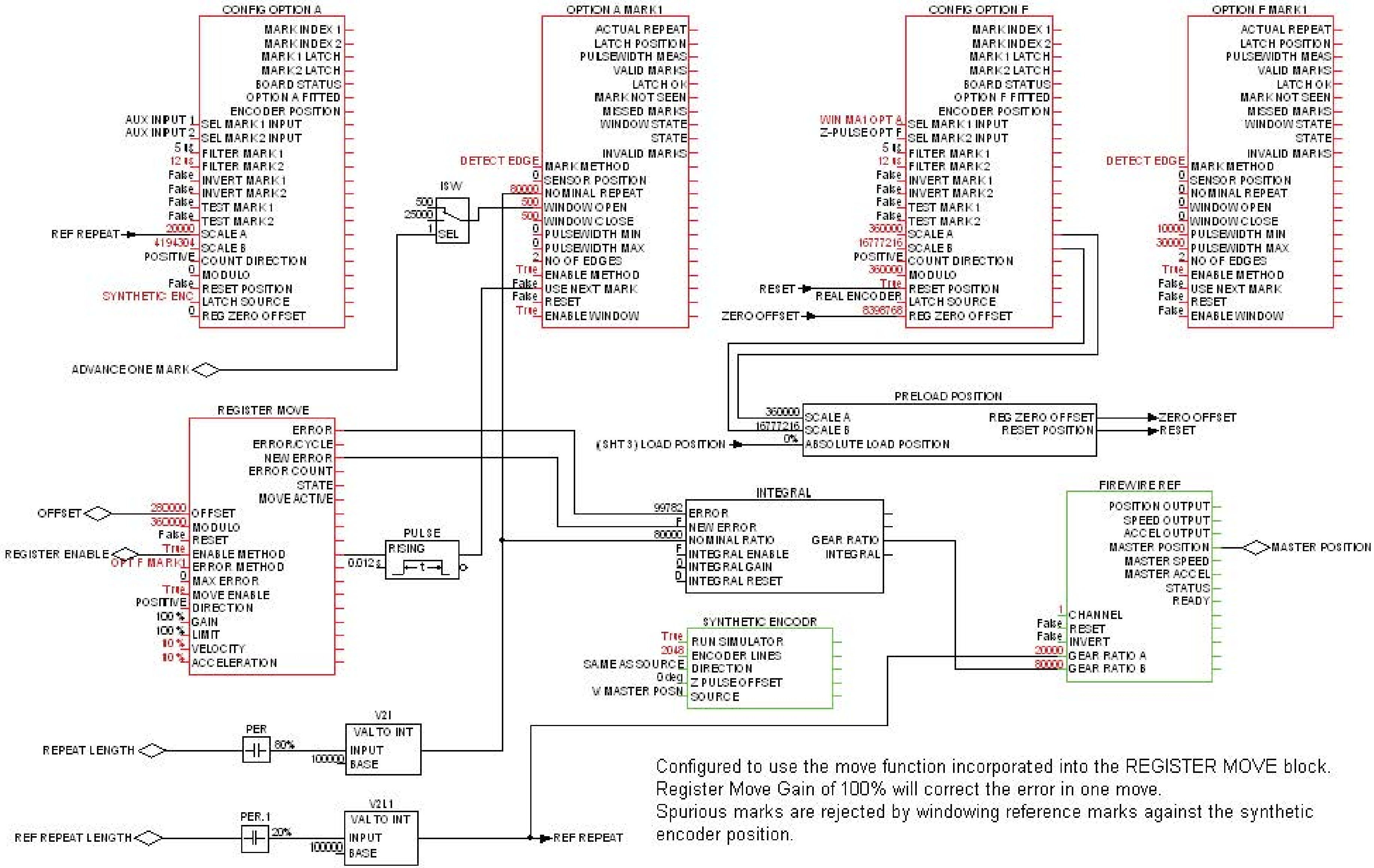

REFERENCE
SKIP FREQUENCIES
OUTPUT
OUTPUT Hz
INPUT Hz
0 % INPUT
0 Hz BAND 1
0 Hz FREQUENCY 1
0 Hz BAND 2
0 Hz FREQUENCY 2
0 Hz BAND 3
0 Hz FREQUENCY 3
0 Hz BAND 4
0 Hz FREQUENCY 4
REFERENCE
SPEED DEMAND
SPEED SETPOINT
REVERSE
LOCAL SETPOINT
LOCAL REVERSE
FWIRE SETPOINT
SPEED DEMAND
0 % REMOTE SETPOINT
0 % SPEED TRIM
110 % MAX SPEED CLAMP
-110 % MIN SPEED CLAMP
False TRIM IN LOCAL
False REMOTE REVERSE
0 % COMMS SETPOINT
1500 RPM MAX SPEED
REVERSE
REFERENCE RAMP
RAMPING
LINEAR RAMP TYPE
10 s ACCEL TIME
10 s DECEL TIME
False SYMMETRIC MODE
10 s SYMMETRIC TIME
True SRAMP CONTINUOUS
10 /s2 SRAMP ACCEL
10 /s2 SRAMP DECEL
10 /s3 SRAMP JERK 1
10 /s3 SRAMP JERK 2
10 /s3 SRAMP JERK 3
10 /s3 SRAMP JERK 4
False HOLD
REFERENCE JOG
10 % SETPOINT
1 s ACCEL TIME
1 s DECEL TIME
REFERENCE STOP
RUN RAMP RUN STOP MODE
10 s STOP TIME
0.1 % STOP ZERO SPEED
0.5 s STOP DELAY
RAMP FAST STOP MODE
30 s FAST STOP LIMIT
0.1 s FAST STOP TIME
1200 Hz/s FINAL STOP RATE
FEEDBACK
FEEDBACKS
DC LINK VOLTS
TERMINAL VOLTS
SPEED FBK RPM
SPEED FBK REV/S
SPEED FBK %
HEATSINK TEMP
HEATSINK TEMP
TORQUE FEEDBACK
FIELD FEEDBACK
MOTOR CURRENT %
MOTOR CURRENT A
STACK RATING A
False QUADRATIC TORQUE
HIGH OVERLOAD LEVEL
100 ms
SPEED
100 ms
TORQUE
ZERO SPEED
AT ZERO SPD FBK
AT ZERO SPD DMD
AT STANDSTILL
0.1 % HYSTERISIS
0.5 % THRESHOLD
ZERO SPEED
SPEED LOOP
TOTL SPD DMD RPM
TOTAL SPD DMD %
SPEED ERROR
TORQUE DEMAND
DIRECT INPUT
PHASE INPUT
DEMAND SOURCE
SPD PI OUTPUT
20 SPEED PROP GAIN
100 ms SPEED INT TIME
False INT DEFEAT
0 % SPEED INT PRESET
0 ms SPEED DMD FILTER
0 ms SPEED FBK FILTER
0 % AUX TORQUE DMD
0 % ADAPTIVE THRESH
20 ADAPTIVE P-GAIN
NONE DIRECT IP SELECT
1 DIRECT RATIO
110 % DIRCT IP POS LIM
-110 % DIRCT IP NEG LIM
110 % SPEED POS LIM
-110 % SPEED NEG LIM
False TORQ DMD ISOLATE
2000 Hz COMPENSATION F1
NONE COMPENSATN TYPE
2000 Hz COMPENSATION F2
SPEED LOOP 2
NONE SELECT TQ COMP 2
2000 Hz TQ COMP 2 FREQ
NONE SELECT TQ COMP 3
2000 Hz TQ COMP 3 FREQ
POSITION LOOP
POSN LOOP RSPONS
POSITION ERROR
POSITN INTEGRAL
SPD FEEDFORWARD
PID OUTPUT
OUTPUT
LIMITING
FOLLOWING ERROR
TOTAL OFFSET
POSITION DEMAND
MODE
10 PROP GAIN
500 ms INTEGRAL TIME
False INTEGRAL DEFEAT
True ENABLE
10 % LIMIT
TORQUE/CURRENT
TORQUE LIMIT
ACTUAL POS LIM
ACTUAL NEG LIM
150 % POS TORQUE LIM
-150 % NEG TORQUE LIM
150 % MAIN TORQUE LIM
False SYMMETRIC LIM
150 % FAST STOP T-LIM
CURRENT LIMIT
150 % CURRENT LIMIT
True REGEN LIM ENABLE
PATTERN GEN
DRIVE FREQUENCY
ACTUAL PWM FREQ
True RANDOM PATTERN
3000 Hz FREQ SELECT
2 s DEFLUX DELAY
4 KHz PWM FREQ PMAC
OPERATOR MENU
EMC CAPACITORS
CONNECTED EMC CAPACITORS
LOCAL CONTROL
REMOTE SEQ
REMOTE REF
LOCAL/REMOTE SEQ MODES
LOCAL/REMOTE REF MODES
REMOTE POWER UP MODE
False SEQ DIRECTION
COMMS CONTROL
COMMS SEQ
COMMS REF
COMMS STATUS
FIREWIRE REF
False REMOTE COMMS SEL
TERMINALS/COMMS REMOTE SEQ MODES
TERMINALS/COMMS REMOTE REF MODES
0x0000 COMMS COMMAND
True FIREWIRE REF SEL

MOTOR CONTROL Function Block : sheet 2

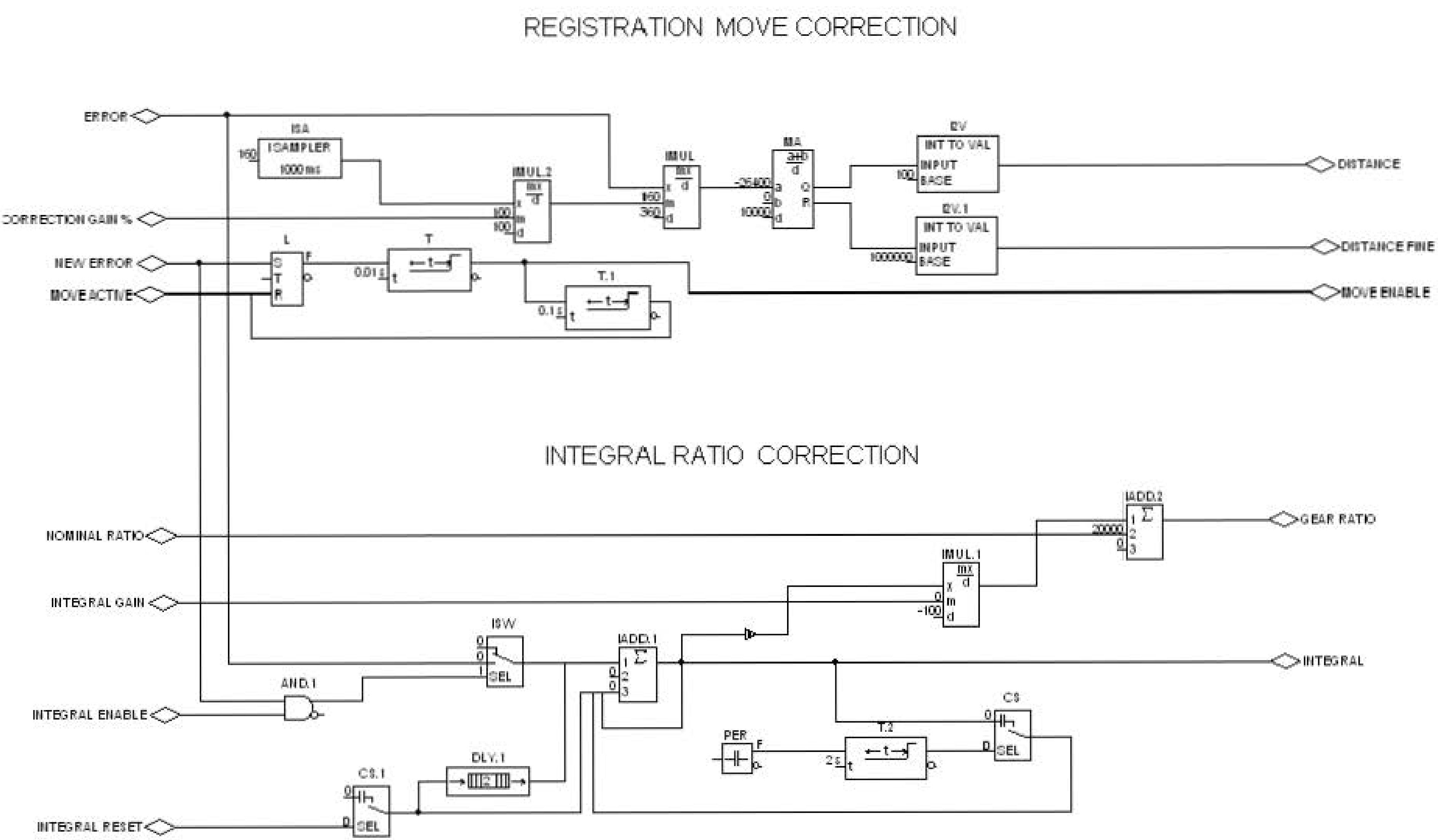



INDUCTION MOTOR ONLY
MOTOR INDUCTION
2.2 kW POWER
50 Hz BASE FREQUENCY
400 V MOTOR VOLTAGE
4.9 A MOTOR CURRENT
1.96 A MAG CURRENT
1420 RPM NAMEPLATE RPM
STAR MOTOR CONNECTION
4 POLE MOTOR POLES
0.78 POWER FACTOR
2 OVERLOAD
3.5348 Ohm * STATOR RES
75.01 mH * LEAKAGE INDUC
300.04 mH * MUTUAL INDUC
136.75 ms * ROTOR TIME CONST
0 kgm2 * TOTAL INERTIA
INVERSE TIME
IT LIMITING
INVERSE TIME OP
IT WARNING
105 % AIMING POINT
60 s DELAY
10 s DOWN TIME
120 s UP TIME
SLIP COMP
False ENABLE
150 RPM * MOTORING LIMIT
150 RPM * REGEN LIMIT
VOLTAGE CONTROL
NONE VOLTAGE MODE
100 % BASE VOLTS
STABILISATION
True ENABLE
INJ BRAKING
ACTIVE
0.5 s * DEFLUX TIME
9 Hz * FREQUENCY
100 % I-LIM LEVEL
2 s * DC PULSE
1 s * FINAL DC PULSE
2.5 % * DC LEVEL
90 s TIMEOUT
100 % * BASE VOLTS
FLUXING
LINEAR LAW V/F SHAPE
0 % FIXED BOOST
0 % AUTO BOOST
0 % ACCELRTN BOOST
False ENERGY SAVING
10 % USER FREQ 1
10 % USER VOLTAGE 1
20 % USER FREQ 2
20 % USER VOLTAGE 2
30 % USER FREQ 3
30 % USER VOLTAGE 3
40 % USER FREQ 4
40 % USER VOLTAGE 4
50 % USER FREQ 5
50 % USER VOLTAGE 5
60 % USER FREQ 6
60 % USER VOLTAGE 6
70 % USER FREQ 7
70 % USER VOLTAGE 7
80 % USER FREQ 8
80 % USER VOLTAGE 8
90 % USER FREQ 9
90 % USER VOLTAGE 9
100 % USER FREQ 10
100 % USER VOLTAGE 10
FLYCATCHING
ACTIVE
SETPOINT
False VHZ ENABLE
ALWAYS START MODE
BIDIRECTIONAL SEARCH MODE
9 % * SEARCH VOLTS
40 % * SEARCH BOOST
10 s * SEARCH TIME
5 Hz MIN SEARCH SPEED
3 s * REFLUX TIME
False VECTOR ENABLE
PMAC SERVO MOTOR ONLY
MOTOR PMAC 1
MANUFACTURER
MODEL
Axe CONSTRUCTION
Standard ATMOSPHERE
400 V MAX VOLTAGE
False THERM PROTECTION
4300 MAX SPEED
10.6 A MAX CURRENT
4.9 A PERM CURRENT
6.4 Nm PERM TORQUE
0 LOW SPEED VALUE
10 POLES
85.6 BACK EMF
3.63 Ohm R
24.3 mH L
0 deg PHASE
0 deg MAX PHASE
12.8 Nm MAX TORQUE
1.376 KT
0 IFMB
0.0011 INERTIA
kgm2 INERTIA SCALE
10.6 A STAND CURRENT
224.8 s THERMAL TIME CST
600 Hz CUR LOOP BWDTH
150 Hz INTEGRAL FREQ
MOTOR PMAC 2
230 V MPS1
400 V MPS2
480 V MPS3
10.6 A CURRENT AT MPS1
10.6 A CURRENT AT MPS2
10.6 A CURRENT AT MPS3
2300 SPEED AT MPS1
4000 SPEED AT MPS2
4800 SPEED AT MPS3
MOT PMAC PROTECT
I2T LIMIT MOTOR
I2T MOTOR LOAD
MOTOR I2T TRIP
False I2T INHIBIT
INVERS TIME PMAC
IT LIMITING
INVERSE TIME OP
IT WARNING
105 % AIMING POINT
4 s DELAY
1 s DOWN TIME
1 s UP TIME
MOT POLARISATION
ELEC POS
CURRENT
STATE
MANUAL SWITCH ON START
DISABLE POLARISATION
False POLAR START
1:STANDARD TYPE
U PHASE 1:MOTOR PHASE
50 % 1:MOT CUR PCNT
1 s 1:MOT CUR RAMP
0 deg ELEC POS OFFSET
SLOT F MOTOR FEEDBACK
ENCODER
ENCODER FEEDBACK
SHAFT POSITION
LOAD POSITION
CALIBRATN STATUS
REV COUNT
LINE COUNT X4
10 V PULSE ENC VOLTS
2048 ENCODER LINES
False ENCODER INVERT
ABS ENDAT MT ENCODER TYPE
1 OUTPUT GBOX IN
0 deg ENCODER MECH O/S
5V SINCOS ENC VOLTS
False RESET LINE COUNT
False CAL FAIL RETRY
1 OUTPUT GBOX OUT
RESOLVER
RESOLVER POS OUT
TRIP
INIT DONE
LINE COUNT X4
2 NAME
0.5 POLES
10000 RATIO
20 SPEED MAX
7 V ACCURACY
0.046 A CARRIER VOLTAGE
24 CURRENT
0 deg INERTIA
False POSITION SET UP
100 Hz REVERSE CNT DIR
0 deg SPEED FILTER
SOFT PHASE SHIFT
False TRIP SELECTION
RESET LINE COUNT

MOTOR CONTROL Function Block : sheet 4



Configured to use the move function incorporated into the REGISTER MOVE block.
Register Move Gain of 100% will correct the error in one move.
Spurious marks are rejected by windowing reference marks against the synthetic encoder position.


REGISTRATION MOVE CORRECTION
ERROR
ISA
ISAMPLER
1000 ms
160
IMUL.2
IMUL
MA
DV
INT TO VAL
INPUT
BASE
DISTANCE
DV.1
DISTANCE FINE
CORRECTION GAIN %
NEW ERROR
MOVE ACTIVE
L
T
T.1
0.01 s
0.1 s
MOVE ENABLE
-26400
100
1000000
INTEGRAL RATIO CORRECTION
NOMINAL RATIO
IADD.2
20000
GEAR RATIO
INTEGRAL GAIN
IMUL.1
-100
ISW
SEL
IADD.1
INTEGRAL
AND.1
INTEGRAL ENABLE
PER
T.2
2 s
CS
CS.1
DLY.1
INTEGRAL RESET

PHASE CONTROL