Modicon TSX Quantum
140 ERT 854 10
User manual

840 USE 477 00

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Table of Contents

Safety Information

Important Information

NOTICE

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of this symbol to a Danger or Warning safety label indicates that an electrical hazard exists, which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

DANGER
DANGER indicates an imminently hazardous situation, which, if not avoided, **will result** in death or serious injury.

WARNING
WARNING indicates a potentially hazardous situation, which, if not avoided, **can result** in death, serious injury, or equipment damage.

CAUTION
CAUTION indicates a potentially hazardous situation, which, if not avoided, **can result** in injury or equipment damage.

PLEASE NOTE Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

About the Book

At a Glance

Document Scope

This manual describes the mode of functioning and performance of the 140 ERT 854 10 module as well as the usage with the TSX Quantum. It should show you how to provide your Quantum with time stamped data.

Validity Note

The information in this document is valid for concept version 2.2 and later.

Related Documents

Title of Documentation	Reference Number
Concept User Manual	840 USE 493 00
Quantum Hardware User Manual	840 USE 100 00
DCF 077 Benutzerhandbuch	840 USE 470 02
COM ESI Planning Manual	840 USE 458 00
PRO TSX 101 Planning Guidelines	840 USE 476 00

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User Comments

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Function Overview

I

Introduction

Overview

The first part of the manual for the intelligent input module 140 ERT 854 10 gives an overview of the structure of the module, the functionality and shows typical applications.

What's in this Part?

This part contains the following chapters:

Introduction

1

Module Overview

Overview

The 140 ERT 854 10 is an intelligent 32 point input module for TSX Quantum that allows full configuration of inputs and evaluates the input signal status every 1ms. Up to 9 ERTs can be installed on a local or remote module rack and can be used with Concept versions starting from V2.2.

The Inputs

The 32 inputs are designed for input voltages of 24 to 125 VDC and are distributed in 2 independent groups. Each group is supplied with a separate external reference voltage (typically 24, 48, 60 or 125 VDC), to influence the threshold limit and minimum current consumption. The module status Ready, Active and Error as well as the input status (status of the terminals) are clearly displayed by the status LEDs on the module.

140 ERT 854 10 firmware processes inputs in four separate configurable function blocks with 8 inputs which support the following functions that can be selected.

- Binary inputs: input values are sent cyclically to the PLC.
- Event inputs: Time registered event logging for 1, 2 or 8 processed inputs, with 5 byte time register, integrated FIFO buffer for 4096 events and acknowledging PLC transfer by the user.
- Counter inputs: 32 bit addition of processed events up to 500 Hz that are transferred cyclically to the PLC.

Parameters can be set for processing individual inputs: (disabled, inverted, and with debouce filter). A configurable chatter filter can be activated for the event and counter inputs and event edge monitoring carried out.

Time Synchronization

The module clock requires a time synchronization signal and provides a 24 VDC input with potential isolation for the following standard time receiver with DCF 77 format.

- DCF 77E (long wave reception only in Europe)
- 470 GPS 001 (Global satellite receiver)

The ERT internal software clock can alternatively be created by the application program, or be free running.

Validity reserve

A validity reserve can determine how long the module clock can continue running without external synchronization. The ERT data evaluated can be buffered with a maximum current consumption of 0.07 mA by the 140 XCP 900 00 battery module in the event of power loss.. The current internal software time is transferred to the PLC at proportional intervals and enables the CPU clock to be set by the application program. For further information see *Time synchronization with standard time, p. 25*.

User Functions and Services

2

Introduction

Overview

the 32 inputs of the 140 ERT 854 10 module can be individually preprocessed and transferred to the PLC as binary value, counter value or event. The following chapter describes the functions and services available.

What's in this Chapter?

This chapter contains the following topics:

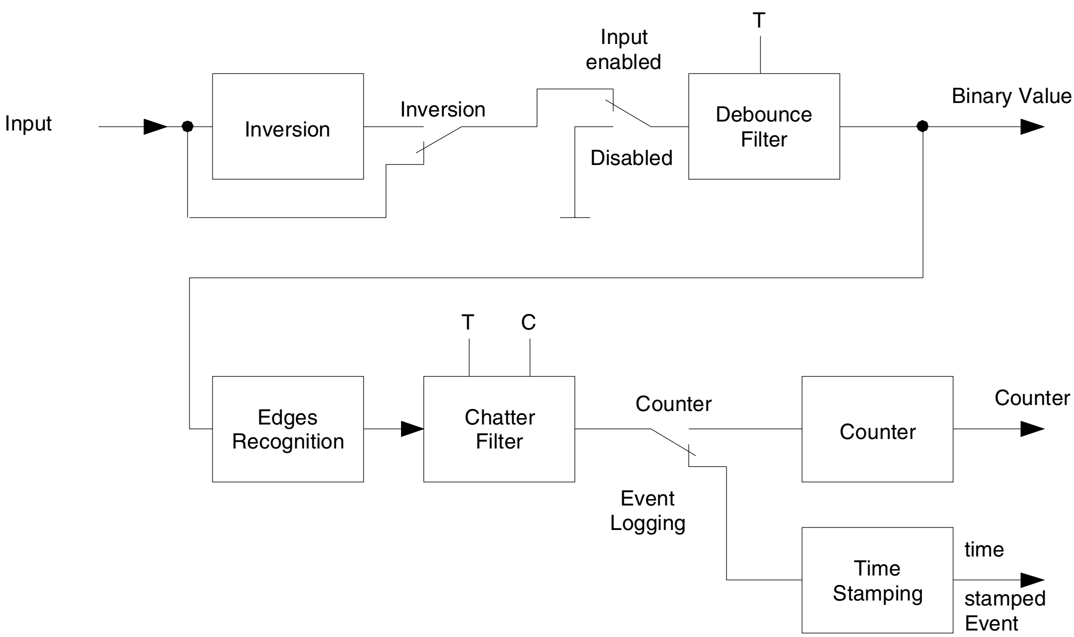
Input Processing - Registration and Filtering

Overview

The input signals connected to the 140 ERT 854 10 go through a multistage processing before that are available to the user program as binary, counter values or events. The processing can be set with parameters for each individual input.

Signal Processing Sequence

The processing of the input signals is done according to the parameters set. Parameters are set on the Parameter Screen in Concept I/O Configurator.



Registration

Overview

The processing of the individual inputs is completely configurable: (disabled, inverted and with debounce time). The event inputs can also have a configurable chatter filter activated and an edge event evaluation.

Disabling

A disabled input always shows the value "0" independent for its input state.

Inverting

The input polarity is inverted before further processing. If this is active, the opposite to the input signal status shown on the status LEDS is passed on for further processing.

Edge Recognition

Selects the edge transitions which should be used for active events and counter inputs. "Both Edges" processes rising and falling edges. Otherwise only a signal edge is processed: rising/falling, either with or without active inversion.

Filtering

Overview

The configurable filtering is done in 2 stages: debounce and chatter removal.

> **⚠ CAUTION**
>
> **Danger of incorrect interpretation of the input data**
>
> Filters are used to suppress the input recognition in a defined way. Filtering should only be used in a suitable way to prevent too much or undesired suppression of input data.
>
> **Failure to follow this instruction can result in injury or equipment damage.**

Debounce

Debouncing can be used on all input functions and prevents the processing of fast state changes of the inputs, like for example, those caused by contact bouncing. Signal changes are ignored depending on the filter type and the preset time. The value range for the filter time is 0 to 255 ms; the value 0 deactivated the debounce filter. The selection of the debounce filter type "stable signal" or "integrating" affects all 8 function block inputs.

- "Stable Signal" Filtering: A signal change is only registered if the polarity change stays stable for longer than the filter time (each new change resets the filter time).
- "Integrating" Filtering: A signal change is only registered if the time integral of the input signal reaches the programmed filter time taking any polarity change into account.

> **Note:** Debounce Time>=1 ms is recommended to ensure enough immunity against electromagnetic disturbances. This means that input signal states >= 2 ms and events up to 250 Hz can be processed. In non-critical electromagnetic environments, the debounce time can be set to 0 to avoid unnecessary filter delays. This means that input signal states >= 1 ms and events up to 500 Hz can be processed.

Chatter Removal

Chatter removal can only be used for event and counter inputs. It limits the number of events to a configurable value during a configurable time period. This should prevent multiple event registrations for the same input, e.g. disturbance influences due to slowly changing inputs (because the hysteresis is possibly set to small). The chatter counter is configurable for each individual input, the chatter time for each input pair. The selection of "chatter removal" on the parameter screen activates the chatter filter for all 8 function block inputs. The chatter filtering for individual inputs can always be disabled by selecting the value of 0 as chatter count value. A "Chatter Filter Active" bit within the "status" output word (Bit 7 - DC) which is returned from the transfer EFB "ERT_854_10" indicates that at least one "chatter" input is being filtered (see *ERT_854_10: Data transfer EFB, p. 74*). The bit is reset as soon as the chatter time of the last active filtered input has run out.

- Chatter Time: The time period in which the chatter count limit has an effect. Value range from 1 ... 255 * 100 ms = 0.1 ... 25.5 Seconds.
- Chatter Count: The maximum number of registered events which are allowed to be passed on within the chatter time period. Value range from 1 ... 255, the value 0 deactivates the chatter filter.

⚠ CAUTION

Danger of incorrect interpretation of the input data

The chatter removal is a very powerful processing tool which can have undesired side effects. Its use with counter inputs is questionable. If edge recognition is performed for "Both Edges" then, in the case of odd-numbered chatter suppression, two successive events with the same edge (2 rising, 2 falling) appear when transferred to the PLC.

Failure to follow this instruction can result in injury or equipment damage.

Input Data Processing

Overview

The input signal can be used as binary inputs, counter values or for event recording depending on the parameters set in the concept I/O Paramter dialog box.

Normally the input data of the ERT 854 module is processed by the corresponding EFBs (see *EFBs for the140 ERT 854 10, p. 65*)

Binary Inputs

All inputs of the function block are transferred to the PLC after the third processing stage (i.e. enabling, inverting and debounce filtering) before the chatter filter and edge recognition are performed. The processed values of all 32 inputs are cyclically transferred (every second PLC cycle) to that first and second input register word of the7 word 3x register block of the ERT The address sequence of the module inputs corresponds to standard digital input modules, i.e. inputs 1 ... 16 correspond to bits 15 ... 0) The confirmation by the user is not necessary because the EFB ERT_854_10 must exist and be enabled. The processed values are available for all 32 inputs independent of the further processing as counter or event counter. The input processing is always done according to the configuration, but the ERT copies the processed values from the input immediately after the third input processing stage !

Note: If the BoolArr32 output array "Input" of the "ERT_854_10" transfer EFB has been configured (see *ERT_854_10: Data transfer EFB, p. 74*) , the processed values are available as boolean values.

Counter Values

ALl inputs of the function block go through all five input processing stages (i.e. enabling, inverting, debounce and chatter filtering as well as edge recognition). The counting is done as soon as the edge reaches the edge recognition. For edge recognition which is not set as "both edges", the configured inverting decides if rising or falling edges are counted.

Note: Inversion is probably not sensible to use with the recognition of "both edges"

Counter values are 32 bit totals. The PLC receives a complete sequence (configured as 8, 16, 24 of 32) of time consistent counter values in a multiplex procedure for the "ERT_854_10" transfer EFB (see description of the EFB, section *EFBs for the 140 ERT 854 10, p. 65*). The EFB sets the values in the configured UDINTArr32 output array"Cnt_Data", without the confirmation of the user. After the transfer of the new counter values is completed, the EFB sets the signal "new data", a boolean variable from "ND_Count", for one PLC cycle.

Note: The transfer of the counter values starts with function block 1 and ends with the last function block which is configured as counter inputs. If a consecutive sequence of function blocks starting with the first block are configured as counter inputs, transfer resources are saved. Since the transfer of the counter values competes with the transfer of the recorded events, faster reactions time for both types can be achieved if an ERT module is completely configured as either counter or completely as event inputs. Binary and condition inputs have no effect on this.

Event logging

This function allows input state changes to be registered in time order with a high resolution. The input state changes are logged with a time stamp with high resolution. The events can later be shown in the correct sequence. The time stamp logging of events can be configured so that a group of 1, 2 or 8 inputs can be processed in parallel. ALl inputs of the function block go through all five input processing stages (i.e. enabling, inverting, debounce and chatter filtering as well as edge recognition). The logging (including time stamping) is done as soon as the edge reaches the edge recognition. For edge recognition which is not set as "both edges", the configured inverting decides if rising or falling edges are logged.

Note: Inversion is probably not sensible to use with the recognition of "both edges".

A group of inputs is logged as an event if at least one of the inputs in this group has an edge which has been recognized, i.e.:

- any single input (1, 2 ... 7, 8),
- any input of an input pair (1-2, 3-4, 5-6, 7-8),
- an input of an 8 bit group.

Events contain a lot of information in an 8 byte block, including the processed values of all inputs in the group with the corresponding time stamp:

- Module Number
- Type of input group and number of the first bit
- The current value of the inputs in the group
- Time Stamp: Milliseconds
- Time Stamp: Minute
- Time Stamp: Hour
- Time Stamp: Day of the week / Day in the month

The current value of the inputs is stored right justified in an event structure byte. Teh ERT saves up to 4096 events in its battery backed FIFO buffer. The ERT provides error bits (bit 5/6 - PF/PH) for buffer overflow/Buffer half full within the "status"output word which is returned from the "ERT_854_10" transfer EFB. Individual events are transferred in a "ERT_10_TTag" structure on the PLC by the "ERT_854_10" transfer EFB. After processing the events, the user must actively signal readiness for the receiving of new events. See EFB Description *ERT_854_10: Data transfer EFB, p. 74*. If desired, the parameter "complete time report" can be selected to provide the month and year. For this purpose, there is a special pseudo event without values which contains the complete time information with month and year. The event is marked as a "complete time report" and precedes the "actual", time stamped event. (See additional information about "Complete time Report" in *Parameter and Default values, p. 48*).

Status Inputs

Status word

The "status" output word which is cyclically returned by the "ERT_854_10" transfer EFB contains the following error bits:

- D8 ... D0 ERT error bits
- D11 ... D9 reserved
- D15 ... D12 EFB error bits

A complete description of the error bits is in the *Assignments of the Error Bits, p. 84*

After the transfer of the new status inputs is completed, the EFB sets the signal "new data", a boolean variable from "ND_Stat", for one cycle.

> **Note:** ERT/EFB error messages are displayed in the Concept screen **Online** → **Event Display** with error number and explanation (see *Online error display, p. 86*).

Time Synchronization

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Time synchronization with standard time

Overview

The time stamped event logging requires a precise internal clock. The ERT module uses a software clock for creating the time in millisecond intervals. This software clock is normally synchronized with the help of an external time signal (standard time receiver) in one minute intervals. It can also be synchronized via a telegram or be free running.

The incoming time signal is checked for plausibility. Runtime deviations from the software clock are corrected. The time reception takes a few minutes before the time becomes available after startup. The software clock is synchronized to this time. The module then determines the deviation from the software clock with regard to the external clock within a specific period, and offsets the deviation accordingly. This is carried out continuously during the entire runtime. After a few hours runtime (generally within 2 hours) the software clock reaches maximum precision.

If implausible or incorrect time messages are received, the software clock continues running without sychronization. The deviation gets larger during this time. If this time phase does not exceed the "Power Reserve" specified, the clock resynchronizes when the next valid time information is received. However, if the time period is exceeded before the module receives a valid time signal, the ERT sets bit "Invalid Time" in the "Status" output word (bit 3 - TU), returned by the "ERT_854_10" transfer EFB (see *ERT_854_10: Data transfer EFB, p. 74*). All time stamps set after this are invalid (the high priority byte for millisecond information is set to FF). The bit is reset as soon as the next valid time message is received.

If the module receives no valid time messages for 10 minutes, the ERT sets the bit "Time Reference Error" in the "Status" output word (bit 2 - TE), returned by the "ERT_854_10" transfer EFB (see *ERT_854_10: Data transfer EFB, p. 74*). The bit is reset as soon as the next valid time message is received.

Synchronization

There are three types of synchronization available:
- DCF 77E reception module (German standard - long wave reception only in Europe)
- 470 GPS 001 00 satellite receiver, DCF77 formated signal given (global satellite reception)
- Synchronized by the PLC using "ERT_854_10" EFB (low precision)

DCF Time base

The DCF 77E receiver delivers a 24VDC signal in DCF77 format and can supply up to 16 ERT modules concurrently. The BCD coded time signal is transferred once a minute and synchronizes the ERT minutes changeover. When the ERT is restarted the software clock is synchronized within three minutes of receiving the first information. After this the ERT software clock time matches the standard time sender. If the send signal becomes unavailable the free running software clock can still be used but is not as precise. The DCF sender delivers CET (Central European Time), takes into account summer/winter time changes as well as transition seconds and leap years.

GPS Time base

A GPS receiver such as the 470 GPS 001 must be used for applications which use GPS satellite time references. This module demodulates the GPS signal and delivers DCF77 format output signal from 24 VDC. The ERT decodes the signal and synchronizes the minutes transition for the internal software clock. GPS satellites sends UTC time (Universal Time Coordinated) which GMT (Greenwich Mean Time = Western European Time) corresponds to. Seconds and years transitions are taken into account. Depending on the location, the local time relative to GMT as well the local summer/winter time changes can be configured with the 470 GPS 001 receiver. The recommended power reserve for the DCF/GPS time base signal is one hour (the settings range for DCF/GPS sync is between 1 ... and 5 hours). Several ERT module groups can be synchronized simultaneously using a GPS receiver. Further information can be found in the manual for 470 GPS 001 00 Recievers.

EFB synchronized internal clock

If a clock only requires a lower precision, the ERT internal software clock can be synchronized with a time value sent by the master. The software clock runs freely until the next time value is received. Precision is usually within 100 milliseconds per hour and the software clock must be synchronized correspondingly often. The "ERT_854_10" transfer EFB provides the required time synchronization. This means several ERT modules can be supplied with approximately the same time; the time source used is the ESI 062 00 module data structure "DPM_Time". The power reserve settings for the EFB synchronized internal software clock moves in the range between 1 ... and 254 hours). However, if the time period is exceeded before the next transfer of a time signal, the ERT sets bit "Invalid Time" in the "Status" output word (bit 3 - TU), returned by the "ERT_854_10" transfer EFB. All time stamps set after this are invalid (the high priority byte for millisecond information is set to FF). The bit is reset as soon as the next valid time message is received.

Free running internal clock

The ERT internal software clock can also be used on its own. Setting the power reserve for the internal software clock to 0 activates duration mode, shown by the bit "Time not synchronized" in the "Status" output word (bit 4 - TA) which is returned by the "ERT_854_10" transfer EFB. In this case there is no power reserve that can be exceeded and therefore no invalid time stamps. The bits "External Reference Error" and "Invalid Time" in the output word "Status" (Bit 2/3 - TE/TU) are never set; the time starts automatically without synchronization. The default start settings for the internal clock is 0 hours, 1/1/1990. The time settings can be made through:

- a telegram (e.g. by IEC 870-5-101)
- the CPU clock (using the "DPM_Time" data structure)

Note: Using the free running internal software clock enables even more precise processing of events within an individual ERT.

Typical Application Areas

4

Typical areas of application

Overview

The ERT 854 10 is particularly suited for determining the binary input status and counter value that require a time stamp

140 ERT 854 10 Applications

The following areas of application are valid for the 140 ERT 854 10:

- Processing binary inputs: Use as a standard I/O module with filtering and an input range of 24 - 125 VDC.
- Event Logging: The event of an individual process status can be logged with the corresponding time (time stamp). This enables the later reconstruction of the time point and the sequence of process signals "coming" or "going".
- Counter value: Use as a standard I/O module (with filtering, 32 bit summing with max. 500 Hz) with an input range of 24 - 125 VDC.
- Periodic time stamping of process values: Recording counter values in defined time intervals. The combined use of both function groups can be used as an advantage here.
- Time dependent switching actions: Outputs can be set regardless of time for contolling lighting, heating, ventilators, temperatures (building automation), or for opening/closing doors, machines, ... (safety measures). The output status can be recorded with the ERT.

Module Description

II

Introduction

Overview

The 140 ERT 854 10 is an intelligent digital input module for evaluating input values with or without event recording.

What's in this Part?

This part contains the following chapters:

Module Description

5

Introduction

Overview

This chapter provides information about the structure of the 140 ERT 854 10 module and its technical data.

What's in this Chapter?

This chapter contains the following topics:

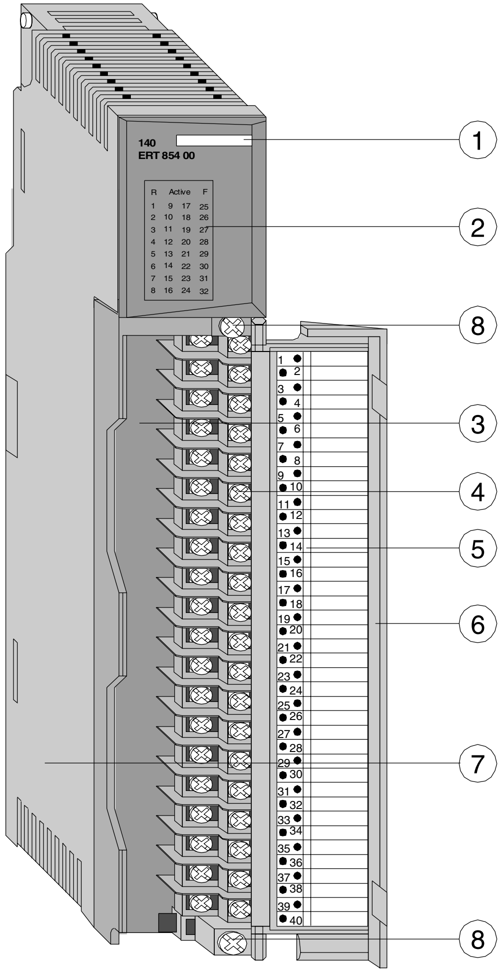
Overview

Introduction

The 140 ERT 854 10 is a Quantum Expert Module with 32 binary inputs (24 ... 125 VDC). The module is suitable for the evaluation of digital inputs, counter pulses and events.

Front View of the Module

Front View of the ERT 854 10



Location of Operating Elements

1 Color Code
2 Display field (LEDs)
3 Terminal Block
4 Connection terminals
5 Sliding Label (inside)
6 Cover for the terminal blocks
7 Standard housing
8 Screws for terminal block

Features and Functions

Features

The ERT 854 10 is a Quantum Expert Module with 2 groups of 16 binary inputs (24 ... .125 VDC). The input groups are potentially isolated to each other and to the internal logic. In addition to counted values, discrete inputs can be registered with or without event logging. A digital time standard (DTS) receiver can be connected for time synchronization.

Mode of Functioning

The registers of the ERT 854 10 count impulses with frequencies of up to 500 Hz with an interruption/impulse period of 1 ms and provide these values as 32 bit counter values for the CPU. The module is logically divided into 4 blocks of 8 inputs. The inputs of each block can be processed as binary input signals, event or counters, depending on the parameters set.

The input processing (debounce time, edge recognition and inversion) can be configured separately for each input.

The module supports DCF77 formatted time receivers over a 24 VDC input.

Planning

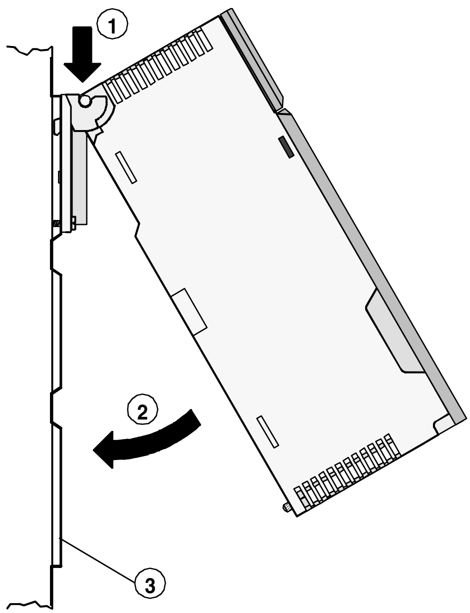
What is to be planned

You plan:
- a slot in the Quantum rack (local or RIO station).
- the ERT Paramteres. Each of the 4 ERT 854 10 input blocks can be configured with a different functionality (e.g. counters or inputs with our without event recording).
- the connection of the reference voltage for each input group.
- the Process Peripherials Connection.
- the connection of an external time receiver.

Mounting Position in the Rack

Insert the module in any I/O slot on the Quantum and screw it to the rack. The module must be screwed into position to ensure correct operation (EMC).

Mounting the Module



1 Insert the module
2 Screw the module to the rack
3 Rack

Module Cabling

Overview

This section describes the connection of time receivers, supply voltages and external input signals.

Reference Voltage

The input voltage range for the inputs is defined with the reference voltage. Reference voltages and input signals of the same group are to be protected with a common fuse. In addition, the inputs can also be individually protected.

⚠ CAUTION

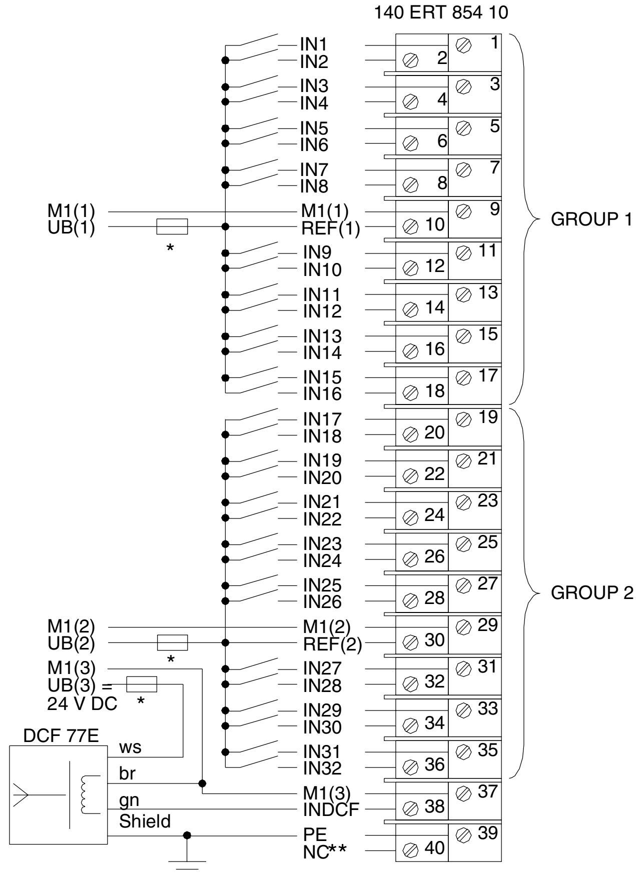
Damage of the Module

Never use the ERT module without a proper reference voltage to avoid damage to the module.

Failure to follow this instruction can result in injury or equipment damage.

DCF 77E

Connection example for the ERT 854 10 with a DCF 77E time receiver

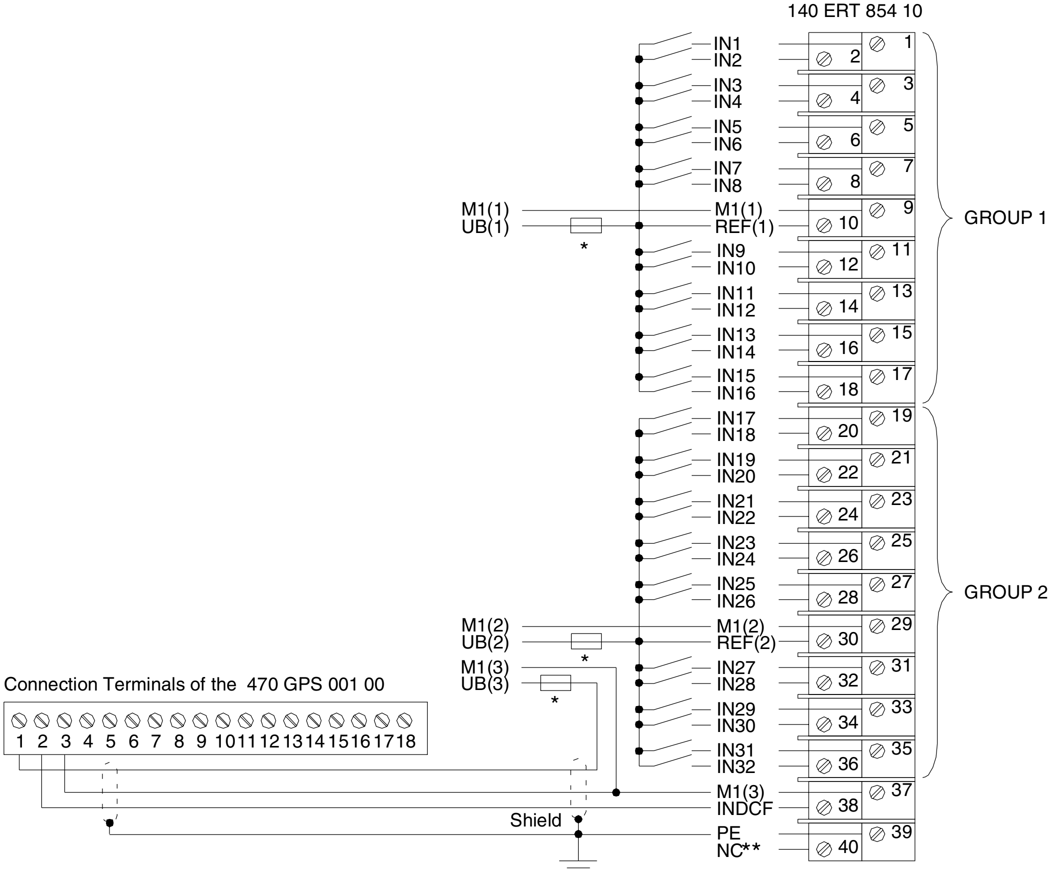


* UB(1), UB(2):24 ... 125 VDC, UB(3): 24 VDC, separate protection recommended

** not connected, suitable for support clamp for UB(3)

GPS 001

Connection example for the ERT 854 10 with a GPS 001 time receiver



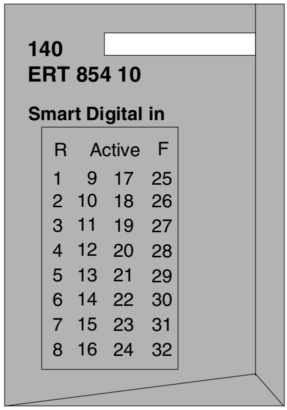
* UB(1), UB(2):24 ... 125 VDC, UB(3): 24 VDC, separate protection recommended

** not connected, suitable for support clamp for UB(3)

Diagnosis

Condition Display

The modules have the following indicators:



Meaning of the Indicators:

Indicators:	Color	Meaning
R	green	ready. Self test successful when voltage connected The firmware is running correctly and the module is ready for operations.
Active	green	The communication with the Quantum CPU is active.
F	red	Group Error. Lights when the configured error occurs.
1 ... 32	green	Input Signal. Indicator for process input signal "1".

Technical data

Supply

Data of the Supply

Reference voltage for each process input group	24 ... 125 VDC, (max. 18 ... 156 VDC) Current consumption per group: max. 3 mA
internal via the rack	5 VDC, max. 300 mA
Current requirements for buffer operation	maximum 0.07 mA from XCP 900 00

Process Inputs

Data of the Process Inputs

Number	32 in 2 Groups			
Input Voltage	24 ... 125 VDC			
Potential isolation	Inputs to the Quantum Bus, Group 1 to Group 2 (Opto-coupler)			
Debounce time	0 ... 255 Millisecunds (configurable)			
Inversion	Set with parameters			
Max. Cable length	400 m unshielded, 600m shielded			
Switching Level: Nominal voltage for the input signals Min current for a 1 signal	24V 6mA	48V 2.5mA	60V 2.5mA	125V 1mA
Signal level 0 signal Signal level 1 signal	nominal 0% of the group reference voltage, max. +15 %, min. -5 % nominal 100% of the group reference voltage, max. 125 %, min. 75 %			
Internal power loss from all process inputs	max 7.5 W			

Input for the time receiver

Data for the time receiver

Number	1, DCF77 Data format from DCF- 077E or GPS - 470 001 00
Input Voltage	24 VDC
Potential isolation	Optocoupler
Time Stamp resolution	1 ms
Current consumption	5 mA

Mechanical structure

Dimensions and Weight

Format	Width = 40.34 mm (Standard Housing)
Mass (weight)	0.45 kg

Connection Type

Data of the Connections

Process Inputs, DCF receiver	40 pins Terminal Block

Environmental conditions

Data of the Environmental Conditions

System Data	See Quantum User Manual
Power loss	Max. 9W, typical 5W

Configuration

III

Introduction

Overview

The 140 ERT 854 10 in included as a standard module from version 2.2 of Concept. In this section, the configuration of the modules and the parameter setting of the corresponding EFBs are described. An example is given for the most important applications.

What's in this Part?

This part contains the following chapters:

Parameter Screen

6

Parameter Screen

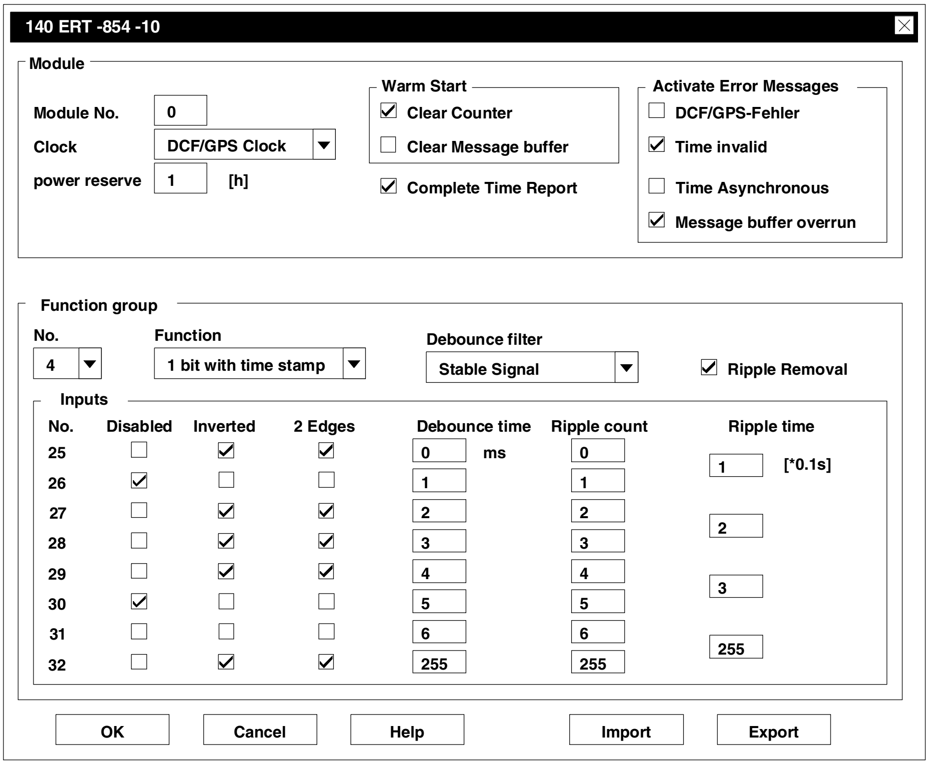
Call

To get the parameter screen for the 140 ERT 854 10 module, select the screen for the I/O configuration of the module and click on the **Params** button.

Parameter screen layout

The parameter screen contains general module parameters on four pages which contain specific parameters for each function group. The parameters are preset in the "I/O connection" with default values and can be edited by the user. The export function saves the module parameter settings in a (*.ert) file. The values can be reloaded using the Import function. (these files can also be used as an interface to an Offline parameter tool). Editing parameters is only possible as long as the application program is not running.

Parameter Screen construction



Parameter and Default values

The following list gives an overview of the parameters available and their default values.

Module The following parameters are valid for the entire module.

Name	Default value	Area	Meaning
Module No.	0	1... 127	User defined, inserted in event message. The uniqueness of the value is not checked. 0 = Default, no selection made.
Clock	DCF/GPS clock	DCF/GPS clock	External synchronization in DCF77 format by the DCF or GPS clock.
		Internal clock	Synchronization by telegram; the clock runs either without monitoring or is monitored within a power reserve.
		No	Internal clock is deactivated
Power reserve	1 hour	1 ... 254 hours	Internal clock: Time from the last synchronization until setting the TU bits and the time until th etime stamp becomes invalid.
		0	Internal clock: 0 = free run mode without elapsed time (TE/TU bits are not set)
		1 ... 5 hours	DCF/GPS clock: 1 hour recommended
Complete time report Output	y	n/y	starts/stops the transfer of the complete time telegram (with month and year). Transfer of the complete time report is made as a dummy event 1x directly before a time stamp event: the prerequisite is ALWAYS transferring a time stamp event for monthly transitions, every start/stop of application programs, clearing the time stamp buffer, starting/setting the clock, otherwise the complete time telegram is not sent.
Warmstart:			
Clear counter	n	n/y	Clear counter on Warmstart
Clear message buffer	n	n/y	Clear FIFO buffer on Warmstart
Activate error message			
DCF/GPS error	n	n/y	Error values shown by the error LED "F": The enabled bits are treated as errors. Every disabled bit is treated as a warning. (The error bits for an error during a self test are always set).
Time invalid:	y	n/y	
Asynchronous time	n	n/y	
Message buffer overflow	y	n/y	

Function group

The following parameters are valid for individual groups (i.e. 4 individual masks)

Name	Default value	Area	Meaning
No.	1	1....4	Number of the selected function groups
Function	1 bit with time stamp	Binary	Only binary inputs
		Counter	Binary and counter values
		1 bit with time stamp	Binary + 1 bit event logging
		2 bit with time stamp	Binary + 2 bit event logging
		8 bit with time stamp	Binary + 8 bit event logging
Debounce filter	Stable signal	Integrated Stable Signal	Debounce filter mode
Dechattering	n	n/y	Disabling/enabling the chatter filter

Inputs

The following parameters refer to all individual inputs (attention: chatter time refers to two inputs next to each other)

Name	Default value	Area	Meaning
No.	1 - 8	1 - 8, 9 - 16, 17 - 24, 25 - 32	Input number sequence for the function group selected
Disabled	n	n/y	Impedes processing of input data for the input (always 0)
Inverted	n	n/y	Reverse polarity of the input
2 edges	y	n/y	Edge monitoring for both edges
Debounce time	1	0 .. 255	Debounce time 0 ... 255 milliseconds 0 = without internal SW delay
Chatter number	0	0 .. 255	Chatter number 0 ... 255 (for event/counter inputs) 0 = chatter filter deactivated
Chatter time	1	1 .. 255	Chatter filter time duration 1 ... 255*0.1 seconds (attention: affects two inputs positioned next to each other!)

Startup the140 ERT 854 10

7

Introduction

Overview

This chapter describes the preconditions and boundary conditions required for starting the 140 ERT 854 10 and provides a check list with the necessary steps.

What's in this Chapter?

This chapter contains the following topics:

140 ERT 854 10 Module and Ressource Limitations

Limitations

Check whether the following conditions have been adhered to before starting the configuration:

- Concept V 2.2 or higher
- Can be used in local or remote module racks (RIO) with RIO Drop Firmware higher than V1
- Cannot be used in DIO Drops
- Up to 9 ERTs can be mounted on each local or remote module rack (several module racks possible)
- Processing signal status > 1 millisecond + filter time possible
- Counter inputs up to 500Hz with 32 bit addition
- Each ERT requires an "ERT_854_10" transfer EFB
- 7 INPUT words, 5 OUTPUT words per ERT
- Several ERT modules can be connected to one standard time receiver. The 140 ERT 854 10 requires 5 mA from the receiver
- Maximum power consumption of 0.07mA from the battery module XCP 900 00 required for receiving counter, event FIFO buffer and parameter data.

Time receiver

The standard time receiver must provide an output signal in DCF77 format for 24 VDC.

The following standard time receivers are provided:

- DCF77E: DCF long wave receiver for Europe
- 470 GPS 001 00: A GPS satellite receiver

DCF Receiver

Overview

The DCF 77E module operates as an internal receiver with integrated antenne.

The module receives and converts the received time signal in a 24 VDC signal in DCF77 format, and amplifies it before sending it on to the 140 ERT 854 10 module.

DCF Signal

The time signal received in the Central European Time zone is known as the DCF77 and provides CET. It is sent from the atomic clock to the National Institute for Science and Technology Braunschweig, Germany, and sends a long wave signal of 77.5 kHz (from which DCF77 derives its name) via a transmitter in Frankfurt am Main. The signal can be received throughout Europe (in a radius of approximately 1000 km from Frankfurt).

When selecting a location for erecting an antenne, the following sources of interference should be taken into account which could disturb or destroy signal reception through their DCF receivers:

- electromagnetically contaminated areas. Avoid areas with potential sources of interference, such as strong transmitters, switching stations and airports. Strong interference can also be caused by industrial machinery and cranes.
- Steel supports in buildings, rooms and appartments. Poor reception can occur in cellars, underground car parks and closed operating cabinets.
- "Shadows" and "dead band" in mountain areas, high buildings, ...

GPS Receiver

Overview

The 470 GPS 001 00 module is a GPS time signal receiver. Other usual GPS standard time receivers can also be used as long as they deliver the time signal in DCF77 format with a 24 VDC potential.

GPS Signal

A group of lower orbiting GPS satellites (Global Positioning System) send radio signals from which entensive time information can be derived. Their orbits are distributed evenly so that every point on earth is covered by at least 3 different satellites. The GPS signal can be received accross the whole world. The absolute time precision achieved by the GPS signal is considerably higher than that reached by the DCF receiver.

GPS satellites sends UTC time (Universal Time Coordinated) which corresponds to GMT (Greenwich Mean Time). Seconds and years transitions are taken into account. The 470 GPS 001 can be configured using a time offset from UTC corresponding to the local time zone. Summer/winter time change overs can be configured likewise.

Calendar and day data is diverted from the GPS signal and transferred to the 140 ERT 854 10 module.

The antenne must be ordered separately from the GPS receiver. More details are contained in the technical data section of your reciever.

When selecting a location for erecting an antenne, the following sources of interference should be taken into account which could disturb or destroy signal reception through their GPS receivers:

- electromagnetically contaminated areas: Avoid areas with potential sources of interference, such as strong transmitters, switching stations and airports.
- limitred to the sky and the horizon: The antenne must be erected outside to ensure disturbance operation. Enclosed spaces or operating cabinets impedes satellite reception.
- Length of the antenne cable: Do not exceed the maximum permitted length of the antenne cable
- Atmospheric conditions: Heavy snowfall and rain can impede your GPS receiver or even prevent any signal reception.

Behaviour when starting/restarting and the data storage

Cold Start

This is the default behavior of the ERT when connecting or reconnecting a stabile power supply.

- All recorded events, counter values and the current parameters of the ERT are initialized with a defined state.
- The recording of the process data is delayed until the PLC has been started and can therefore provide the ERT with a valid parameter set.
- Since the ERT does not have a hardware clock, the internal software clock is invalid until it has been synchronized in a suitable form:
  - Depending on the source which has been configured for time synchronization, the time stamps for all recorded events are set to invalid time until either: the internal clock is set with a DPM_Time value using the EFB or time synchronization with an external time signal has occurred.
  - A special case: If the "clock" parameter of the ERT was configured as an "internal clock" in free running mode (with a power reserve of zero), the internal clock starts with a default setting at hour 0 on 1/1/1990.
- If a "complete time report" has been configured, a complete time transfer is done directly before the first recorded event so that the clock synchronization follows.

Data Storage

The current data of the ERT 854 10 can be protected from a power loss if the rack has a 140 XCP 900 00 battery module. If the supply voltage falls below a defined limit, it will be recognized by the rack. All recorded data, counter values and the current parameter set are saved in a non-volatile RAM by the firmware and remain until the next warm start (see below). In situations where the saving in the ERT does not happen (5 VDC short circuit or hot swap of the ERT module), a cold start is performed.

Warm Start

Reconnecting a stabile supply voltage causes a warm start of the ERT module, as long as the module is in a state where it can store the current data in a consistent form.

- All recorded events, counter values and the current parameters of the ERT are restored from the non-volatile RAM.
- If the "warm start" parameters ("Clear counter"/"clear message buffer") are configured, the recorded events and/or counter values are erased.
- Recording of the process data with the ERT is immediately continued with the same parameter set even if the PLC is not started yet or the remote connection could not be restored at this time.
- Since the ERT does not have a hardware clock, the software clock is invalid until it has been synchronized in a suitable form:
  - Depending on the source which has been configured for time synchronization, the time stamps for all recorded events are set to invalid time until either: the internal clock is set with a DPM_Time value using the EFB or time synchronization with an external time signal has occurred.
  - A special case: If the "clock" parameter of the ERT was configured as an "internal clock" in free running mode (with a power reserve of zero), the internal clock starts with a default setting at hour 0 on 1/1/1990.
- If a "complete time report" has been configured, a complete time transfer is done directly before the first recorded event so that the clock synchronization follows.
- If the corresponding "ERT_854_10" transfer EFB is active in the PLC again, the transfer of the events and counter values in the FIFO buffer of the ERT is continued. Current binary input values and status words are also transferred.
- If the PLC provides a new parameter set when starting which would mean a change in the time of process data evaluation, all recorded events and counter values are cleared since they would no longer be consistent with the new parameter set.

Check List

Step by Step

The following steps are to be performed for a successful commissioning of the 140 ERT 854 10:

Step	Action
1	Plug the 140 ERT 854 10 module into the local or remote rack.
2	Connect the designated process peripherals and the standard time receiver to the module(see *Module Cabling, p. 38*).
3	Do not forget to connect the reference supply voltage for the ERT input groups. **Note:** Please ensure that the notes for installation of antennas for the standard time receiver are followed.
4	Enter the 140 ERT 854 10 in the I/O map. **Note:** Take special note that the module requires seven 3x registers and 5 4x registers in the signal memory.
5	Configure the 140 ERT 854 10 in the corresponding parameter screens to provide the required functionality (see *Parameter Screen, p. 47*).
6	Use the correct EFB from the ANA_IO function block library to provide the "slot" input parameter for the "ERT_854_10" transfer EFB. Either QUANTUM for local or QUANTUM and DROP for remote racks (see *DROP: COnfiguring an I/O Station Rack, p. 67* or *QUANTUM: Configuring a Central Rack, p. 70*).
7	Define EFB user data structures for the required data types. Events can be "used", for example, by outputting them at a printer or storing them in central data storage.
8	Use the "ERT_854_10" transfer EFB from the EXPERTS function block library to transfer ERT data (see *ERT_854_10: Data transfer EFB, p. 74*). **Note:** The transfer of new events with the "ERT_854_10" EFB overwrites the previous event information. The user confirmation should be provided only when the data are completely evaluated and no longer needed.
9	Please note the difference in the behavior of the ERT when starting/restarting depending on if the rack has an XCP module (see *Behaviour when starting/ restarting and the data storage, p. 55*).

Integration in the Application Program

8

Introduction

Overview

The chapter contains information about how the ERT 854 10 module and respective EFBs are inserted in the Concept application program.

What's in this Chapter?

This chapter contains the following topics:

Linking intelligent I/O modules

Introduction

To link intelligent I/O modules there are EFBs. The EFBs are arranged so that the FDB program can be designed, almost independent of the hardware module used The project specific information is processed and stored in data structures on the PLC using hardware dependent EFBs (e.,g. ERT_854_10). The ERT_854_10 data transfer EFB works with these data structures, which reads the raw values from the Input words (3x), processes them and writes them into the output words (4x) along with the ERT handshake and clock synchronization data. The result of this is that the changes of direct addresses or changes in the input or output parameters are automatically evaluated by the EFBs.

Division into sections

Since the evaluation of the configured data is only done once after loading, it is recommended that the EFBs for linking to intelligent modules are divided into several sections.

A division into at lease two sections is recommended.
- Configurations Section
- Processing Section

By division into a configuration section and several processing sections, the CPU load can be reduced because the configuration part (configuration section) only has to be executed once (after a restart or a warm start). The processing section must usually be continually executed.

The configuration section is controlled with the EN input of the corresponding EFB. The EFBs are enabled with internal variables that are set to 1 in the first cycle.

Configuration Section

Configurations Section

The configuration section is to configure the analog input and output modules and controls the data exchange between the analog EFBs, the Signal memory and the configuration data.

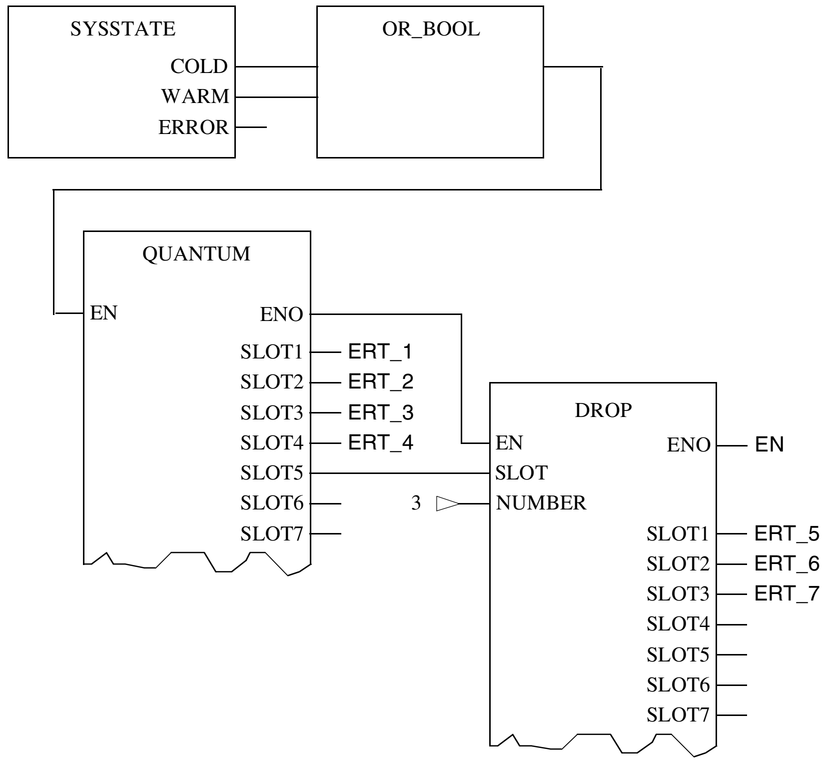
The configuration section should be called "CfgErt" and the internal variable which controls it should be called "CfgErtDone" to guarantee the compatibility to future Concept versions.

There are 2 possibilities for the control of the configuration sections:
- using the EN input of the individual EFBs
- using the enable or disable of the configuration section

Example 1: Control using the EN inputs

The control of the configuration section can be done with the En inputs of the individual EFBs in this section. The enable for the EFBs is done using the EFB SYSSTATE, whose outputs COLD or WARM are set to 1 for a cycle after a cold start or a warm start.

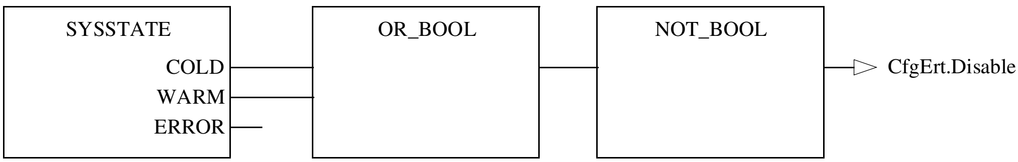
Example of a Configuration Section "CfgErt"



Example 2: Control using Section Enable

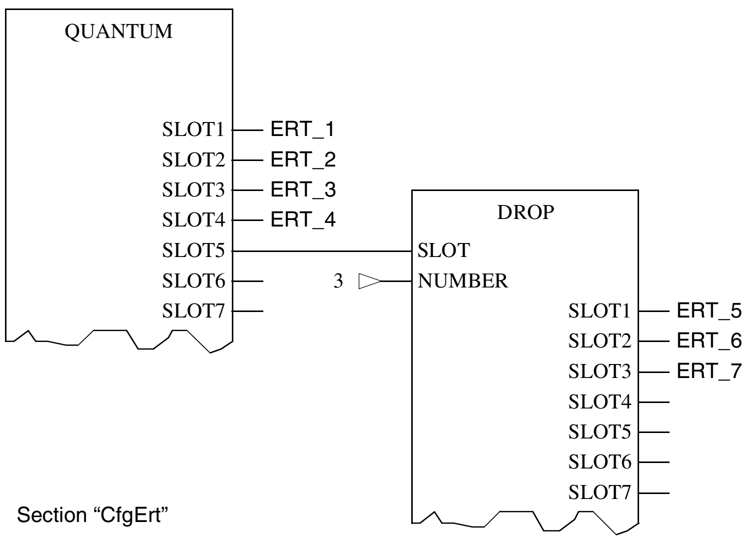
The control of the configuration section can be done with the enabling and disabling of this section. The enable for the Configuration Section is done in a separate section using the EFB SYSSTATE, whose outputs COLD or WARM are set to 1 for a cycle after a cold start or a warm start. This 1 signal is used to enable and disable the configuration section, A link from EN and ENO of the EFB is not necessary with this solution.

Example of a Control Section "Config_Ctrl"



Section “Config_Ctrl”

Example of a Configuration Section "CfgErt"



Section “CfgErt”

Processing Section

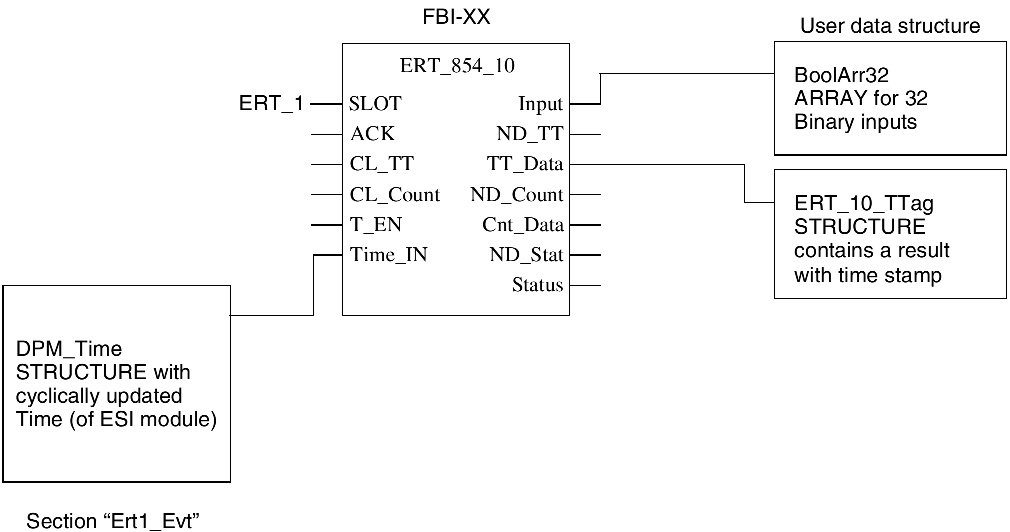
Processing Section

The processing section is for the actual analog value processing.

Example

The following example of a processing section uses the parameter "slot" for its ERT_854_10 EFB which can be taken from a QUANTUM or a DROP EFB. (See also *Configurations Section, p. 61*.)

Typical implementation of an ERT_854_10 EFB in the processing section



EFBs for the140 ERT 854 10

9

Introduction

Overview

The EFBs described in this chapter are required for operating the 140 ERT 854 10.

What's in this Chapter?

This chapter contains the following sections:

9.1 DROP: Configuring an I/O Station Rack

Overview

Introduction

This chapter describes the DROP function block.

What's in this Section?

This section contains the following topics:

Short description

Function description

The Function Block is to prepare configuration data of a remote or distributed I/O station for further processing by module configuration EFBs.

FOr configuration an I/O station rack, the function block DROP in the Configuration Section is connected to the corresponding SLOT output of the function block QUANTUM. At the NUMBER input of the function block DROP, the number of the I/O station must be given, as defined in the I/O connections. The SLOT output connects to the function block for configuration of the analog modules of the I/O station.

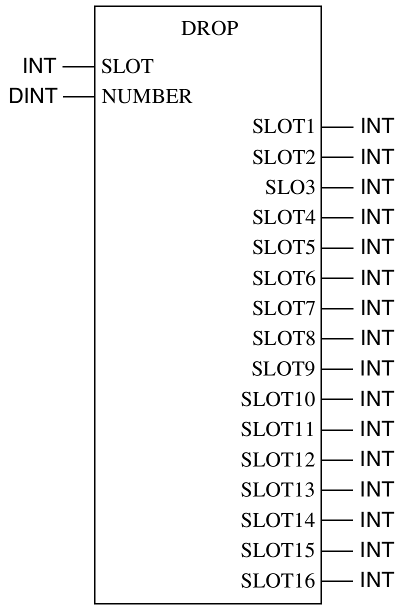
The parameters EN and ENO can used additionally.

Note: The module ERT 854 10 can not be used in the distributed I/O stations (DIO).

Representation

Symbol

Block representation:



Parameter description

Block parameter description:

Parameter	Data type	Meaning
SLOT	INT	Slot for RIO, DIO, NOM
NUMBER	DINT	Number of RIO, DIO, NOM
SLOT1	INT	Slot 1
:	:	:
SLOT16	INT	Slot 16

Runtime error

Runtime error

If no "Head" has been configured for the I/O station subrack, an error message appears.

9.2 QUANTUM: Configuring a Central Rack

Overview

Introduction

This chapter describes the QUANTUM function block.

What's in this Section?

This section contains the following topics:

Brief description

Function description

The Function block is used to edit the configuration data of a QUANTUM primary subrack for subsequent use by the scaling EFBs.

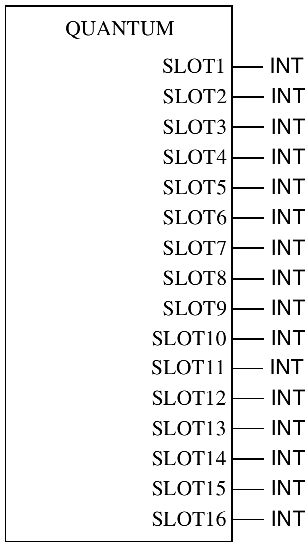
To configure a QUANTUM primary subrack, the QUANTUM Function block is inserted into the configuration section. The function blocks for the configuration of analog modules or the DROP Function block for the I/O station are connected at its SLOT outputs.

EN and ENO can be projected as additional parameters.

Representation

Symbol

Block representation:



Parameter description

Block parameter description:

Parameter	Data type	Meaning
SLOT1	INT	Slot 1
:	:	:
SLOT16	INT	Slot 16

Application example for Quantum

At a Glance

To precisely monitor the output values, it is advisable to implement the scaling with two EFBs. The first EFB (scaling EFBs) scales the analog value and the second EFB monitors the scaled value for ranges preset by the process. In the following process, either the original Y output of the scaling EFB or the limited OUT output of the Limiter EFB can be used.

Application example

A simple example shows how the EFBs can be used.

The example assumes a boiler with a capacity of 350 liters. The input voltage ranges from 0.0 Volt for 0 liters to 10.0 Volt for 1000 liters. A PI controller should guarantee a volume between 200 and 300 liters. The Limiter EFB detects violations in this range and will limit the output.

Given values:

BoilerMn: 0

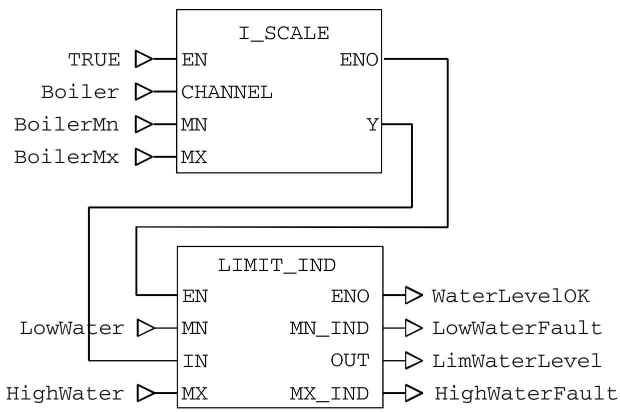
BoilerMx: 1 000

LowWater: 199

HighWater: 301

"Boiler" is an unlocated variable of the ANL_IN type and is linked to an AVI030-EFB.

Application example



9.3 ERT_854_10: Data transfer EFB

Overview

Introduction

This chapter describes the ERT_854_10 module.

What's in this Section?

This section contains the following topics:

Brief description

Function description

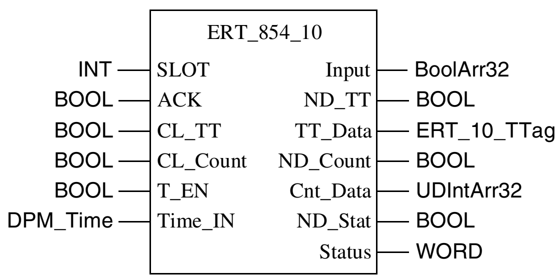
The ERT_854_10 EFB provides the programmer with a software interface to the ERT 854 10 module. It allows easy access to functions like counters, time stamp, status or time synchronization. Using the input and output registers, the ERT_854_10 EFB can coordinate the flow of Multiplex data from the ERT to the PLC. It also ensures that the intermediate counter values are stored in an internal memory area until the data is complete, so a consistent set of all counter values is made available to the statement list. A flag "New data" is always set for every data type if the input data type was copied into the corresponding EFB output structure.

The parameters EN and ENO can also be configured.

Representation

Symbol

Function Block representation:



Parameter description

Description of the function block parameters:

Parameter	Data type	Meaning
SLOT	INT	The Slot index is assigned to the ERT-EFB from either the QUANTUM EFB or DROP EFB and contains the configured input and output references (3x and 4x registers)
ACK	BOOL	Event confirmation: Setting ACK signals that the user is ready to receive the next result and deletes the TT_Data register. If ACK remains set, "continuous operation" is done.
CL_TT	BOOL	Delete the ERT event FIFO buffer by setting CL_TT. Storage of events is blocked until the CL_TT is reset to 0.
CL_Count	BOOL	Delete all ERT counters by setting CL_Count. Counting is interrupted until CL_Count is reset to 0.
T_EN	BOOL	Enables a time transfer, e.g. from the ESI via Time_IN, if set
Time_IN	DPM_Time	Structure of the input time, e.g. from the ESI, for time synchronization of the ERT (contains the edge controlled time synchronization in the "Sync" element)
Input	BOOLArr32	Output array for all 32 digital inputs in BOOL format (also provided in the form of word references as 3x registers 1+2)
ND_TT	BOOL	Flag, new data in TT_Data structure: remains set until user confirmation with ACK
TT_Data	ERT_10_TTag	Event message output structure with time stamp. An event is held and NDTT is set to 1 until there is a user enable with ACK = 1.
ND_Count	BOOL	Flag, new counter data in Cnt_Data structure: The value 1 is set for only one cycle and is not acknowledged.
Cnt_Data	UDIntArr32	Output array for 32 counter values (is overwritten after the EFB has received a complete set of consistent counter values (configured as:8, 16, 24, or 32).
ND_Stat	BOOL	Flag; new status data in status word: The value 1 is set for only one cycle and is not acknowledged.
Status	WORD	Output word for EFB/ERT status (for internal details see *Data Flow, p. 82*)

Internal time synchronization

Structure of DPM_Time for ERT internal time synchronization e.g. via the ESI:

Element	Element type	Meaning
Sync	BOOL	Clock synchronization with positive edge (hourly or on command)
Ms	WORD	Time in milliseconds
Min	BYTE	Time invalid / minutes
Hour	BYTE	Summer time / hours
Day	BYTE	Day of the week / Day in the month
Mon	BYTE	Month
Year	BYTE	Year

Event structure

Event structure of the ERT_10_TTag with 5 Byte time stamp (further information can be found in *Data Flow, p. 82*):

Element	Element type	Meaning
User	BYTE	Complete time / user number [module number]
Input	BYTE	Event set type / No. of the first input
In	BYTE	Event data: 1, 2 or 8 managed positions
Ms	WORD	Time in milliseconds
Min	BYTE	Time invalid / minutes
Hour	BYTE	Summer time / hours
Day	BYTE	Day of the week / Day of the month

Mode of Functioning

ERT data transfer

The number of I/O words available on the local and remote subracks is limited to 64 inputs and 64 outputs. For this reason, the number of ERT modules which can be used per local/remote backplane is limited to 9, with the currently selected minimum requirements of 7 input words and 5 output words per module.

The size of the required ERT data transfer is considerably larger:
- 32 counters = 64 words,
- an event with a 5 byte time stamp = 4 words,
- 32 digital values and the ERT status = 3 words.

These inconsistent size requirements necessitate the use of a special transfer EFB called ERT_854_10 to execute the required operations on the PLC and to adjust the ERT representation of the data in Multiplex form. An EFB is required for every ERT module.

To simplify matters, only the EFB parameters which will actually be used need to be configured. This saves on the amount of configuration effort, particularly when the counter inputs and event inputs are not mixed together. Unfortunately memory cannot be reserved for this because Concept has occupied the outputs with invisible dummy variables.

Basic structure of the ERT_854_10 input register block with seven 3x registers for transfer from the ERT to the PLC

Basic structure of the register block

ERT_854_10 input register block:

Contents	Function
Digital inputs 1 …. 16	Digitally processed input data which is cyclically updated (the module's input address corresponds to that of the digital standard input modules, i.e. inputs 1 … 16 correspond to bits 15 … 0)
Digital inputs 17 …. 32	
Transfer status	IN transfer status (TS_IN)
MUX 1	Multiplex data block for block transfer, such as:
MUX 2	1 event with 5 byte time stamp or
MUX 3	2 counter values of possible configured maximum 32 or
MUX 4	1 status word

Simplified structure of the ERT_854_10 output register block with five 4x registers for the transfer of the SPS to the ERT

ERT_854_10 output register block:

Contents	Function
Transfer status	OUT transfer status (TS_OUT)
MUX 1	Time data block for the ERT for the clock synchronization
MUX 2	
MUX 3	
MUX 4	

Note: User interface is normally for the inputs and outputs of the ERT_854_10 EFB, not the 3x and 4x registers.

Use of the DPM_Time Structure for the synchronization of the internal ERT clock

Time synchronization

If the time can not be synchronized through a standard time receiver, the time information can alternatively be transferred from the 140 ESI 062 01 communication module. The ESI makes the updated time available in a DPM_Time structure directly using the "Time_IN" parameter. The data structure can also be filled by the user program and the corresponding bits can be set. In this manner, the time can also be set, for example, by the CPU.

With power reserve

As soon as the "clock" parameter of the ERT is configured to "internal clock" with a power reserve not equal to zero (i.e. not free running), the EFB must use the time provided by the ESI for synchronizing the internal ERT clock. Until the first synchronization has taken place, the ERT sends back "status" output word with the bit "invalid time" set (Bit 3 TU).

The conditions of the first synchronization of the internal ERT using above the DPM_Time structure are:

The EFB Parameter "T_EN" must change from 0 to 1 to enable the time setting.

The time in "TIME_IN" provided by ESI must be represented as follows:
- valid (i.e. the bit for the message "time invalid" in "Min" value must not be set),
- and the values in "Ms" must change continually.

If, at a later point in time, the time data is invalid or no longer set, the TU changes to 1 after the configured power reserve has run out.

The synchronization/setting of the internal ERT clock takes place using the DPM_Time structure, if:
- EFB-Parameter "T_EN" is set to 1 to enable the time setting.
- The time data in "Time_IN" provided by ESI are valid (i.e. the "Time invalid" Bit in the "Min"value must not be set).
- The status of the DPM_Time element "Sync" changes from 0 to 1. This change is done every complete hour by the 140 ESI 062 01, but can also be triggered by a suitable telecontrol command.

The precision of the ESI and ERT synchronized time can be influenced by delay caused by the PLC cycle time, as well as by the cumulative components, which reflect the differences of the ERT software clock (< 360 milliseconds/second).

Without power reserve

If the "clock" parameter of the ERT was configured as an "internal clock" in free running mode (with a power reserve of zero), the internal clock starts with a default setting at hour 0 on 1/1/1990. In this case, the time can also be provided by using the DPM_Time data structure of the 140 ESI 062 01 module, as described above. As there is no power reserve to "run out", the time will never be invalid and the bit "Time not synchronized" is always set in the "status" output word (Bit 4 TA) which is returned by the EFB, .

Data Flow

Digital Inputs

No flag for new data is provided for this input type. The digital inputs in the first two input register words are updated every second cycle directly by the ERT. The EFB makes the processed values available as Bool if the BoolArr32 output field has been configured accordingly.

Counter Inputs

Cyclic updating of the counter values takes significantly longer than for other data types. Counter values are saved as a data record in "Cnt_Data" after a complete series (configured as: 8, 16, 24 or 32) of time consistent counter values in multiplex form has been transferred from the ERT. The flag for new data "ND_Count" is set for one cycle.

Event Inputs

As readiness to receive new events must be actively confirmed by the user, the management of the registers becomes somewhat more complex (a handshake mechanism is required). Event data remain in the data structure ERT_10_TTag and the flag for new data "ND_TT" stays set until the "ACK" input is set by the user and therefore requests a new event. The EFB responds to this by resetting "ND_TT" for at least one cycle. After the new event has been sent to the ERT_10_TT register structure, "ND_TT" is reset by the EFB. To prevent the new event data from being overwritten, the user must take care that the "ACK" input is reset after the EFB has reset the "ND_TT" flag. This state can then be kept stable to allow the user program enough time for event processing. Each subsequent event which is recorded with the ERT is temporarily stored within the event FIFO buffer.

New events are sent directly from the internal buffer of the EFB in intervals of at least 2 cycles for as long as the "ACK" input is set (for the special continuous operating mode); the effect is, however, that the "ND_TT" only stays set for one cycle. In this special mode, it is still the job of the user program to finish event processing before "ND_TT" signals the transfer of other new events to the ERT_10_TT structure because handshake protection by "ACK" is not available in this case.

ERT_10_TTag

ERT_10_TTag event structure with 5 byte time stamps

Byte	Bits	Function
1	D0...D6 = Module No.. 0...127 D7 = CT	Rough time: CT = 1 indicates that this time stamp contains the whole time value including month and year in bytes 2 + 3. The Module no. can be set in any way in the parameter screen.
2	D0…D5 = input no. D6 = P1 D7 = P2	No. of the first input of the event group: 1...32 Type of the event message (P2, P1). 1.. 59 see *Note 1:, p. 83* [Month value if CT = 1]
3	D0…D7 = data from the event group (D7…D0 with right alignment)	1, 2 or 8 managed positions [Month value if CT = 1]
4	Time in milliseconds (least significant byte)	0 ... 59999 milliseconds (max. 61100) see *Note 2:, p. 84*
5	Time in milliseconds (most significant byte)	0 ... 59999 milliseconds (max. 61100) see *Note 2:, p. 84* and *Note 3:, p. 84*
6	D0...D5 = minutes D6 = R D7 = TI	Minutes: 0...59 Time invalid: TI = 1 means invalid time / reserved = 0 see *Note 3:, p. 84*
7	D0...D4 = hours D5 = R D6 = R D7 = DS	Hours: 0...23 Summer time: DS = 1 indicates that summer time is set With switchover from ST -> WT, hour 2A has ST, and hour 2B has WT
8	D0...D4 = DOW D5...D7 = DOM	Weekday: Mon-Sun = 1…7 Day of the month: 1...31 The code corresponds to CET and thus deviates from the standard used in the US, Sun = 1.

Note 1:

Interpretation for Byte 2

D7 D6	Type of the event message	D5...D0	No. of the first input of the event group
0 1	1 pin message	1 ... 32	Input pin number
1 0	2 pin message	1, 3, 5, ...31	First input of the group
1 1	8 pin message	1, 9, 17, 25	First input of the group

Note 2:

The value for the milliseconds is a maximum of 61100 ms with the second of transition (61000 plus a tolerance of 100 milliseconds)

Note 3:

For time stamps containing an invalid time (TI = 1), the time in milliseconds is set to FFFF HEX. Minutes, hours and DOW/DOM values are invalid (i.e. undefined).

Rough Time Output

If the "rough time declaration" has been activated during the ERT configuration, the transfer of the complete time (with month/year) is executed under the following conditions: when the month changes, after the module restarts, during every start or stop of the PLC user program, when the event FIFO buffer is deleted, when the clock is started or set. The transfer of this complete time output without the data input values is "triggered" basically takes place through a correct time stamped event. If this does not happen the values remain "stuck" in the ERT until an event occurs. Within the time stamp of a "rough time output", the CT bit is always set so that byte 2 contains the information about the month, byte 3 the information about the year and bytes 4 to 8 show the same time stamp values of the triggering event, which is immediately followed by the event message for rough time output.

Status Inputs

The flag for new status data "ND_Stat" is set for one cycle. The status inputs can be overwritten after 2 query cycles.

The status word contains EFB and ERT error bits

Assignments of the Error Bits

Internal structure of the EFB/ERT status word:

EFB error bits					**ERT error bits**										
D15 ...	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0

ERT Error Bits

D8 ... D0 ERT error bits

Bit	Abbreviation	Meaning
D0	FW	Firmware errors, self test errors within EPROM, RAM or DPM (severe module errors)
D1	FP	Parameter errors (severe internal errors)
D2	TE	External time reference error (time-basis signal disrupted or not available)
D3	TU	Time became invalid
D4	TA	Time is not synchronized (Free running mode, permanent running without time error message, see also: *Without power reserve, p. 81*)
D5	PF	FIFO buffer overflow (loss of the most recent event data)
D6	PH	FIFO buffer half full
D7	DC	Dechattering active (some event data lost)
D8	CE	ERT communication error (procedure errors or time out)

When configuring the *Parameter Screen, p. 47* Sreens parameter, some of these errors can be assigned to grouped error messages with the "F" light as well as the module's error byte within the status table. All other errors are then defined as warnings.

D11 ... D9 reserved

EFB Error Bits

D15 ... D12 EFB error bits:

Bin.	Hex.	Meaning
1000	8 HEX	EFB communication time out
0101	5 HEX	Wrong slot
0110	6 HEX	Health status bit is not set (ERT appears not to be available)
other values		internal error

Online error display

The following ERT/ERB error messages are displayed in the **Online** → **event viewer** Concept window with an error number and explanation.

EFB error messages:

Message	Error	Meaning
-2710	User error 11	EFB communication time out
-2711	[User error 12] =	EFB internal error
-2712	[User error 13] =	EFB internal error
-2713	[User error 14] =	EFB internal error
-2714	[User error 15] =	EFB internal error
-2715	[User error 16] =	Wrong slot
-2716	[User error 17]	Health status bit is not set (ERT appears not to be available)
-2717	[User error 18]	EFB internal error

ERT error messages:

Message	Error	Meaning
-2700	User error 1]	ERT internal error
...	...	...
-2707	[User error 8]	ERT internal error
-2704	[User error 5]	ERT communication timeout (e.g. EFB disabled too long)

Other functions

Input markers

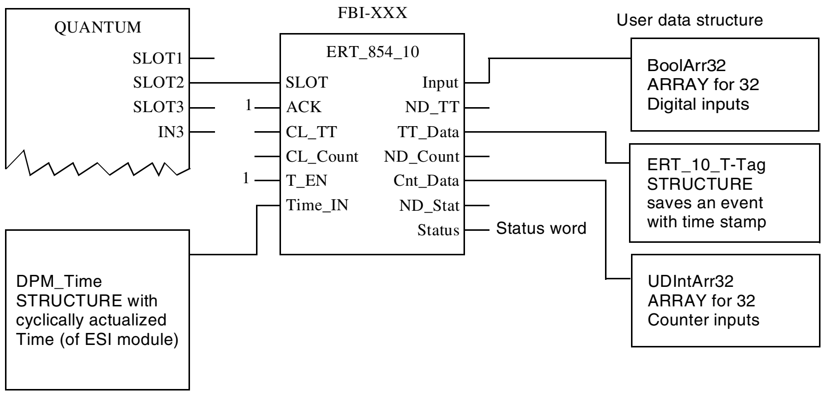
Setting the input marker "CL_TT" causes the FIFO buffer event of the ERT to be cleared. Setting the markers for one cycle is sufficient.

Setting the input marker "CL_Count" causes the ERT counter to be cleared by the ERT. Setting the markers for one cycle is sufficient.

Simple example

Structure diagram

Principle structure



Using the ERT >EFB time data flow

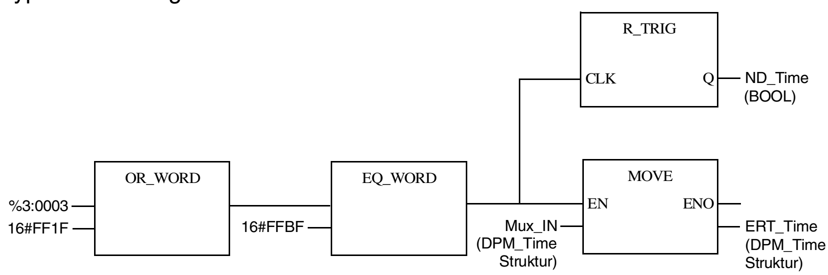
Application Examples:

This section shows an internal function which is made available by the ERT for diagnostics and development. It covers the cyclic transfer of the ERT internal time to the corresponding EFB in greater intervals. This time can be used for display or setting the PLC clock and so on, irrespective of whether it comes from the free-running internal clock or was synchronized through an external reference clock signal. The time appears as a DPM_Time structure beginning at word 4 of the IN register block of the ERT. The following diagram shows the program elements involved in selection.

Startup information:

During the I/O addressing, the IN references 30001 …30007 were assigned to an ERT_854_10. The IN transfer status (TS_IN) in the third word of the register block is sent to an OR_WORD block. A DPM_Time structure is defined in the variable editor as Variable Mux_IN in the fourth word of the IN register block and has address 30004 ... 30007. This variable is given as an input to the MOVE block. The MOVE block output is a DPM_Time structure defined by the variable editor as variable ERT_Time.

Typical recording mechanism for ERT time data



Note: The ERT_854_10-EFB must be active and error free.

Explanation:

The MOVE block transfers the time data (which is cyclically stored in the MUX range of the IN register block) to the DPM_Time structure ERT_Time of the user as soon as the OR_WORD and the EQ_WORD block signal for a time data transfer. R_TRIG provides a signal in "ND_Time" for one cycle to allow further processing of the time data. The BOOL "Sync" element value of the ERT_Time should begin to "tick" during each new transfer from the ERT. There is a new transfer after a maximum of each 200 PLC cycles.

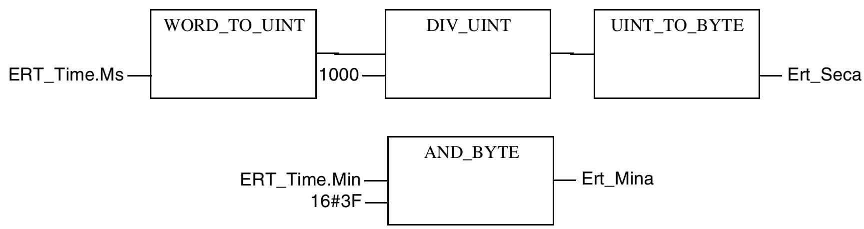
Example 1: Using time values for display (or with SET_TOD-EFB)

A number of simple logical operations is needed to obtain a meaningful display of the time information of the DPM_Time structure. The same commands can also be used for the ERT_10_T Tag structure. As example 2 deals with setting the PLC clock while using the SET_TOD-EFB, individual values are directly converted into the required formats.

> **Note:** The reference data editor (RDE) can provide the "ms" value directly in the Uns-Dec-WORD format and the "Min" value in the Dec-BYTE format.

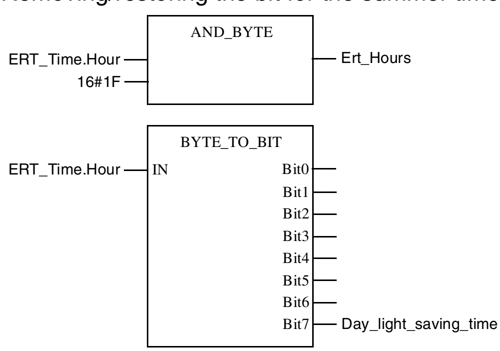
SET_TOD requires that the WORD millisecond value "ms" is converted into a BYTE second value. The BYTE minute value "Min" contains the error bit which must be removed (values greater than 127 are invalid).

Conversion of the WORD millisecond value into a seconds BYTE



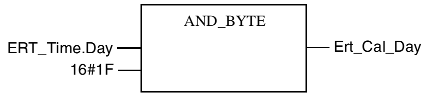
The BYTE value "Day" contains week and calendar day values. The weekday Monday is displayed as 1 in the DPM_Time structure. The weekday parameter in SET_TOD uses the value 1 for Sunday.

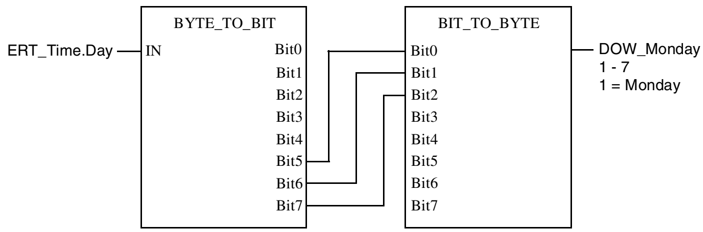
Removing/restoring the bit for the summer time of the "Hour" value.



The BYTE value "Day" contains week and calendar day values. The weekday Monday is displayed as 1 in the DPM_Time structure. The weekday parameter in SET_TOD uses the value 1 for Sunday.

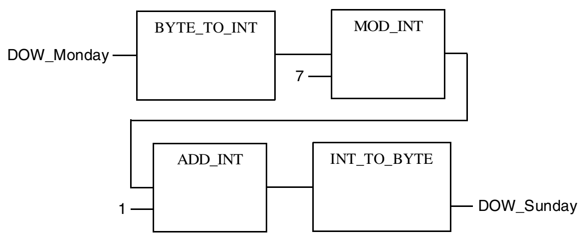
Using the calendar day and weekday based on Monday





Further steps must be taken to convert the weekday based on the value of 1 for Monday into the value of 1 for Sunday.

Calculating the remainder values (Mod) and addition for converting the weekday values



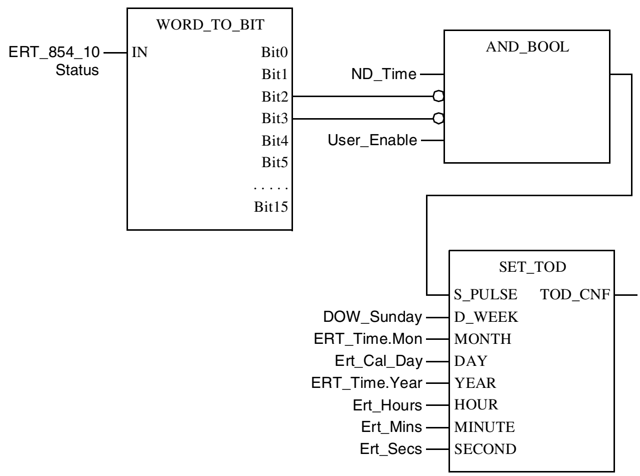
Example 2: Setting the PLC clock with the SET_TOD EFB while using ERT time data

All the parameter values required for the SET_TOD-EFB were created in example 1. The "ND_Time" signal required for transferring the time into the DPM_Time structure with the MOVE block is combined with a user enable here (e.g. only once per hour) to set the PLC clock only when new, error-free time data have been transferred by the ERT. (The ERT error bits are never set when the internal clock is in free run mode).

The SET_TOD-EFB is in the HSBY group of the SYSTEM block library. If it is used, the clock must be activated by storing the TIME OF DAY register in the SPECIALS range of the configuration with 4x addresses.

> **Note:** The "status" parameter value is not exactly synchronized with the time data flow and for this reason can only "tend" to reflect the correct value.

User-enabled setting system for the PLC clock while using the SET_TOD-EFB



Glossary

A

Active window
The window that is currently selected. Only one window can be active at any given time. If a window becomes active, the color of it's title bar changes so it can be distinguished from other windows. Windows that are not selected are inactive.

Addresses
(Direct) addresses are memory areas on the PLC. They are found in the signal memory and can be assigned to input/output modules.
Direct addresses can be displayed/entered in the following formats:
- Standard Format (400001)
- Separator Format (4:00001)
- Compact Format (4:1)
- IEC Format (QW1)

ANL_IN
ANL_IN stands for data type "analog input" and is used to process analog values. The data type is assigned to the 3x references defined in the I/O map for the configured analog input module automatically and therefore can only be used with unlocated variables.

ANL_OUT
ANL_OUT stands for data type "analog output" and is used to process analog values. The data type is assigned to the 4x references defined in the I/O map for the configured analog output module automatically and therefore can only be used with unlocated variables.

ANY
In this version, "ANY" includes the elementary data types BOOL, BYTE, DINT, INT, REAL, UDINT, UINT, TIME and WORD and data types derived from them.

ANY_BIT
In this version, "ANY_BIT" includes data types BOOL, BYTE and WORD.

ANY_ELEM In this version, "ANY_ELEM" includes data types BOOL, BYTE, DINT, INT, REAL, UDINT, UINT, TIME and WORD.

ANY_INT In this version, "ANY_INT" includes data types DINT, INT, UDINT and UINT.

ANY_NUM In this version, "ANY_NUM" includes data types DINT, INT, REAL, UDINT and UINT.

ANY_REAL In this version, "ANY_REAL" includes data type REAL.

Application window The window containing the workspace, the menu bar and the tool bar for the application program. The name of the application program is shown in the title bar. An application window can contain several document windows. In Concept, an application window corresponds to a project.

Argument Same as current parameter.

Array Variables Variables assigned to a defined derived data type using the keyword ARRAY. An array is a collection of data elements of the same data type.

ASCII Mode American Standard Code for Information Interchange The ASCII mode is used for communication with various host devices. ASCII works with 7 data bits.

Atrium The PC based controller is on a standard AT board and can be operated in an ISA bus slot on a host computer. The module has a motherboard (requires an SA85 driver) with two slots for PC104 daughter boards. One PC104 daughter board is used as CPU and the other for INTERBUS control.

B

Backup file (Concept EFB) The backup file is a copy of the last source code file. The name of this backup file is "backup??.c" (assuming that you never have more than 100 copies of your source code file). The first backup file has the name "backup00.c". If you have made changes to the definition file which do not require an interface change for EFB, you can edit your source code file instead of having to create a backup file (**Objects** → **Source**). If a backup file is created, you can give it the name of the source file.

Base 16 Literals

Base 16 literals are used to enter integer values in hexadecimal. The base must be identified using the prefix 16#. The values are not allowed to have a sign (+/-). Underline characters (_) between the numbers are not significant.

Example
16#F_F or 16#FF (decimal 255)
16#E_0 or 16#E0 (decimal 224)

Base 2 Literals

Base 2 literals are used to enter integer values in binary. The base must be identified using the prefix 2#. The values are not allowed to have a sign (+/-). Underline characters (_) between the numbers are not significant.

Example
2#1111_1111 or 2#11111111 (decimal 255)
2#1110_0000 or 2#11100000 (decimal 224)

Base 8 Literals

Base 8 literals are used to enter integer values in octal. The base must be identified using the prefix 8#. The values are not allowed to have a sign (+/-). Underline characters (_) between the numbers are not significant.

Example
8#3_77 or 8#377 (decimal 255)
8#34_0 or 8#340 (decimal 224)

Binary Connections

Connections between FFB inputs and outputs with data type BOOL.

Bit sequence

A data element consisting of one or more bits.

BOOL

BOOL stands for data type "boolean". The data element length is 1 bit (stored in 1 Byte in memory). The variable values for this data type are 0 (FALSE) and 1 (TRUE).

Bridge

A bridge is used to join network segments. It allows communication between two network nodes. Each network has its own token passing sequence - the token is not passed through bridges.

BYTE

BYTE stands for data type "8 bit sequence". Entries are made as Base 2 Literals, Base 8 Literals or Base 16 Literals. The data element length is 8 bits. A numeral value range cannot be assigned to this data type.

C

Call
Procedure used to start execution of an operation.

Clipboard
The clipboard is temporary memory for cut or copied objects. These objects can be inserted in sections. Each time something is cut or copied, the old contents of the clipboard are overwritten.

Coil
A coil is an LD element that transfers a state on the left of on the horizontal connection unchanged to the right of on the horizontal connection. The state in the respective variables/direct address are also stored.

Compact Format (4:1)
The first digit (the reference) is separated from the following address by a colon (:), and the preceding zeros are not given for the address.

Connection
A control or data flow connection between graphic objects (e.g. steps in the SFC Editor, function blocks in the FBD Editor) within a section, graphically displayed as a line.

Constants
Constants are unlocated variables which are assigned a value that cannot be changed by the program logic (write protected).

Contact
A contact is a LD element that transfers a state to the right on the horizontal connection. This state results from a boolean UND link between the state of the horizontal connection to the left and the state of the corresponding variables/direct address. A contact does not change the value of the corresponding variables/direct address.

Current parameters
Currently connected input/output parameters.

D

Data transfer settings
Settings that determine how information is transferred from your programming device to the PLC.

Data Types

The overview shows the hierarchy of the data types, as they are used for inputs and outputs for functions and function blocks. Generic data types are identified with the prefix "ANY".

- ANY_ELEM
  - ANY_NUM
    ANY_REAL (REAL)
    ANY_INT (DINT, INT, UDINT, UINT)
  - ANY_BIT (BOOL, BYTE, WORD)
  - TIME
- System data types (IEC extensions)
- Derived (from ’ANY’ data types)

DCP I/O Station

With a distributed control processor (D908), you can set up a decentralized network with higher level PLC. When using an D908 with a decentralized PLC, the higher level PLC views the decentralized PLC as a decentralized I/O station. The D908 and the decentralized PLC communicate via the system bus which results in improved performance with minimal effects on the scan time. Data exchange between the D908 and the higher level PLC takes place at 1.5 Megabit per second via the decentralized I/O bus. A higher level PLC can support up to 32 D908 processors.

DDE (Dynamic Data Exchange)

The DDE interface allows dynamic data exchange between two programs in Windows. The user can use the DDE interface in the advanced monitor to call his own display applications. With this interface, the user (i.e. the DDE Client) can not only read data from the advanced monitor (the DDE Server), he can also write data to the PLC via the server. In this way, the user can change data directly on the PLC while monitoring and analyzing the results. When using this interface, the user can create his own "Graphic Tool", "Face Plate" or "Tuning Tool" and integrate it into the system. The tools can be written in any language that supports DDE, e.g. Visual Basic, Visual-C++. The tools are called if the user presses a button in the advanced monitor dialog box. Concept Graphic Tool: Using the DDE link between Concept and Concept Graphic Tool, project signals can be represented as a clock diagram.

Decentralized Network

Decentralized programming in a Modbus Plus Network allows the maximum data transfer performance and special requirements for links. Programming a decentralized network is simple. No additional ladder diagram logic is required to set up the network. All requirements for data transfer are handled by corresponding entries in the Peer Cop Processor.

Declaration

Mechanism to determine the definition of a language element. A declaration is normally comprised of the identifier connection with a language element and attribute assignments such as data types and algorithms.

Definition File (Concept EFB)

The definitions file contains general information about selected EFB and its formal parameters.

Derived data types
Derived data types are data types which are derived from the elementary data types and/or other derived data types. The definition of the derived data types is made in Concept's Data Type Editor.
A differentiation is made between global data types and local data types.

Derived Function Block (DFB)
A derived function block represents the call for a derived function block type. Details of the graphic form of the call can be found in the definition "Function Block (sample)". Unlike calls for EFB types, calls for DFB types are represented by double vertical lines on the left and right side of the rectangle block symbols.
The output side of a diverted function block is created in FBD language , but only in the current version of the programming system. Until now, other IEC languages could not be used to define DFB types, and derived functions could not yet be defined in the current version.
A differentiation is made between local and global DFBs.

DINT
DINT stands for data type double integer. The entry is made as Integer Literal, Base 2 Literal, Base 8 Literal or Base 16 Literal. The length of the data element is 32 bits. The value range for variables of this data type is from -2 exp (31) to 2 exp (31) -1.

Direct Representation
A method for representing variables in the PLC program which allows the assigned logical memory location, and indirectly the physical memory location to be found.

Document Window
A window in a application window. Several document windows can be opened in an application window at the same time. But only one document window can be active. Document windows in Concept are e.g. sections, the message window, the reference data editor and the PLC configuration.

DP (PROFIBUS)
DP = Decentralized Peripheral

Dummy
An empty file consisting of a text header with general file information such as author, creation date, EFB name etc.. The user has to add additional entries to complete this dummy file.

DX Zoom
These properties allow you to connect to a program object to monitor and change its data values (if necessary).

E

Elementary Functions/ Function Blocks (EFB)
Functions or function blocks with type definition which are not formulated in one of the IEC languages i.e. there output sides cannot be modified e.g. with the DFB editor (Concept DFB). EFB types are programmed in "C" and are provided in libraries in precompiled form.

EN / ENO (enable / error notification)
If the value of EN is "0" when the FFB is called, the algorithms defined by the FFB are not executed and all outputs keep their previous values. If the value of EN is "0" when the FFB is called, the algorithms defined by the FFB are not executed and all outputs keep their previous values. After successfully completing these algorithms, the value of ENO is automatically set to "1". If an error occurs when executing these algorithms, ENO is automatically set to "0". The output behavior of the FFB depends on if the FFBs are called without EN/ENO or with EN=1. If the representation of EN/ ENO is turned on, the EN input must be used. Otherwise the FFB will never be executed. The configuration of EN and ENO is turned on or off in the dialog box for function properties. The dialog box is called using the menu item **Objects** → **Properties...** or by double clicking on the FFB.

Error
If an error is recognized when processing a FFB or a step (e.g. invalid input values or a timing error), an error message is given which you can view with the menu command **Online** → **Event viewer ...** For FFBs, the ENO output is set to "0".

Evaluation
Process that determines a value for a function or for the outputs of a function block when executing a program.

Expression
Expressions consists of operator and operands.

F

FFB (functions/ function blocks)
Collective term for EFB (elementary functions/function blocks) and DFB (derived function blocks)

FIR Filter
(Finite Impulse Response Filter) Filter with finite impulse response

Formal parameter
Input/output parameters used in the logic for a FFBs and represented as inputs/ outputs from the FFB.

Function (FUNK)
A program organization unit which delivers exactly one data element when executed. A function has non internal status information. Multiple calls of the same function with the same input parameter values always deliver the same output values.
Details of the graphic form of function calls can be found in the definition "Function Block (sample)". Unlike calls for function blocks, function calls have only a single untitled output because its name is the name of the function itself. In FBD, each call is represented by a unique number in the graphic block, this number is created automatically and cannot be changed.

Function Block (Instance) (FB)
A function block is a program organization unit which calculates values for outputs and internal variables according to the functionality defined in the function block type description, if it is called as a certain instance. All outputs values and internal variables for a certain function block instance remain from one function block call to the next. Multiple calls of the same function block instance with the same arguments (input parameter values) do not necessarily deliver the same output value(s).
Each function block instance is represented graphically by a rectangular block symbol. The name of the function block type at the top, center in the rectangle. The name of the function block instance is also at the top, but outside of the rectangle. It is automatically generated when creating an instance, but can be changed by the user if necessary. Inputs are on shown on the left side and outputs on the right side of the block. The names of the formal input/output parameters are shown in the rectangle at the respective locations.
The above description for graphic representation is basically also valid for function calls and DFB calls. Differences are described in the respective definitions.

Function Block Language (FBD)
One or more sections of the graphically represented network consisting of functions, function blocks and connections.

Function block type
A language element consists of: 1. the definition of a data structure, divided in input, output and internal variables; 2. a set of operations carried out with elements of the data structure, if an instance of the function block type is called. This set of operations can either be formulated in one of the IEC languages (DFB type) or in "C" (EFB type). A function block type can have multiple instances (calls).

Function counter
The function counter is used to clearly identify a function block in a program or DFB. The function counter cannot be edited and is given automatically. The function counter always has the structure: .n.m

n = Number of the section (consecutive numbers)
m = Number of the FFB object in the section (consecutive numbers)

G

Generic data type
A data type that stands for several other data types.

Generic Literals
If the data type of a literal is not relevant to you, simply enter the value for the literal. In this case, Concept automatically assigns the literal a suitable data type.

Global DFBs
Globally DFBs are available in each Concept project and are stored in directory DFB directly under the Concept directory.

Global Macros Globally macros are available in each Concept project and are stored in directory DFB directly under the Concept directory.

Globally derived data types Globally derived data types are available in each Concept project and are stored in directory DFB directly under the Concept directory.

Groups (EFBs) Some EFB libraries (e.g. the IEC library) are divided into groups. This makes it easier to find the EFBs, especially for extensive libraries.

I

I/O Connection List I/O and expert modules for various CPUs are configured in the I/O connection list.

IEC 1131-3 International Standard: Programmable Logic Controllers - Part 3: Programming Languages. March 1993.

IEC Format (QW1) The first character of the address contains an IEC identifier, followed by the five digit address:
- %0x12345 = %Q12345
- %1x12345 = %I12345
- %3x12345 = %IW12345
- %4x12345 = %QW12345

IEC naming convention (identifier) An identifier is a sequence of letters, numbers and underlines beginning with a letter or underline (e.g. name of a function block type, an instance, a variable or a section). Letters from national character sets (e.g: ö,ü, é, õ) can be used except in project and DFB names.
Underlines are significant in identifiers; e.g. "A_BCD" and "AB_CD" are interpreted as different identifiers. Multiple leading underlines and consecutive underlines are invalid.
Identifiers cannot contain spaces. Not case sensitive; e.g. "ABCD" and "abcd" are interpreted as the same identifier.
Identifiers cannot be keywords.

IIR Filter (Infinite Impulse Response Filter) Filter with infinite impulse response

Initial step The first step in a sequence. Each sequence must contain a initial step definition. The initial step is used when starting the sequence for the first call.

Initial value The value assigned to a variable when stating the program. The assignment of the value is made in the form of a Literal.

Input bits (1x references)
The 1/0 state of input bits is controlled by the process data which are sent from an input device to the CPU.

> **Note:** The x after the first number of the reference type represents a five digit memory location in application data memory, e.g. reference 100201 stands for an input bit at address 201 in signal memory.

Input parameter (input)
Transfers the respective Argument when calling a FFBs.

Input word (3x references)
An input word contains information which comes from an external source and is represented by a 16 bit number. A 3x register can also contain 16 consecutive input bits which are read into the register in binary or BCD (binary coded decimal) format. Note: The x after the first number of the reference type represents a five digit memory location in application data memory, e.g. reference 300201 stands for a 16 bit input word at address 201 in signal memory.

Instance Name
An identifier belonging to a certain function block instance. The instance name is used to clearly identify a function block in a program organization unit. The instance name is automatically created, but can be edited. The instance name must be unique throughout the entire program organization unit (not case sensitive). If the name entered already exists, a warning is given and you have to select another name. The instance name must correspond to the IEC naming conventions, otherwise an error message is given. The automatically created instance name always has the structure: FBI_n_m

FBI = Function Block Instance
n = Number of the section (consecutive numbers)
m = Number of the FFB object in the section (consecutive numbers)

Instancing
Creating an instance.

Instruction (LL984)
When programming electrical controllers, the user must implement operational coded assignments in the form of picture objects which are separated into recognizable contact forms. The program objects created are converted to computer compatible OP codes on the user level during the loading process. The OP codes are decoded in the CPU and processed by the firmware functions on the controller so that the desired controller is implemented.

Instruction list (IL)
IL is a text language based on IEC 1131 in which operations such as conditional or unconditional function block and function calls, conditional or unconditional jumps, etc. are represented by instructions.

Instructions (IL) Instructions are the "commands" used in programming language IL. Each instruction begins on a new line and is followed by an operator, if necessary with modifier and, if needed for the respective operation, by one or more operands. If several operands are used, they are separated by commas. A label can be placed before the instruction which is followed by a colon. The comment, if used, must be the last element in the line.

Instructions (ST) Instructions are the "commands" used in programming language ST. Instructions must be concluded with a semicolon. Several instructions can be in a line (separated by semicolons).

INT INT stands for data type integer. The entry is made as Integer Literal, Base 2 Literal, Base 8 Literal or Base 16 Literal. The length of the data element is 16 bits. The value range for variables of this data type is from -2 exp (15) to 2 exp (15) -1.

Integer Literals Integer literal are used to enter integer values in the decimal system. The values can have a preceding sign (+/-). Individual underlines (_) between numbers are not significant.

Example
-12, 0, 123_456, +986

INTERBUS (PCP) To use the INTERBUS PCP channels and the INTERBUS process data processing, the Concept Configurator has the new I/O station type INTERBUS (PCP). This I/O station type is permanently assigned to the INTERBUS connection module 180-CRP-660-01.
The only difference between the 180-CRP-660-01 and the 180-CRP-660-00 is a significantly larger I/O area in signal memory on the controller.

J

Jump Element of the SFC language. Jumps are used to jump over areas in the sequence.

K

Keywords

Keywords are unique character combinations which are used as special syntactic elements as defined in Appendix B of IEC 1131-3. All keywords used in IEC 1131-3 and therefore in Concept, are listed in Appendix C of IEC 1131-3. These listed keywords are not allowed to be used for any other purpose, e.g. not as variable names, section names, instance names, etc.

L

Ladder Diagram (LD)

Ladder diagram is a graphic programming language according to IEC1131 which resembles the "current paths" in a relay circuit diagram.

Ladder Logic 984 (LL)

Ladder in the terms Ladder Logic and Ladder Diagram refers to the representation. Unlike a circuit diagram , a ladder diagram is used by electrical engineers to draw a circuit (using electrical symbols) that represents a chain of events and not the actual wires connecting the devices. A standard user interface to control actions on automation devices, allows a ladder diagram interface so that electrical engineers can implement a control program without having to learn a programming language they are not used to.
The structure of the actual ladder diagram allows electrical elements to be connected using a method that creates a control output which is dependent on a logical current flow through the electrical objects used. These electrical objects represent the previously defined conditions for a physical electronic device.
In a simple form, the user interface is an edited video display from the PLC programming application which sets up a vertical and horizontal grid where programming objects are placed. The diagram contains current on the left side of the grid and when connected to objects which are activated, the current flows from left to right.

Landscape format

Landscape format means that the printed text page is wider than it is tall.

Language element

Each basic element in one of the IEC programming languages, e.g. a step in SFC, a function block instance in FBD or the initial value for a variable.

Library Collection of software objects that can be reused when programming new projects or even to create new libraries. Examples are the libraries for the elementary function block types.
EFB libraries can be divided into groups.

Literals Literals are used to directly provide values for FFB inputs, transition conditions, etc. These values cannot be overwritten by the program logic (write protected). A differentiation is made between generic and typed literals.
Additionally, literals are used to assign a value to a constant or an initial value to a variable.
The entry is made as Base 2 Literal, Base 8 Literal, Base 16 Literal, Integer Literal, Real Literal or Real Literal with Exponent.

Local DFBs Local DFBs are only available in a single Concept project and are stored in the DFB directory under the project directory.

Local Link The local network link is the network which connects the local nodes with other nodes either directly or through a bus amplifier.

Local Macros Local macros are only available in a single Concept project and are stored in the DFB directory under the project directory.

Local network nodes A local node is the one being planned.

Locally derived data types Locally derived data types are only available in a single Concept project and its local DFBs and are stored in the DFB directory under the project directory.

Located Variable Located variables are assigned a signal memory address (reference addresses 0x, 1x, 3x,4x). The value for these variables is stored in signal memory and can be changed online with the reference data editor. These variables can be accessed using their symbolic names or their reference address.

All inputs and outputs on the PLC are connected to signal memory. Access by the program of peripherals signals connected to the PLC only takes place using located variables. external access via Modbus or Modbus Plus interfaces on the PLC e.g. from visualization systems are also possible using located variables.

M

Macro

Macros are created using the software Concept DFB.
Macros are used to duplicate often used sections and networks (including logic, variables and variable declaration).
A differentiation is made between local and global macros.
Macros have the following properties:
- Macros can only be created in programming languages FBD and LD
- Macros only contain one section
- Macros can contain a section of any complexity
- For programming, there is no difference between instanced macro, i.e. a macro inserted in a section and a conventional section.
- Calling DFBs in a macro
- Declaration of variables
- Using custom macro data structures
- Automatic acceptance of variables declared in the macro
- Initial values for variables
- Multiple instancing for a macro in the entire program with different variables
- The section name, the variable names and the data structure name can contain up to 10 different exchange marking (@0 to @9).

MMI

Man-Machine Interface

Multielement Variables

Variables assigned to a derived data type defined with STRUCT or ARRAY.
A differentiation is made between array variables and structure variables.

N

Network

A network is the connection of devices on a common data path which communicate with each other using a common protocol.

Network nodes

A node is a device with an address (1...64) on the Modbus Plus network.

Node address

The node address is used as a unique code for a network node in the routing path. The address is set directly on the node, e.g. with a rotary switch on the back of the module.

O

Operand	An operand is a literal, a variable, a function call or an expression.
Operator	An operator is a symbol for a mathematics or boolean operation to be executed.
Output parameter (output)	A parameter that returns the results(s) of a FFB evaluation.
Output/register bits (0x references)	An output/register bit can be used to control real output data through a control system output unit, or to define one or more discrete outputs in signal memory. Note: The x after the first number of the reference type represents a five digit memory location in application data memory, e.g. reference 000201 stands for an output or register bit at address 201 in signal memory.
Output/register word (4x references)	An output/register word can be used to save numerical data (binary or decimal) in signal memory or also to send the data from the CPU to a output unit in the control system. Note: The x after the first number of the reference type represents a five digit memory location in application data memory, e.g. reference 400201 stands for a 16 bit output/register word at address 201 in signal memory.

P

Peer Processor	The peer processor processes token passes and the data flow between the Modbus Plus network and the PLC application logic.
PLC	Programmable Logic Controller
Portrait format	Portrait format means that the printed text page is taller than it is wide.
Program	The highest program organization unit. A program is completely loaded on a single PLC.
Program cycle	A program cycle consists of reading inputs, processing program logic and setting outputs.
Program organization unit	A function, a function block, or a program. This term can refer to either a type or an instance.

Programming device Hardware and software that supports programming, project creation, testing, commissioning and error search in PLC applications as well as in decentralized system applications to allow source documentation and archiving. The programming device can sometimes also be used for process visualization.

Project General name of the highest level of a software tree structure which determines the upper level project names for a PLC application. After determining the project name, you can save your system configuration and your control program under this name. All data that is produced when creating the configuration and the program belong to this higher level project for this special automation task.
General term for the complete set of programming and project creation information in the project database which represents the source code describing the automation of a system.

Project database The database in the programming device which contains the project creation information for a project.

Prototype File (Concept EFB) The prototype file contains all prototypes for the assigned functions. A type definition for internals is then made, if available

R

REAL REAL stands for data type floating point number. The input tales place as Real Literal or Real Literal with Exponent. The length of the data element is 32 bits. The value range for variables of this data type is from 8.43E-37 to 3.36E+38.

Real Literals Real literals are used to enter floating point values in the decimal system. Real literals are represented by entering the decimal point. The values can have a preceding sign (+/-). Individual underlines (_) between numbers are not significant.

Example
-12.0, 0.0, +0.456, 3.14159_26

Real Literals with Exponent

Real literals with exponent are used to enter floating point values in the decimal system. Real literals with exponent are represented by entering the decimal point. The exponent defines the power of ten which is to be multiplied by the original number to get the value to be represented. The values can have a preceding sign (+/-). Individual underlines (_) between numbers are not significant.

Example
-1.34E-12 or -1.34e-12
1.0E+6 or 1.0e+6
1.234E6 or 1.234e6

Redundancy system programming (Hot Standby)

A redundancy system consists of two identically configured PLC devices which communicate via redundancy processors. If the primary PLC drops out, the secondary PLC takes control. Under normal conditions, the secondary PLC does not handle control function, instead checks the status information to recognize errors.

Reference

Each direct address is a reference beginning with a code that shows if this is an input or an output and if this is a bit or a word. References beginning with code 6 represent registers in extended signal memory.
0x area = output/register bits
1x area = input bits
3x area = input words
4x area = output/register words
6x area = register in extended memory

> **Note:** The x after the first number of each reference type represents a five digit memory location in application data memory, e.g. reference 400201 stands for a 16 bit output/register word at address 201 in signal memory.

Register in extended memory (6x reference)

6x references are register words in extended memory on the PLC. They can only be used by LL984 application programs and only when using a CPU 213 04 or CPU 424 02.

RIO (Remote I/O)

Remote I/O defines the physical location of the I/O point control device in reference to the controlling processor. Remote I/O points are linked with the control device using a communication cable.

RTU Mode

Remote Terminal Unit
RTU mode is used for communication between the PLC and an IBM compatible PC. RTU works with 8 data bits.

Runtime error Errors that occur while processing the program on the PLC, for SFC objects (e.g. steps) or FFBs. They are e.g. when the value range is exceeded for counters or timing errors for steps.

S

SA85 modules The SA85 module is a Modbus Plus Adapter for IBM AT or compatible computers.

Section A section can be used for example to describe the function of a technological unit such as a motor.
A program or DFB consists of one or more sections. Sections can only be programmed with IEC languages FBD and SFC. Only one of these programming languages can be used within a section.
Each section has its own document window in Concept. However to make things clearer, it is advisable to divide large sections into several smaller sections. The scroll bar is used to scroll through the section.

Separator Format (4:00001) The first digit (the reference) is separated by a colon (:) from the following five digit address.

Sequential Function Chart (SFC) The SFC language elements allow the PLC program organization unit to be subdivided into a number of steps and transitions, which are connected with each other using directional connections. A number of actions belong to each step, and each transition is connected to a transition condition.

Serial connections With serial connections (COM), information is transferred bit-wise.

Signal memory The signal memory is the memory location for all sizes accessed via references (direct representation) in the application program. For example, input bits, output/register bits, input words, and output/register words in signal memory.

Source code file (Concept EFB) The source code file is a standard C++ source file. After executing the menu command Create **Library** → **Files**, this file contains an EFB code frame where you have to enter a specific code for the selected EFB entries. To do this, call the menu command **Objects** → **Source**.

Standard Format (400001) The five digit address is directly after the first number (the reference).

Status bits
Each node with global input or specific input/output of peer cop data has a status bit. If a defined group of data is successfully transferred within the set timeout, the respective status bit is set to 1. Otherwise this bit is set to 0 and all data for this group is deleted (set to 0).

Step
SFC language element: Situations in which the behavior of a program (with regard to inputs and outputs) follows the operations used to define the corresponding step actions.

Step name
The step name is used to clearly identify a step in a program organization unit. The step name is automatically created, but can be edited. The step name must be unique throughout the entire program organization unit, otherwise an error message is given.
The automatically created step name always has the structure: S_n_m

S = Step
n = Number of the section (consecutive numbers)
m = Number of the step in the section (consecutive numbers)

Structured Text (ST)
ST is a text language based on IEC 1131 in which operations such as function block and function calls, conditional execution of instructions, repeating instructions etc. are represented by instructions.

Structured Variables
Variables assigned to a derived data type defined with STRUCT (structure).
A structure is a collection of data elements also in general, different data types (elementary data types and/or derived data types).

SY/MAX
In Quantum control devices, Concept also provides I/O connections on SY/MAX I/O modules for RIO control using the Quantum PLC. The SY/MAX remote module rack has a remoter I/O adapter in slot 1, which communicates via a Modicon S908 R I/O system. The SY/MAX I/O modules are listed for you to mark and include in the I/O connections for the Concept configuration.

Symbol (Icon)
Graphic representation of various objects in Windows, e.g. drives, user programs and document window.

T

Template File (Concept EFB)
The template file is an ASCII file with layout information for the Concept FBD Editor, and the parameters to create the code.

TIME TIME stands for data type time duration. Entry takes place as Time Literal. The length of the data element is 32 bits. The value range for variables of this data type is from 0 to 2exp(32)-1. The unit for the data type TIME is 1 msec.

Time Literals Valid units for time (TIME) are days (D), hours (H), minutes (M), seconds (S) and milliseconds (MS) or combinations of them. The time must be represented with the prefix t#, T#, time# or TIME#. "Overshooting" the most significant unit is allowed; e.g. the entry T#25H15M is allowed.

Example
t#14MS, T#14.7S, time#18M, TIME#19.9H, t#20.4D, T#25H15M, time#5D14H12M18S3.5MS

Token The network "Token" controls the temporary transfer rights for an individual node. The token is passed through the nodes in circular (increasing) address order. All nodes follow the token pass and can receive all data that is sent.

Traffic Cop The Traffic Cop is a connection list generated from the user connection list. The traffic cop is managed in the PLC and contains information in addition to the user connection list e.g. status information about I/O stations and modules.

Transition The condition in which the controller goes from one or more process steps to one or more following steps along a defined connection.

Typed Literals If your want to define the data type for a literal yourself, you can do it with the following construction: ’Data type name’#’value of the literal’.

Example
INT#15 (data type: Integer, value: 15),
BYTE#00001111 (data type: Byte, value: 00001111)
REAL#23 (data type: Real, value: 23)

When assignment with data type REAL, it is also possible to enter the value as follows: 23.0.
Entering a decimal point automatically selects data type REAL.

U

UDEFB User Defined Elementary Functions/Function Blocks (EFB)
Functions or function blocks created in C programming language and available to Concept in libraries.

UDINT

DINT stands for data type unsigned double integer. The entry is made as Integer Literal, Base 2 Literal, Base 8 Literal or Base 16 Literal. The length of the data element is 32 bits. The value range for variables of this data type is from 0 to 2exp(32)-1.

UINT

DINT stands for data type unsigned integer. The entry is made as Integer Literal, Base 2 Literal, Base 8 Literal or Base 16 Literal. The length of the data element is 16 bits. The value range for variables of this data type is from 0 to (2exp 16)-1.

Unlocated Variable

Unlocated variables are not assigned signal memory addresses. Therefore they do not use a signal memory address. The value for these variables is stored internally in the system and can be changed with the reference data editor. These variables are only accessed with their symbolic names.

Signals that do not require access of peripherals, e.g. intermediate results, system registers etc. should be preferably declared as unlocated variables.

V

Variables

Variables are used to exchange data within a section, between several sections and between the program and the PLC.
Variables consist of at least one variable name and a data type.
If a variable is assigned a direct address (reference), this is a located variable. If a variable is not assigned a direct address, this is an unlocated variable. If the variable is assigned a derived data type, this is a multielement variable.
There are also constants and literals.

W

Warning

If a critical status is recognized when processing a FFB or a step (e.g. critical input values or a time limit exceeded), a warning is given which you can view with the menu command **Online** → **Event viewer ...** For FFBs, the ENO output remains "1".

WORD

WORD stands for data type bit sequence 16. The entry is made as Base 2 Literal, Base 8 Literal or Base 16 Literal. The length of the data element is 16 bits. A numerical value range cannot be assigned to this data type.

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