# Training document for the company-wide automation solution Totally Integrated Automation (T I A)

### MODULE B1

### Error diagnostics / error handling

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Information



Programming

Notes



### 1. FORWARD



The Module B1 is assigned content wise to the Additional functions of STEP 7- Programming.

#### Learning goal:

In this module, the reader will learn about the procedure of error diagnostics. The following module contains:

- Diagnostic functions in STEP 7
- Error types and appropriate Organization Blocks
- Types of Organization Blocks

#### **Requirements:**

For the successful use of this module, the following knowledge is assumed:

- Knowledge in the use of Windows 95/98/2000/ME/NT4.0
- Basics of PLC- Programming with STEP 7 (e.g. Module A3 'Startup' PLC programming with STEP 7)
- Debug- and Online- Functions in STEP 7 (e.g. Module A7 Debug- and Online- Functions)

|--|

#### Required hardware and software

- 1 PC, Operating system Windows 95/98/2000/ME/NT4.0 with
  - Minimal: 133MHz and 64MB RAM, approx. 65 MB free hard disk space
  - Optimal: 500MHz and 128MB RAM, approx. 65 MB free hard disk space
- 2 Software STEP 7 V 5.x
- 3 MPI- Interface for the PC (e.g. PC- Adapter)
- 4 PLC SIMATIC S7-300

Example configuration:

- Power supply: PS 307 2A
- CPU: CPU 314
- Digital inputs: DI 16x DC24V
- Digital outputs: DO 16x DC24V / 0.5 A



Forward	Diagnostics	Error types

### 2 DIAGNOSTICS

You can test the following diagnostic functions presented e.g. with the STEP 7 project 'Startup' from Module A3 – 'Startup' PLC- Programming with STEP 7.

#### 2.1. THE HARDWARE DIAGNOSTICS



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With the help of **Hardware Diagnostics** in SIMATIC Manager, you quickly obtain an overview of the structure and system state of the automation system.

1. This call takes place after the blocks from the project were already loaded into the CPU. In **SIMATIC Manager** choose the folder **Blocks**. ( $\rightarrow$  Blocks)

SIMATIC Manager - star	tup				
	Uptions Window Help	) 💽 📰 🛲 🖬 👘	< No Filter \	<b>▼</b> 7/₩@	
Startun C:\Siemens\S	ten7\S7nroi\STABTU	) <u></u> ::::: [===]	(NOTIRCI )		
	🕞 081	🕞 FC1	I VAT1		
E- ST Program(1) B Sources					
Blocks					
Press F1 to get Help.					li.

Forward	Diagnostics	Error types



2. Now the application can be called over the menu **PLC** , **Hardware Diagnostics** ( $\rightarrow$  PLC  $\rightarrow$  Hardware Diagnostics).

iager	- startı	q			
PLC	<u>V</u> iew	<u>O</u> ptions	<u>W</u> indow	<u>H</u> elp	
Ac	cess <u>Rig</u>	ghts			•
Do Up Up Cop Do	wnload Ioad Ioad Sta by RA <u>M</u> wnload	atio <u>n</u> to ROM user progr	am to mem	ory card	Ctrl+L
Sa Re	v <u>e</u> Proje trieve <u>P</u>	ct on Mer roject from	nory Card Memory C	ard	
Ma	nage M	<u>7</u> System.			
Dis	play <u>A</u> c	cessible N	odes		
CP Dis Mo	U Me <u>s</u> s play <u>F</u> or nitor/Mo	ages :ce Values odify⊻aria	: bles		
Pre	pgre Lir	ne Diagno	stics		
<u>H</u> a	rdware l	Diagnostic	s		
Mo <u>O</u> p Cle Sel	dule <u>I</u> nfi erating I ar/Rese : <u>T</u> ime o	ormation Mode et f Day			Ctrl+D Ctrl+l
Ass Ass <u>D</u> ar Up	sign <u>E</u> th sign PRI sign P <u>G</u> i ncel PGi date Op	ernet Addi DFI <u>B</u> US A /PC /PC assig verating S <u>y</u>	ress ddress nment istem		

3. After the call of hardware diagnostics, a **Quick View** appears. The quick view shows the CPU and distributed modules. The picture here shows the module information of the CPU (RUN) and the error module SM- digital.

Over the command button **Module Information**, you reach the dialog **Module Information** of the module that is highlighted in blue. It appears for the digital module e.g. as the following. ( $\rightarrow$  Module Information)

Hardware Diagnostics -	Quick View	,			×
Path: startup\S7-Pro	gramm(1)				
CPU/Eaulty Modules					
Module	Addr.	DP	R	S	Module Information
🐰 CPU	-	-	0	2	
🔀 SM digital	ΕO	-	0	4	
					Upen Station UNLINE
					Undate
1					
When diagnosing <u>h</u> ard	lware, display	Quick View			
Close					Help

Forward	Diagnostics	Error types



4. The index card **General** shows the operation mode and the status of the digital module. The order number, rack- and slot number as well as the address of the module are shown in the middle area of the window.

In the area **Status**, the module announces the emerged error. In this case there exists a **Preset/Actual mismatch** of the module. You can find help for an error occurrence under the command button **Help**. The operation mode is then closed with the button **Close** ( $\rightarrow$  Close).

📆 Module Informat	🖞 Module Information - Digital input ONLINE							
Path: startup\S7-Pr Status: ∳ Preset/Act General	ogramm(1) tual mismatch	Operating mode of the CP Operating mode of the mo	PU: 🔶 RUN adule:					
Description:	Digital input	System Identification: SI	MATIC 300					
<u>V</u> ersion:	Order No. / Description	Component	Version					
Rack:	0	Address: I 0	)					
Slot	4	Module width: 1						
<u>S</u> tatus:	Module available and o.k. Preset/Actual mismatch: (inserted and configured mod - Expected type: Digital in - Current type: Digital m	lule types are not the same) put (Order No. = ???) odule (Order No. = ???)	4					
Close	Update Print		Help					



**Note:** Repair this error through an exchange of the module in the hardware configuration and download the new configuration into the CPU.

Forward	Diagnostics	Error types



5. Then likewise should one open the operation mode of the CPU with the command button **Operation Mode** ( $\rightarrow$  Operation Mode).

H	ardware Diagnostics -	Quick View				×
	Path: startup\S7-Pro	gramm(1)				
	CPU/ <u>F</u> aulty Modules					
	Module	Addr.	DP	R	S	Module Information
	🐰 CPU	-	-	0	2	
	🚺 SM digital	E 0		0	4	
	✓ When diagnosing hard	ware, display	Quick View			Open <u>S</u> tation ONLINE Update
	Close					Help

6. The operation state of the operation mode is divided into eight different index cards. At this location, only the index card **Diagnostic Buffer** should be regarded. The card shows the running event number with the date and time of day in the field **Events**. In the column **Event**, one finds a short description to the event. The change of state of the CPU is announced such as the occurred error. The third event acclaims **Parameter error**. The exact error definition follows in the lower window area through an **Event ID** and a description of the error type.

By means of this diagnostic buffer in the CPU, it is possible to detect and remove the error sources ( $\rightarrow$  Diagnostic Buffer)

Module Information - CPU 314C-2 PtP ONLINE							
<u>P</u> ath: Status:	startup\S7-Progra OK	ımm(1)		Operating mode of the Not a force job	e CPU:	🚯 RUN	
	Time System	Performan	ce Data	Communica	tion	Stacks	
	General	Diagnostic Bu	íffer	Memory	S	ican Cycle Time	
<u>E</u> ve	Events: Elter settings active						
No	o. Time of day	Date	Event			▲	
1	09:50:08:296 a	am 10/07/02	Mode tran	nsition from STARTUP	to RUN		
2	09:50:08:295 a	am 10/07/02	Request f	or manual warm restart			
3	09:43:02:546 a	am 10/07/02	Parameter	enor			
4	U9:43:02:546 a	am 10/07/02	Mode tran	sition from STUP to ST	ARTUP		
0	09:42:27:267 8	am 10/07/02	Parameter	renor			
7	03:42:27:200 (	am 10/07/02	Mode tran	or manual warm restart wition from STOP to ST			
8	09:40:52:696 /	am 10/07/02 am 10/07/02	STOP car	used hu ston switch hei	ing activa	ted 🔳	
<u>D</u> eta	ails on Event: 3	of 10		Eve	ent ID:	16# 5961	
Pau Our Pau En Op Ex	Parameter Error by the CPU module parameters Output address: 0 of the module with Parameter Error Parameter assignment: Module type identifier Error type: Parameter slot not assigned Operation Mode: STOP External error, following event						
	Save As Settings Open Block Help on Event						
C	Close Update Print Help						

Forward

Diagnostics

#### 2.2 DIAGNOSTIC MESSAGES

With the help of the diagnostic messages, there is a possibility to directly give out error messages by sporadic errors in the equipment. The messages let themselves be displayed on a program device or on a Modify-and Monitor device e.g. an operator or touch panel. As soon as the CPU goes through an error in Stop, a message window in the PG or OP appears.



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In order to display the diagnostic messages, proceed as follows:

1. Change into SIMATIC Manager and choose the folder S7 Program(1). ( $\rightarrow$  S7-Program(1))



Forward	Diagnostics	Error types	





Open **CPU Messages** in the menu **PLC** ( $\rightarrow$  PLC  $\rightarrow$  CPU Messages)



3. Then all announced CPUs and S7-Programs will be displayed. Activate the control box W and A. (  $\to W \to A$  )



## 1

#### Meaning of the abbreviation W:

• Click on this field, in order to activate the message from system diagnostics, respectively user diagnostic messages. A further click deactivates the message.

#### Meaning of the abbreviation A:

 Click on this field, in order to activate the message from operation and alarm messages (ALARM\_S/SQ). A further click deactivates the messages. The application 'CPU Messages' checks if the respected module supports any ALARM\_S, respectively the ALARM\_SQ. When this is not the case, a message will be given out..



**Note:** After each memory reset, the message display must be again activated!

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Choose **Customize** for the archive ( $\rightarrow$  Options  $\rightarrow$  Customize).

🚰 CPU Messages
Eile Edit PLC View Options Help
W A Module
V startup\S7 Program(1)

5. Set the 'Size' of the 'Archive' or choose 'Empty Archive' ( $\rightarrow$  Size  $\rightarrow$  Empty Archive  $\rightarrow$  OK).

Settings - CPU Messages	×
Archive <u>S</u> ize: <u>300</u>	Empty Archive
Modules Save List of the <u>m</u> odules logged on on exit <u>R</u> estore connection status when starting	
Display info text of message	
<u>ОК</u>	Cancel Help

6. All arriving messages are now displayed.

🚰 CPU Messa	nes			
<u>File Edit PLC</u>		p		
S. 🖬 🎵	🗗 🎦 🖉 🕅	<u>{?</u>		
W A Modu	Jle			
🔽 🔽 startu	p\S7-Programm(1)			
Event ID: PG date: Program: STOP through P Present Operation Requested Operation	16# 4304 10/7/02 Startup/SIMAT. G Stop-operation or be in Mode: RUN stion Mode: STOP	PG time: 12:39:00:668 IC300(1)CPU315-2DP(S7Program(1) cause of SFB20 "STOP"		
Event ID: PG date: Program STOP through p Cause OB 1 Prin FC number 5	16# 4562 10/7/02 Startup\SIMAT. rogram error (OB not d prity class 1	PG time: 12:39:40:712 IC300(1)CPU315-2DP(S7Program(1) ownloaded or possibly no FRB available )		
Block address 2 Present Operatio Requested Opera	e n Mode: RUN ation Mode: STOP			
Ready			Message 1 of 6 preselected	NUM /

Forw	ard Diag	nostics	rror types

#### 3 ERROR TYPES

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There are error organization blocks in the SIMATIC S7-300 CPUs that are called when an error appears. Then this block is not available in the CPU, so it goes into STOP This call will also be displayed in the diagnostic buffer of the CPU: The error is divided into two error categories:

#### Synchronous error

A synchronous error is generated from the operating system of the CPU when an error appears in immediate relation with the program processing. Synchronous errors are divided into programming errors and access errors. If a synchronous error appears, the operating system calls the appropriate error organization block.

#### Asynchronous error

Asynchronous errors are errors that can appear independent from program processing. If a asynchronous error appears, the operating system calls an error organization block.

#### 3.1 SYNCHRONOUS ERRORS

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Synchronous errors are directly determined by the processing of a command. For example, if a function call FC10 is programmed and this block is not available, then a synchronous error appears and the automation system goes into the stop mode and the red SF LED (system error) lights.

An error OB is an organization block that decides the behavior of the CPU in an error instance. By a programming error, the organization block **OB121** is called and by an access error, the organization block **OB122** is called. If no organization block is available in the CPU, the stop mode is reached in the error instance.

For	ward Diagnostics	Error types

#### 3.1.1 **EXAMPLE FOR A PROGRAMMING ERROR**



LAD/STL/FBD - [FC5 startup\\$7-Programm(1)]				_ 🗆 ×
File Edit Insert PLC Debug View Options Window Hell	P			_ <u>_</u> ×
0	?			
				<b>_</b>
FC5 : Program error				
Comment:				
Network 1: Title:				
Comment:				
MOVE				
EN OUT -DB10.DBW0				
MU20 TH FNO				
H020 IN END				
Les loaded.	•	offline	Abe	Nix 1

In the function 5, the memory bit word 20, is saved in the Data Block 10, starting from word 0. The Data Block 10 is not available in the CPU. Since no error OB is programmed, the CPU will skip the call of the FC5 in stop mode.

### Exercise to this programming error:

1. Program the error in FBD in the FC5

🔣 LAD/STL/FBD - [FC5 startup\S7-Programm(1)]					_	П×
⊡ Eile Edit Insert PLC Debug View Options Window	<u>H</u> elp				-	٥×
	⊡ - <b>№</b>					
FC5 : Program error						
Comment:						
Network 1: Title:						
Comment:						
MOVE EN OUT DB10.DBW0 MW20 IN ENO						
						¥
						•
Block loaded.		9	offline	Abs	Nw 1	1

2. Program the block call in STL in OB1.

#### Call FC 5

Dowpload the blocks in the CPU 3. Diagnostics Error types

4.



#### Read out of the diagnostic buffer

The diagnostic buffer shows by event number 1 under the column **Event** the message **Stop through program error (OB not downloaded or ...)**.

The event number 2 reports Data block not downloaded.

In the window **Details on event**, the cause of the message, OB1 and FC5 can be read in this instance. The announcement is made in the window by one mouse click on the event. The command button **Open Block** opens the block online. The cursor jumps to the area where the error appeared.

📆 Mod	ule Informat	tion - CPL	I 314C-2 Pt	P ONLIN	1E		
<u>P</u> ath: Status:	startup\SIMA OK	ATIC 300(1)	\CPU 314C-2	PtP\S	Operating mode of th Not a force job	e CPU:	🐨 STOP
	Time System	1	Performance	ce Data	Communica	ation	Stacks
	General	C	)iagnostic Bul	ífer	Memory	ៃ ទ	Scan Cycle Time
					· ·		· · ·
<u>E</u> ver	nts:		E E	iter setting	s active		
No.	. Time of da	ay	Date	Event			▲
1	09:50:08:	297 am	10/07/02	Stop thr	ough program error(OI	3 not dow	vnloaded or) 📃
2	09:50:08:	296 am	10/07/02	DB not o	lowloaded		
3	09:50:08:	295 am	10/07/02	Mode tra	nsition from STARTUP	to RUN	
4	09:50:07:	961 am	10/07/02	Request	for manual warm restar	t	
5	09:43:02:	546 am	10/07/02	STOP ca	aused by stop switch be	eing activ	ated
6	09:42:27:	267 am	10/07/02	Mode tra	nsition from STARTUP	to RUN	
7	09:42:27:	266 am	10/07/02	Request	for manual warm restar	t	
8	09:42:26:	941 am	10/07/02	Mode tra	nsition from STOP to S	TARTUP	<u> </u>
<u>D</u> eta	ils on Event:	1 of 100	)		Ev	ent ID:	16# 4562
Stop	o through prog	ram error((	)B not downlo	ad or poss	ibly no FRB available		
Cau	se OB l Prio	rity class	1				
FC 1	number 5						
Bloo	:k address 2						
Pres	ent Operation	ı Mode: RU	N 				
Requ	iested Operatio	on Mode: S	ТОР				
	Save <u>A</u> s	<u>s</u>	ettings	Opt	en <u>B</u> lock		Help <u>o</u> n Event
Cl	ose	<u>U</u> pdate	<u>P</u> rir	it			Help

5. The command button Help on Event gives tips to debugging.

🔗 Help on Events	_ 🗆 ×
Datei Bearbeiten Lesezeichen Optionen ?	
Inhalt Index Zuriick Drucken	
Help on Event 4x 62	
Causes:	<b>_</b>
This program error occurs when the associated OB (OB121) or FRB is not yet downloaded or activated.	
To correct or avoid errors:	
Download an OB121 or activate a FRB in order to execute the program error, or avoid these occurences.	
FRB= Function Request Block, in terms of M7	
	•



The error can be removed through the programming of an error OB121 or through the downloading of Data Block 10. The error OB121 does not remove the reason

Forward	Diagnostics	Error types

Note:

#### 3.1.2 **PROGRAMMING OF THE ERROR OB 121**



1. The organization block is inserted in the block container over the menu S7 Block, Organization Block. (Insert S7-Block Organization Block)



In the dialog box Properties Organization Block give the block the name 'OB 121' and the 2. created in language FBD(OB121 FBD OK).

Properties - Organization	Block		×
General - Part 1 General	Part 2 Calls Attributes		
<u>N</u> ame:	OB121		
Symbolic Name:			
Symbol <u>C</u> omment:			
Created in <u>L</u> anguage:	FBD		
Project path:			
Storage location of project:	C:\Siemens\Step7\S7proj\START		
<b>D</b>	Code	Interface	
Date created: Last modified:	18/09/2002 12:56:29	18/09/2002 12:56:29	
C <u>o</u> mment:		×	
		Y	
ОК		Cancel	Help

Forward	Diagnostics	Error types	
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3. When you download the OB 121 into the automation system and carry out a new start, the CPU will no longer be ignored in the stop mode. The system error is displayed over the SF LED and in the CPU and in the **Diagnostic Buffer**, a new error is displayed.

🕅 Module Information - CPU 314C-2 PtP ONLINE									
<u>P</u> ath: Status:	st OK	artup\SIMATIC 3 (	300(1)\CPU 314	C-2 PtP\S	Operating n Not a force	node of the job	e CPU:	🔶 RUN	
	Tim	ne System	Perform	ance Data	_ ) c	ommunica	tion	) St	acks
	Ge	neral	Diagnostic I	Buffer	Mem	ory	-	Scan Cycle i	Time
<u>E</u> ve	ents:		Г	<u>Filter</u> settin	gs active				
N	o. 🛛	Time of day	Date	Event					
1		12:20:37:506 p	m 10/07/02	2 Length	of area error	by writing	3		
2		12:20:37:505 p	m 10/07/02	2 DB not	downloaded				
3		12:20:37:497p	m 10/07/02	2 Length	of area error	by writing	3		
4		12:20:37:496p	m 10/0//02	2 DB not	downloaded				
5		12:20:37:378p	m 10/07/02	2 Length	of area error	by writing	3		
6		12:20:37:377p	m 10/07/02	2 DBnot	downloaded				
6		12:20:37:221p	m 10/07/02	2 Lengin 2 DB pot	downloaded	by whith <u>y</u>	3		
		12.20.37.220p	111 10/07/02		uowinoaueu		-		
<u>D</u> et	ails	on Event: 1 d	of 10			Eve	ent ID:	16#2523	
Le	engt	h of area error	by writing						
- GI	oba	I DB word acc	ess Accessa	address (	)				
OB number: 121									
Priority class: 1									
Internal error, following event									
	Sa	ve <u>A</u> s	<u>S</u> ettings	0	pen <u>B</u> lock			Help <u>o</u> n	Event
	Close	e <u>U</u> pd	late <u>F</u>	Print					Help

The error message says **Length of area error by writing**, the cause is a Global Data Block and **Data block not downloaded**, the cause is the **DB10**.

#### Repairing the program errors:

- 1. Apply the Data Block 10
- 2. Transfer the data block
- 3. Carry out a new start
- 4. Control the result

#### **Result:**

The SF-LED on the CPU goes out, the error is removed.

	Forwar	d Diagnostics	Error types	
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### 3.1.3 ACCESS ERROR



An access error is activated through direct access onto a defective or unavailable module.

The operating system call the OB 122 by an access error. If it is not available, the CPU goes into stop mode.

#### 3.2 ASYNCHRONOUS ERRORS

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Asynchronous errors assign themselves to no particular program actuator. This means that they appear asynchronous to the program processing.

Error type	Example	Error OB
Time error	Exceeding of the max cycle time	OB 80
Power supply error	Failure of the buffer battery	OB 81
Diagnostic interrupt	Wire break at the input of a supporting diagnostic module	OB 82
Insert/Remove Module interrupt	Insertion/Removal of a module	OB 83
CPU- Hardware fault	Error by the interface to the MPI- Network, to the internal communications bus (C-Bus) or to the interface for the distributed I/O	OB 84
Priority class error	Start request for a non downloaded OB, module defect	OB 85
Rack failure (only S7-400)	Failure of the module mounting by the S7-400	OB 86
Communication error	False cable recognition	OB 87

Error types