CL350/CL400/CL500, CL550/PCL, ICL700

KETTExxx, DIAGxxx
Sequence controls with diagnosis
Software module description

Version 101

CL350/CL400/CL500
CL550/PCL
ICL700

KETTE, DIAGMMI
KETTEPCL, DIAGPCL
KETTE700, DIAG700
Sequence controls with diagnosis
Software module description

1070 072 303-101 (01.06) GB

1. Safety instructions

Read this manual before you put the program modules “KETTExxx” and “DIAGxxx” into operation. Keep the manual in a location that is accessible to all users at all times.

1.1 Use in accordance with intended purpose

This manual contains information on the use in accordance with intended purpose of the products described.

The products described

- have been developed, manufactured, tested and documented in compliance with the safety standards. If the handling regulations and technical safety instructions regarding project engineering, assembly and operation in accordance with the intended purpose are observed, the product will not normally present any hazard to persons or property.
- meet the requirements
  - of the EMC Directives (89/336/EWG, 93/68/EEC and 93/44/EEC)
  - the Low Voltage Directive (73/23/EEC)
  - the harmonized standards EN 50081-2 and EN 50082-2
- are intended for operation in industrial environments (Emission Class A), i.e.
  - no direct connection to the public low voltage power supply,-
  - connection via transformer to the medium-voltage or high-voltage mains supply.

  For deployment in residential areas, in office and commercial areas as well as in small enterprises, the following applies:
  - Installation of the system in a switch cabinet or a housing with high transmission loss shielding.
  - leads exiting from the shielded must be fitted with filtering or shielding.
  - You require specific permission of the national authorities or testing body; in Germany, this is the Federal Bureau of Post and Telecommunications and local bureaus.

⇒ **This is a Class A unit. This unit can cause radio interference in residential areas; in this case, operators can be forced to implement appropriate measures at their own expense.**

The perfect and safe operation of the products assumes proper transport, storage, setup and installation as well as care exercised in operating the unit.

1.2 Qualified personnel

The requirements as regards qualified personnel are based on the profiles of requirements described by ZVEI and VDMA, see:

Training in automation technology
Editors: ZVEI and VDMA
MaschinenbauVerlag
Postfach 71 08 64
60498 Frankfurt

This manual is intended for PLC technicians. They require special knowledge of the CL350/CL400/CL500, CL550, PCL or ICL700.

Interventions in the hardware and software of our products not described in this manual may only be performed by trained Bosch personnel.

In the event of unqualified interventions in the hardware and software or non-observance of the warnings in this manual or on the product, severe personal injury or damage to property can occur.

Only skilled electricians in accordance with IEV 826-09-01 (modified) who are aware of the contents of this manual may install and service the products described.

These are persons who

- due to their training and skills, knowledge and experience as well as their knowledge of the applicable standards, can assess the tasks to be performed and recognize possible hazards;
- due to a number of years of experience in similar fields have the same degree of expertise as they would obtain in an official course of training.

In this respect, refer to our comprehensive range of training courses. Information is available from our training centre,
telephone: (+49) (0 60 62) 78-258.

1.3 Safety signs on the products

Warning! Dangerous electrical voltage!

Warning regarding battery hazards!

Electrostatically endangered components!

Remove the mains plug before opening!

Protective earth PE

Function ground, low interfering voltage ground

General earth

1.4 Safety instructions in is manual

DANGEROUS ELECTRICAL VOLTAGE
This symbol warns against **dangerous electrical voltage.** Imprecise observance or non-observance of this instruction can lead to **personal injury.**

DANGER
This symbol is used when imprecise observance or non-observance of instructions can lead to personal injury.

CAUTION
This symbol is used when imprecise observance or non-observance of instructions can lead to damage to devices or files.

⇒ **This symbol is used to draw your attention to special features.**

1.5 Safety instructions for the product described

DANGER
Danger to life due to inadequate EMERGENCY STOP devices! EMERGENCY STOP devices must remain effective and accessible in all operating modes of the system.Unlocking the EMERGENCY STOP device must not lead to a restart of the system! First check the EMERGENCY STOP chain, then switch on!

DANGER
Hazard to persons and property!
Test each new program before you switch on the system!

DANGER
Retrofits or modifications can negatively affect the safety of the products described!

The consequences can be severe personal injury or damage to property and the environment.Possible retrofits or modifications to the system involving equipment from manufacturers other than Bosch must therefore be approved by Bosch.

1.6 Documentation and registered trade marks

Documentation

This manual provides information on the application of program modules for sequence control and diagnosis for the control systems CL350/CL400/CL500, CL550, PCL or ICL700 .

Overview of manuals	Order no.	
	German	English
Control system manuals		
CL400	1070 072 085	1070 072 143
CL500	1070 072 041	1070 072 123
CL550	1070 072 261	1070 072 263
Software manual		
Operations list CL350/CL400/CL500	1070 072 044	1070 072 127
CL550/PCL Programming and operation	1070 072 425	1070 072 189
Sequence language SFC	1070 072 402	1070 072 186
BT-MADAP	1070 072 096	1070 072 163
MMIMADAP, Manual for programmers and project engineers	1070 072 403	1070 072 168
PLC catalog	1070 072 094	1070 072 160

⇒ **In this manual, the floppy disk drive is always drive A: and the hard disk always drive C:.**

Special keys or key combinations are shown in pointed brackets:

- Special keys: e.g. <Enter>, <PgUp>, <Del>
- Key combinations (simultaneous pressing): e.g. <Ctrl> + <PgUp>

Registered trade marks

All registered trade marks of the software installed on supplied Bosch products are the property of the corresponding manufacturers.

On delivery, all installed software is subject to copyright. It may only be copied with the consent of Bosch or in accordance with the license agreement of the relevant manufacturer.

MS-DOS® and Windows™ are registered trade marks of the Microsoft Corp.

2. General

2.1 Sequence control and diagnosis concept

⇒ **The method of sequential-step diagnostics discussed in these pages is best described as the sequential arrangement of individual processing steps to form a coherent processing sequence, i.e., individual steps forming a cascade, or chain (German: "Kette"). As a consequence, the product name (KETTExxx) as well as derivative generic terms, such as "KETTE", "KETTE sequence", or "cascade", will appear throughout this product description.**

The concept is based on the consideration that operating devices for visual processing of diagnostic data are used, enabling rapid display of machine faults in a manner that is easy to interpret. For this reason, the task of step sequence diagnosis as a software solution consists of storing the diagnosed data in a memory area that makes it available to external devices. Operating and display devices and software geared to these devices are used to process and display the data. The transfer memories are data modules in which the processed diagnostic data is stored in coded form. In order to be able to detect program changes automatically, i.e. within a self-learning context, and thus be able to diagnose them, the program parts used for machine control must be bound by a specified formal requirement. Precisely this formal requirement is generated automatically by the programming language SFC.

For the standardised diagnosis displays and machine operation, Bosch provides visualisation devices of various performance classes and the corresponding software solution.

You have the choice as to whether you want to use a simple plain text display or a graphical display with the software package BTMADAP or an industrial PC and the MMIMADAP that is geared to it.

The sequence control and diagnosis concept contains two program modules with central tasks based on one another:

- the control of machines and systems and
- the diagnosis and error analysis

⇒ **The function module KETTExxx for the control of machine and systems can run on its own and does not require the function module DIAGxxx for diagnosis and error analysis. However, DIAGxxx requires the KETTExxx.**
The software packages BTMADAP and MMIMADAP always contain these two modules.

Allocation of program modules / PLC

	CL350/CL400 CL500 (all central units)	CL550 PCL	ICL700
Machine / system control	KETTE	KETTEPCL	KETTE700
Diagnosis / error analysis	DIAGMMI	DIAGPCL	DIAG700

Name conventions

If these program modules are mentioned by name in this document, the following conventions apply for the allocation of the described function to the PLC:

KETTE	only for CL350/CL400 and CL500
KETTEPCL	only for CL550 and PCL
KETTE700	only for ICL700
KETTExxx	for all control systems

DIAGMMI	only	for	CL350/CL400	and	CL500
DIAGPCL	only	for	CL550	and	PCL
DIAG700	only	for	ICL700		
DIAGxxx	for	all	control systems		

3. Module “KETTExxx”

The program module KETTExxx manages and controls the entire sequence structure with

- Operating mode management
- Criteria management for command outputs and step relaying
- Waiting / monitoring periods
- Command outputs
- Sequence branches

One of the most important advantages of this module is that a step is only completed when the action it contains signals a return message, e.g. final position reached. This means that all the conditions for the actions of a step can be monitored at any time and disabled as required.

The function module “KETTExxx” can manage

- 64 step modules, each with
- 128 steps and
- up to 64 criteria per step.

3.1 Program handling

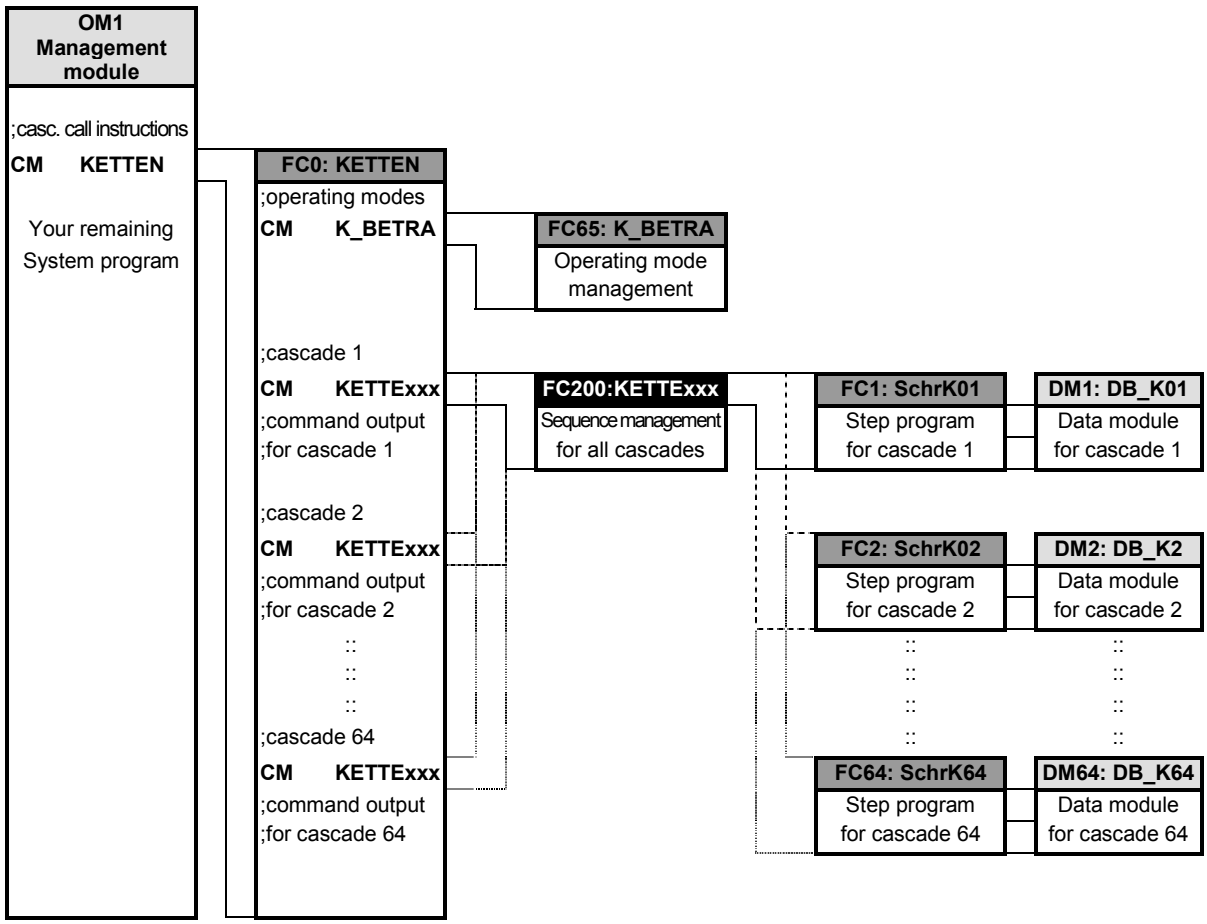
The module FC “KETTExxx” is started once from a program module for each sequence and it then operates the allocated cascade. The operating modes, whose dependencies you have to program system by system, are passed directly to the corresponding parameters of the FC “KETTExxx”.

In order to be able to form functional cascade groups, it is possible to leave gaps when setting up the cascade DMs. That is, the cascades opened in OM1 are skipped and the processing continues with the next.

If step modules are to be excluded from processing, the corresponding cascade module is to be declared in the call instruction as a comment.

3.1.1 Program structure

The program structure that appears below is generated automatically by the WinSPS/SFC (sequence language) and therefore also makes sense for programs that you create with other programming languages.



3.2 Module call instruction

The module call instruction has the following appearance:

```
CM      -KETTExxx,4
;
;                  +--------------------+
P0  W   -FC/DM  ; | WORD    VAR_INPUT  | cascade number
P1  W   -BETR   ; | WORD    VAR_INPUT  | operating mode word
P2  W   -KUE    ; | WORD    VAR_INPUT  | monitoring period
P3  W   -KWA    ; | WORD    VAR_INPUT  | waiting period
;                  +--------------------+
```

3.2.1 Module parameters

⇒ **No flags from the range M230.0 - M255.7 may be used as parameters.**

```
P0   W   -FC/DM      cascade number      (input parameter)
```

The parameter P0 provides the cascade management module “KET-TExxx” with the current cascade number n for the following modules:

- Number of the step module SCHRKn
- Number of the cascade data module DB_Kn

Each processed step cascade n uses the cascade data module DMn for the storage of variable data, e.g. monitoring period and waiting period.

```
P1   W   -BETR       operating mode word (input parameter)
```

This informs the FC “KETTExxx” of the operating mode selection.

```
 P1.0   Manual mode (H)
 P1.1   Inch mode (T)
 P1.2   Automatic mode (A)
 P1.3   Start
 P1.4   S + 1
 P1.5   Set step
 P1.6   Clear halt
 P1.7   Reset
 P1.8   Halt
 P1.9   Synchronise
 P1.10
 P1.11  Generate cascade data module
 P1.12  Step relaying in the same cycle
 P1.13
 P1.14  WSB does not reset BEFA
 P1.15  Clear errors
```

The FC “KETTExxx” writes the operating mode data in the data word D6 (nnBAWAHL) of the corresponding cascade data module.

P2 W KUE monitoring period (input pameter)

The parameter P2 provides the FC "KETTExxx" with the monitoring period value. This is then the same for each step unless it is redefined in the individual steps.

The time basis is always 100ms. Specifying for example **P2 W 20** results in a monitoring period of 20 ∗ 100ms = 2 s

The maximum monitoring period is 109 minutes.

The monitoring period is transferred into the data word D20 of the corresponding cascade data module.

P3 W KWA waiting period (input parameter)

The parameter P3 provides the FC “KETTExxx” with the waiting period value. This is then the same for each step unless it is redefined in the individual steps.

The time basis is always 100ms. Specifying for example **P3 W 15** results in a waiting period of 15 ∗ 100ms = 1.5 s

The maximum waiting period is 109 minutes.

The waiting period is transferred into the data word D18 of the corresponding cascade data module.

3.3 Fixed operands and functions

3.3.1 Modules used

The function module “KETTExxx” can manage

- 64 step modules, each with
- 128 steps and
- up to 64 criteria per step.

These step modules are firmly allocated:

- Program modules FC1 - FC64 as cascades – FCs
- Data modules DM1 - DM64 as cascades – DMs

Here, the FC and DM number correspond to the cascade numbers.

3.3.2 Flags used

From the flag range, the flags listed below receive a fixed function.

Address	Symbol	Function
M255.0	-BEFA	Assignment to command output
M255.1	-WSB	Assignment to relaying
M255.2	-STOEM	Error flag; error present at STOEM = 0;
M255.5	-WZT_HLT	Pause waiting period
M255.4	-HALBAUTO	Relay in inch mode, also without flank S+1
M255.6	-WZT	Status of waiting period 0: waiting period running 1: waiting period elapsed
M255.7	-UEKONTR	Monitoring period control With UEKONTR = 1, the diagnosis is not triggered when the monitoring period expires.
M242	-VERZW	Branch address (word) Step number within the cascade; branching to here when WSB = 1.

3.3.3 PLC registers

The PLC registers A,B,C and D as well as the control flags (e.g. VKE, Carry) are not retained beyond the module call instruction. When the FCs return to the calling program module, the registers contain the following defined contents.

Reg.	Contents
A	Version number of the function module FC “KETTE700”
B	Error codes if cascade data module not created
C	not relevant
D	not relevant

3.4 Operating mode management

3.4.1 Operating mode selection

The “KETTExxx” serves up to 64 step cascade modules with one active step each in the same PLC cycle.

The operating mode set by P1 is reflected by FC “KETTExxx” in the data word D6 of the corresponding cascade data module.

The data word D30 serves for parallel operation of the function module via interfaces. For parallel operation, the data bit D24.2 must be set in the corresponding cascade data module. Manual, inching and automatic cannot be operated in parallel.

For parallel operation, with release by D24.2=1, the following applies:

D6.3 $\wedge$ D30.3	Activate start
D6.5 $\vee$ D30.5	Set step
D6.6 $\vee$ D30.6	Clear error
D6.7 $\vee$ D30.7	Reset
D7.0 $\vee$ D31.0	Halt
D7.1 $\vee$ D31.1	Synchronise
D7.3 $\vee$ D31.3	Generate cascade DB

$\wedge$ = logical AND linked
$\vee$ = logical OR linked

3.4.2 Specifying priorities of operating mode bits

The priority sequence of operating mode bits, with simultaneous specification of several bits, is:

Reset $\rightarrow$ Halt $\rightarrow$ Start $\rightarrow$ Manual $\rightarrow$ Inch $\rightarrow$ Automatic

3.4.3 Operating mode setting bits

Overview of operating mode setting bits in the corresponding D6

Bit	Operating mode
D7.7	Clear errors automatic / manual
D7.6	WSB does not reset BEFA
D7.5	
D7.4	Step relaying in the same cycle
D7.3	Generate cascade data module
D7.2	
D7.1	Synchronise
D7.0	Halt
D6.7	Reset
D6.6	Clear halt
D6.5	Set step
D6.4	S + 1 relay in inch mode
D6.3	Start
D6.2	Automatic
D6.1	Inching mode
D6.0	Manual mode

Description of operating mode setting bits

D6.0 Manual mode
Set manual mode

D6.1 Inching mode
Set inching mode

D6.2 Automatic mode
Set automatic mode

D6.3 Start
Start/Command release

The bit applies to all operating modes.
At start = 0, BEFA is deleted, the monitoring period is paused and the waiting period elapses.
For generation of the cascade DBs and for synchronisation in automatic mode, the “Start” must be deleted.

D6.4 S+1
Run next step

In the **INCH** operating mode, if there is a positive flank for this bit and the relaying condition (WSB = 1) is met, the next step is run.

D6.5 Set step
Adopt preselected step no.

In manual mode, the step prepared in D14 is adopted into the active step (D12) and run.

D6.6 Clear halt
Manual clearance of errors

Only works with D7.7 = 1 (manual clearance of errors).
A positive flank at this bit clears an error (cascade halt) triggered by an elapsed monitoring period or a reset error flag. The waiting and monitoring period are restarted.

D6.7 Reset
Reset of the cascade

D6.7 = 1 triggers the following actions:
- delete active step
- reinitialize cascade
- Create new cascade DB

After reset, step 1 is prepared.

D7.0 Halt
Pause cascade sequence

If the bit is set, the cascade is stopped and the current step processed further. Here, the command output is retained; the monitoring and waiting period are paused.

D7.1 Synchronise
Synchronise cascade

Possible in manual and automatic mode. In automatic mode, D6.3 = 0 is required in addition.

If this bit is set, the FC "KETTExxx" searches the step cascade for met conditions and synchronises the step processing in accordance with the operating mode.

Conditions for a found synchronisation are:

BEFA = 1 and
WSB = 0

For all steps in which the synchronisation conditions have been met, the bit associated with the step is set in the data block D48 to D62.

If precisely 1 step is found in automatic mode for which the synchronisation conditions have been met, this step is prepared.

In the case of And branches, synchronisation on automatic mode is only possible to a limited extent, as the cascades are regarded independently of one another.

D7.3 Learn
Generate cascade data module
If bit D7.3 is set or following a program load or “control on”, the FC “KETTExxx” generates the data for the cascade data module. This cascade-related data is determined from the corresponding step modules and the setting of parameters at the FC “KETTExxx”. For this, D6.3 must = 0.

D7.4 Step relaying in the same cycle
Only in automatic mode.

With D7.4 = 0, only one step is processed in each PLC cycle.
With D7.4 = 1 and set WSB, the next step is activated in the same cycle.

D7.6 WSB does not reset BEFA
Only in manual mode.

With D7.6 = 1, a met WSB does not reset the corresponding BEFA.
With D7.6 = 0 and the met relaying condition WSB, the command output BEFA is reset.

D7.7 Clear
Clearance of errors
If this bit is set, a cascade error that has occurred must be confirmed by the bit D6.6. With D7.7 reset, the cascade clears itself automatically if the relaying condition is met.

3.4.4 Operating modereturn message

The data word D8 of each cascade – DBs contain the return message of the operating mode **after processing** of the FC "KETTExxx“.

Overview of reported operating mode in the corresponding D6

Bit	Operating mode
D9.7	Static error
D9.6	Impulse error
D9.5	
D9.4	
D9.3	Chain data module generated
D9.2	More than one synchronisation step
D9.1	No synchronisation possible
D9.0	Halt: cascade stopped
D8.7	Reset: cascade reset
D8.6	Waiting period running (0) / waiting period elapsed (1)
D8.5	
D8.4	Automatic or inching mode active
D8.3	Start for all operating modes
D8.2	Automatic
D8.1	Inching mode
D8.0	Manual mode

Description of reported operating mode bits

D8.0 Manual mode
The cascade is in manual mode.

D8.1 Inching mode
The cascade is in inching mode.

D8.2 Automatic
The cascade is in automatic mode.

D8.3 Start
The cascade has received the start bit.

D8.4 Automatic/Inching
The cascade is in automatic or inching mode.
This bit is used for the selection of whether the manual or automatic/inch branch is to be used in the cascade module.

D8.5 Synchronisation running
The cascade is in the process of synchronisation and indicates this with D8.5 = 1

D8.6 Waiting period running
A set bit indicates that the waiting period has elapsed for this step.
The state of the D8.6 bit is reflected by the "KETTE700“ prior to starting the step in the flag M255.6, so that the waiting period is available to the steps as a diagnosable operand.
The query `A B M255.6` returns a 1 when the waiting period has elapsed.

D8.7 Reset cascade
The cascade is reset, the active step deleted (D12=0).

D9.0 Chain stopped
The cascade is stopped.

This operating mode is switched on by:
- D7.0 = 1 (Halt),
- error flag M255.2 reset or
- error in automatic mode with elapsed monitoring period (only in the case of manual clearance by D7.7=1).

D9.1 No synchronisation possible
The synchronisation conditions
BEFA = 1 and
WSB = 0 have not been met in any step.

D9.2 More than one synchronisation step
On synchronisation in automatic mode, more than one synchronisation step was found. The synchronised start of automatic mode “automatic set-up” is not possible.

D9.3 Chain data module generated
With D9.3 = 1, the learning or data module generation is concluded.

D9.6 Impulse error
Output of an impulse for one PLC cycle if an error has been detected. Criteria for an error are:
- error flag M255.2 reset or
- monitoring period elapsed.

D9.7 Static error
Output of a static signal if an error has been detected (criteria as with D9.6). The bit is reset by clearing the error.

3.5 Allocation of the cascade DMs

The data modules for administration of the sequence control provides all of the data important for system control.

Entries in the cascade DMs (generated by WinSPS/SFC)

```
; ------------------------------------------------------------------
; data module file DB_Kxy
; ------------------------------------------------------------------
0   UINT        ; error bits
2   UINT        ; cascade number
4   UINT        ; number of steps

; Operating mode selection
;          +-- Error must be cleared with D6.6
;          |+-- WSB does not reset BEFA (manual)
;          ||+--
;          |||+-- No step relaying in the same cycle
;          ||||+-- Generate cascade data module
;          |||||+--
;          ||||||+-- Synchronisation
;          |||||||+-- Halt
;          ||||||||  +-- Reset
;          ||||||||  |+-- Clear error (D7.7=1)
;          ||||||||  ||+-- Set step (Manual)
;          ||||||||  |||+-- S+1 (Inching)
;          ||||||||  ||||+-- Start
;          ||||||||  |||||+-- Automatic
;          ||||||||  ||||||+-- Inch
;          ||||||||  |||||||+-- Manual
;          ||||||||  ||||||||
6   UINT 2#00000000_00000000

Operating mode report
;          +-- Static error
;          |+-- Error as impulse
;          ||+--
;          |||+--
;          ||||+-- Chain data module generated
;          |||||+-- More than one step with BEFA=1bin, synchronisation.
;          ||||||+-- No synchronisation possible
;          |||||||+-- Halt
;          ||||||||  +-- Reset
;          ||||||||  |+-- Waiting period running
;          ||||||||  ||+--
;          ||||||||  |||+-- Inching/Automatic
;          ||||||||  ||||+-- Start
;          ||||||||  |||||+-- Automatic
;          ||||||||  ||||||+-- Inching
;          ||||||||  |||||||+-- Manual
;          ||||||||  ||||||||
8   UINT 2#00000000_00000000

10  UINT        ; Step last processed

12  UINT        ; Step currently processed

14  UINT        ; Step preselection in manual mode

16  UINT        ; Command output step number

18  UINT        ; Current waiting period value

20  UINT        ; Current monitoring period value

22  UINT        ; Internal data words D22 – D46
 :
 :
 :
46
```

```
; synchronisation result binary, step-related D48- D62
; with n = 0, 16, 32, 48.
;          +-- step16+n
;          | +-- step15+n
;          | | +-- step14+n
;          | | | +-- step13+n
;          | | | | +-- step12+n
;          | | | | | +-- step11+n
;          | | | | | | +-- step10+n
;          | | | | | | | +-- step9+n
;          | | | | | | | | +-- step8+n
;          | | | | | | | | | +-- step7+n
;          | | | | | | | | | | +-- step6+n
;          | | | | | | | | | | | +-- step5+n
;          | | | | | | | | | | | | +-- step4+n
;          | | | | | | | | | | | | | +-- step3+n
;          | | | | | | | | | | | | | | +-- step2+n
;          | | | | | | | | | | | | | | | +-- step1+n
;          | | | | | | | | | | | | | | | | |
48   UINT 2#0_0_0_0_0_0_0_0_0_0_0_0_0_0_0_0
50   UINT 2#0
 :
 :
62   UINT 2#0

; active step binary, D64- D78
; with n = 0, 16, 32, 48.
;          +-- step16+n
;          | +-- step15+n
;          | | +-- step14+n
;          | | | +-- step13+n
;          | | | | +-- step12+n
;          | | | | | +-- step11+n
;          | | | | | | +-- step10+n
;          | | | | | | | +-- step9+n
;          | | | | | | | | +-- step8+n
;          | | | | | | | | | +-- step7+n
;          | | | | | | | | | | +-- step6+n
;          | | | | | | | | | | | +-- step5+n
;          | | | | | | | | | | | | +-- step4+n
;          | | | | | | | | | | | | | +-- step3+n
;          | | | | | | | | | | | | | | +-- step2+n
;          | | | | | | | | | | | | | | | +-- step1+n
;          | | | | | | | | | | | | | | | | |
64   UINT 2#0_0_0_0_0_0_0_0_0_0_0_0_0_0_0_0
66   UINT 2#0
 :
 :
78   UINT 2#0

         ; command output binary, step-related D80- D94
         ; with n = 0, 16, 32, 48.
;          +-- step16+n
;          | +-- step15+n
;          | | +-- step14+n
;          | | | +-- step13+n
;          | | | | +-- step12+n
;          | | | | | +-- step11+n
;          | | | | | | +-- step10+n
;          | | | | | | | +-- step9+n
;          | | | | | | | | +-- step8+n
;          | | | | | | | | | +-- step7+n
;          | | | | | | | | | | +-- step6+n
;          | | | | | | | | | | | +-- step5+n
;          | | | | | | | | | | | | +-- step4+n
;          | | | | | | | | | | | | | +-- step3+n
;          | | | | | | | | | | | | | | +-- step2+n
;          | | | | | | | | | | | | | | | +-- step1+n
;          | | | | | | | | | | | | | | | | |
80   UINT 2#0_0_0_0_0_0_0_0_0_0_0_0_0_0_0_0
82   UINT 2#0
:
 :
94   UINT 2#0
```

3.5.1 Error bits in the D0 of the cascade data modules

Allocation of the data word D0: error bits

Bit	Error and/or status message	Correcting error
15	Structure error of the step module	The structure of the jump distributor does not match the order of the programmed steps. Step cascade runs correctly, but diagnosis not possible → Correct structure
14		
13		
12		
11		
10		
9		
8		
7		
6		
5	Error in the linear cascade sequence	The branch address -VERZW points to a step outside the step cascade
4	Step is repeated	The branch address -VERZW points to the currently active step.
3	Jump strip error	The first instruction in the step module must be an indexed absolute jump. Between this and the first jump target, there may only be jump instructions or comment lines. **NB networks!** → Correct program
2	Reference list	The present module is defective. → Re-integrate program and load
1	Step module (FC) is not present	The FCn allocated to a defined DMn is not present. → Integrate module
0	Number of steps too high or zero	Number of steps must be > 0 and ≤128. → Correct program

3.5.2 Evaluation of the actual and target value for waiting and monitoring period

When a jump is made into a new step, “KETTExxx” checks whether the actual values for the waiting and monitoring period (D18, D20) have been set by the user program. In the case of values not equal to zero, these are evaluated as valid times for the active step. Otherwise, the time specified in the parameters P2 and P3 on the FC “KETTExxx” is used.

3.5.3 Error codes in the B register after processing of the FC “KETTExxx”

Content battery B	Correcting error
FFFFh	Chain data module is not present
0001h	P0 of the module “KETTE” is 0
0002h	P0 of the module “KETTExxx” is > 64
0004h	Chain data module is too short < 96

3.6 Command output

The command output takes place directly after the call instruction of the cascade management module FC “KETTExxx” in the modules KETTEN.

There are the following 2 possibilities to run the command output:

- via the data bits as of data word bit D80.0 to D127.7.
  This type of command output is not supported by WinSPS/SFC!
- via the step number in data word D16 with active BEFA bit (KETTE Version 2.6, KETTE700 Version 1.5 required).
  This type of command output is generated by WinSPS/SFC and is easier to interpret, as in D16, with released command output, the step number can be read off directly.

For the release of the command output, the following always applies:

- A valid operating mode Manual, Inch or Automatic
- Start active
- BEFA = 1
- WSB = 0

3.6.1 Command output via data bits

Here, the corresponding data word (D80 – D94) is loaded for the command output.

Example for command output for cascade1:

```
CM          DM1         ; Open cascade DM cascade1

; step1
A     B     D80.0       ; BEFA = 1 for step 1 ?
=     B     O1.0        ; activate output

; step 2
A     B     D80.1       ; BEFA = 1 for step 2 ?
=     B     O2.0        ; activate output

; step 3
A     B     D80.2       ; BEFA = 1 for step 3 ?
=     B     O3.0        ; activate output

; step 4
A     B     D80.3       ; BEFA = 1 for step 4 ?
=     B     O4.0        ; activate output
    :
    :
    :
    :
    :
; step 32
A     B     D83.7       ; BEFA = 1 for step 32 ?
=     B     O4.0        ; activate output
EM
```

These program instructions for command output are to be repeated for all active cascades and for all steps in the module KETTEN following callup of the FC “KETTExxx”.

3.6.2 Command output via step number

Here, the data word D16 is loaded for the command output.

Example for command output for cascade1:

```
CM          DM1         ; Open cascade DM cascade1
L     W     D16,O       ; active output

; step1
CPLA  B     1,O         ; BEFA = 1 for step 1 ?
A     B     SM31.7      ; ... yes
=     B     O1.0        ; then activate output

; step 2
CPLA  B     2,O         ; BEFA = 1 for step 2 ?
A     B     SM31.7      ; ... yes
=     B     O1.1        ; then activate output

; step 3
CPLA  B     3,O         ; BEFA = 1 for step 3 ?
A     B     SM31.7      ; ... yes
=     B     O1.2        ; then activate output

; step 4
CPLA  B     4,O         ; BEFA = 1 for step 4 ?
A     B     SM31.7      ; ... yes
=     B     O1.3        ; then activate output
    :
    :
    :
    :
    :
; step 32
CPLA  B     32,O        ; BEFA = 1 for step 32 ?
A     B     SM31.7      ; ... yes
=     B     O1.3        ; then activate output

EM
```

These program instructions for command output are to be repeated for all active cascades and for all steps in the module KETTEN following callup of the FC “KETTExxx”.

3.7 Structure of the step modules

The formal requirements specified for the diagnosis explained below are generated automatically by WinSPS/SFC.

3.7.1 Use in the CL350, the CL400 and the CL500

The structure of a step module has the following appearance:

```
JP              [A]
JP              step1
JP              step2
:                 :
JP              stepn

step1:

; change the waiting period only for this step
L       W       xxx,O
T       W       O,D18

; change the monitoring period only for this step
L       W       yyy,O
T       W       O,D20

; transfer of a branch address
L       W       zzz,O
T       W       O,M242

; branch manual / automatic mode
L       W       D8,O            ; read reported operating mode
A       B       D8.4            ; Automatic/inch active?
JPB             AUTO            ; -> yes

; links for manual mode
A       B       I0.0
=       B       -BEFA

A       B       I0.1
=       B       -WSB            ; compulsory formal requirement
EM                              ; for the step end

; links for automatic and inch mode
AUTO:
A       B       I0.6
=       B       -BEFA
A       B       I0.7
=       B       -WSB            ; compulsory formal requirement
EM                              ; for the step end

step2
A       B       I0.2
=       B       -BEFA
A       B       I0.3
=       B       -WSB            ; compulsory formal requirement
EM                              ; for the step end
```

In the area between the jump command and the diagnosable links (as of jump target), all the commands from the set of commands in the CL350, CL400 and CL500 are permitted.

If a step is identical in manual and automatic movement, the selection of the operating mode can be omitted (as here in step 2).

3.7.2 Structure of the step module on the CL550, the PCL and the ICL700

The structure of a step module has the following appearance:

```
 JP           [A],n        ; CL550/PCL, n = number of steps
(JP           [A]          ; ICL700)
 JP           step1
 JP           step2
 :              :
 JP           stepn

 step1:
 JPCY         VERKN1       ; only for diagnosis module

 ; change the waiting period only for this step
 L      W     xxx,O
 T      W     O,D18

 ; change the monitoring period only for this step
 L      W     yyy,O
 T      W     O,D20

 ; transfer of a branch address
 L      W     zzz,O
 T      W     O,M242

 ; branch manual / automatic mode
 VERKN1:
 L      W     D8,A         ; read reported operating mode
 A      B     D8.4         ; Automatic/inch active?
 JPB          AUTO         ; -> yes

 ; links for manual mode
 A      B     I0.0
 =      B     -BEFA

 A      B     I0.1
 =      B     -WSB         ; compulsory formal requirement
 EM                        ; for the step end

 ; links for automatic and inch mode
 AUTO:
 A      B     I0.6
 =      B     -BEFA
 A      B     I0.7
 =      B     -WSB         ; compulsory formal requirement
 EM                        ; for the step end

 step2
 A      B     I0.2
 =      B     -BEFA
 A      B     I0.3
 =      B     -WSB         ; compulsory formal requirement
 EM                        ; for the step end
```

The modules KETTEPCL and KETTE700 ensure that the step module is always started with a reset carry flag. This means that the jump command (JPC), which is only inserted for diagnosis purposes, is never run and the program sequence is linear. In the area between the jump command and the diagnosable links (as of jump target), all the commands from the set of commands in the CL550, the PCL and/or ICL700 are permitted.

If only bit links take place within a steps, the jump JPC can be omitted (as here in step 2).

If a step is identical in manual and automatic movement, the selection of the operating mode can be omitted (as here in step 2).

3.8 Specifications of the module “KETTExxx”

Number of managed cascades:	max. 64
Number of steps per cascade:	max. 128
Number of relaying conditions per step:	max. 64

Monitoring period and waiting period	
minimum duration	100 ms
maximum duration	1 hour, 50 min
Time grid	100 ms

4. Module DIAGxxx

The function module DIAGxxx analyses a cascade step specified either by
a cascade fault or per parameter. The criteria are read, coded and stored in a data module.

This code is processed and displayed by the connected operating and display device.

For the standardised diagnosis displays and machine operation, Bosch provides visualisation devices of various performance classes and the corresponding software solution.

You have the choice as to whether you want to use a simple plain text display, a graphical display or an industrial PC as visualisation device.

With this decision, you also determine the software to be used.

Operating / display device with line display BT5 → BTMADAP

Operating / display device with graphic display BT20 → BTMADAP

Operating / display device as industrial PC with monitor → MMIMADAP

4.1 Call instructions and setting parameters of the diagnosis FCs

4.1.1 Use in the CL350/CL400/CL500 and in the CL550/PCL

The module “DIAGMMI” diagnoses exclusively the operand ranges of the CL400/CL500.

The module “DIAGPCL” can be applied to two different address ranges. In one of the settings, it diagnoses exclusively the operand ranges of the CL400/CL500.The second setting enables diagnosis of the entire address range of the PCL and/or CL550.

Both modules are called up using 8 parameters.

```
CM      -DIAGMMI,8   ; CL350/CL400/CL500
(CM     -DIAGPCL,8   ; CL550/PCL)
;
;                    +--------------------+
P0      -Diagakt   ; | BOOL    VAR_INPUT  |
P1      -HANDAUTO  ; | BOOL    VAR_INPUT  |
P2  B   -KETTNr    ; | BYTE    VAR_INPUT  |
P3  B   -KETTEND   ; | BYTE    VAR_INPUT  |
P4  B   -KETTANF   ; | BYTE    VAR_INPUT  |
P5  W   -DIAGMELD  ; | WORD    VAR_OUTPUT |
P6  W   -DIAGDB    ; | WORD    VAR_INPUT  |
P7      -STATION   ; | ANY     VAR_INPUT  |
;                    +--------------------+
```

4.1.1.1 Explanation of the parameters of the DIAGMMI and DIAGPCL

P0 -DIAGAKT Perform manual diagnosis

If you want to perform a manual diagnosis of a certain step sequence, set this bit parameter to the value “1”. If you wish to have an automatic diagnosis of the first value error, set this parameter to the value “0”. This parameter is related to the parameters P1 and P2.

P1 -HANDAUTO Analyse manual/automatic branch

If you have selected manual diagnosis, define at this bit parameter whether the diagnosis is to be run for the automatic branch (value “1”) or the manual branch (value “0”).

P2 B -KETTNR Chain no. for the manual diagnosis

If you activate the manual diagnosis with the parameter P0, you have to enter the desired cascade number (bytes) here. The module DIAGxxx then diagnoses the current step of the specified cascade.

P3 B -KETTEND Last cascade no. of the cascade group

P4 B -KETTEND First cascade no. of the cascade group

P5 W -DIAGMLDG Error message of the diagnosis module

In this parameter word, the module DIAGMMI/DIAGPCL stores error messages that you can evaluate.

P6 B -DIAGDB Number of the DB in which the diagnosis data is stored

P7 W -STATION Station code of the cascade groups

4.1.2 Use in the ICL700

The module “DIAG700” diagnoses exclusively the operand ranges of the CL400/CL500 and it is called up with 5 parameters.

```
CM      -DIAG700,8
;
;                     +--------------------+
P0      -Diagakt    ; | BOOL     VAR_INPUT |
P1      -HANDAUTO   ; | BOOL     VAR_INPUT |
P2  B   -KETTNr     ; | BYTE     VAR_INPUT |
P3  B   -KETTANZ    ; | BYTE     VAR_INPUT |
P4  B   -DIAGMELD   ; | BYTE     VAR_INPUT |
;                     +--------------------+
;
```

4.1.2.1 Explanation of the parameters of the DIAG700

P0 -DIAGAKT Perform manual diagnosis
If you want to perform a manual diagnosis of a certain step cascade, set this bit parameter to the value “1”. If you wish to have an automatic diagnosis of the first value error, set this parameter to the value “0”. This parameter is related to the parameters P1 and P2.

P1 -HANDAUTO Analyse manual/automatic branch
If you have selected manual diagnosis, define at this bit parameter whether the diagnosis is to be run for the automatic branch (value “1”) or the manual branch (value “0”).

P2 B -KETTNR Chain no. for the manual diagnosis
If you activate the manual diagnosis with the parameter P0, you have to enter the desired cascade number (bytes) here. The module DIAGxxx then diagnoses the current step of the specified cascade.

P3 B -KETTANZ Last cascade no. of the cascade group
Here, enter the highest cascade number of the programmed cascades. Chain 1 is always defined as the first cascade.

Example: 3 cascades cascade1, cascade5, cascade7

You must define parameter P3 with the value “7”.

P4 W -DIAGMLDG Error message of the diagnosis module
In this parameter word, the DIAG700 module stores error messages that you can evaluate.

4.1.3 Error messages of the module in the parameter P5

This parameter word contains error messages that you can evaluate.

Bit	Cause of error
15	Collective error, at least 1 error is present
14	
13	DM120 not present or too short
12	Data module for cascade not present or too short
11	
10	Step number too large
9	Chain number not permitted for manual diagnosis
8	Number of cascades not permitted
7	
6	Structure error in the step cascade jump distributor
5	
4	too many conditions in the branch to be diagnosed
3	command not permitted in the branch to be diagnosed
2	
1	
0	Warning: number of cascades = 0, without collective error

4.1.3.1 Correcting error

Bit 0
The parameter P3 of the module “DIAG700” has the value “0” → change the value according to your application.

Bit 1 and bit 2
Reserve

Bit 3
In the BEFA or WSB branch, you have used commands that cannot be diagnosed. You can program these commands at any time before or after the step branches → change your step cascade.

Bit 4
In the BEFA or WSB branch, the maximum number of 64 conditions per BEFA or WSB assignment has been exceeded → split the branch into a number of partial branches.

Bit 5
Reserve

Bit 6
The module "DIAG700" has detected a structure error in the jump distributor of the step cascade. The origin of this can be that the step sequence in the jump distributor does not match the step sequence in the step program → change either the step sequence in the jump distributor or in the sequence in the step module.

Bit 7
Reserve

Bit 8
The parameter P3 of the module “DIAG700” has a value greater than 64. However, you can only process a maximum of 64 step cascades. Change the parameter value.

Bit 9
Parameter P2 of the module “DIAG700” is not within the permitted range between 1 and 64 → change the parameter value.

Bit 10
The step number to be diagnosed is greater than 128. It is possible that in the manual mode of the cascade you have selected a step number greater than 128.

Bit 11
Reserve

Bit 12
The module “DIAG700” wants to diagnose a step cascade, but it cannot find the corresponding data module or not the complete data module → integrate the DMs in the correct module length in your program.

Bit 13
Integrate the DM120 in the correct module length (length = 512) in your program.

Bit 13 and bit 14
Reserve

4.2 operand address ranges and data modules for diagnosis

4.2.1 “Small” address range

The standard address range of the CL400 applies to the diagnosis, also for the CL550, PCL and ICL700.

Diagnosis ranges:

I 0.0	**-**	**I 127.7**
O 0.0	**-**	**O 63.7**
M 0.0	**-**	**M 255.7**
T 0	**-**	**T 127**
C 0	**-**	**C 127**

4.2.2 “Large” address range

For the CL550, PCL, there is the possibility to use the entire address range of the operands for the diagnosis.

Extended diagnosis ranges:

I 0.0	**-**	**I 8191.7**
O 0.0	**-**	**O 8191.7**
M 0.0	**-**	**M 8191.7**
T 0	**-**	**T 255**
C 0	**-**	**C 255**

⇒ **The use of the extended address ranges in the PCL requires a MMIMADAP version higher than 2.3 and a WinPanel version higher than 2.1.**

⇒ **The use of the standard software BTMADAP for the CL550 and/or PCL excludes the use of the extended address range.**

4.2.3 Setting the address ranges for the CL550 and the PCL

The address ranges for the diagnosis can be set in the software MMIMADAP in two ways:

- during the installation of MMIMADAP
- in the panel configurator of MMIMADAP

In both cases, a dialog field for setting the cascade diagnosis appears. The two buttons bear the inscriptions CLxxx and PCL-EA.

The button CLxxx means “small” address range (see 4.2.1);
the button PCL-EA means “large” address range (see 4.2.2).

The control CL550 and/or PCL must then be assigned the diagnosis address ranges in the OM2, DW2.

Controlling the diagnosis characteristics:

DW2 Bit4 0 = small I/O 1 = large I/O
DW2 Bit5 0 = Opel application 1 = MADAP-I/O diagnosis

OM2 entry on the PCL

```
;DW 2:  initialisation flag (entries permitted)
;-------------------------------------------------------
;entry 0 = do  n o t  check or run function
;entry 1 = check or run function
;
DEFW  W  2#0000000000000000
           *******|***||||*      *: not used
;                 |   |||+------ Check set cycle time
;                 |   ||+------- Remanent start if possible
;                 |   |+-------- Suppress cycle time moni-
;                 |   |          toring at start
;                 |   |
;                 |   +--------- “large” diagnosis addr. range
;                 +------------- Copy DM in data buffer
```

OM2 entry on the CL550

```
;DW 2:  initialisation flag (entries permitted)
;-------------------------------------------------------
;entry 0 = do  n o t  check or run function
;entry 1 = check or run function
;
DEFW  W  2#0000000000000000
           *******|**|||||*      *: not used
;                 |  ||||+------ Check set cycle time
;                 |  |||+------- Remanent start if possible
;                 |  ||+-------- Suppress cycle time moni-
;                 |  ||          toring at start
;                 |  |+---------- Use “large” diagnosis addr. range
;                 |  +----------- MMIMADAP
;                 +-------------- Copy DM in data buffer
```

4.2.4 Data modules for the diagnosis

As MMIMADAP has the possibility to run up to 4 control panels (stations 1-4) parallel in one control system or central unit and in addition can diagnose 6 other stations (cascade groups), the corresponding number of DBs are occupied in advance for this. The 6 additional stations are assigned to the control panels and therefore only require the data module for the first value messages in automatic mode and no separate DBs for manual diagnosis.

For more detailed information, consult the manual “MMIMADAP for Programmers and Project Designers 1070 072 168”.

The specified and/or predefined data modules for storage of the diagnostic data can be taken from the following table.

	Automatic diagnosis (first value errors)		Manual diagnosis	Comments
	Standard	*extended*		
CL350 CL400 CL500	St1: DM234 St2: DM239 St3: DM244 St4: DM249		St1: DM234 St2: DM239 St3: DM244 St4: DM249 St5: DM222 St6: DM223 St7: DM224 St8: DM225 St9: DM226 St10: DM227	The DMs for the stations ST1-ST4 also contain the diagnostic data of the corresponding manual diagnosis
CL550 PCL	St1: DM234 St2: DM239 St3: DM244 St4: DM249	*St1: DM256* *St2: DM257* *St3: DM258* *St4: DM259*	St1: DM234/*DM256* St2: DM239/*DM257* St3: DM244/*DM258* St4: DM249/*DM259* St5: DM222 St6: DM223 St7: DM224 St8: DM225 St9: DM226 St10: DM227	The DMs for the stations ST1-ST4 contain the diagnostic data of the corresponding manual diagnosis if the standard address range is used. *If the extended address range is used, the manual diagnosis requires the additional DMs 256-259.*
ICL700	DM120		DM120	The DM120 contains all diagnostic data.

If DMs other than the preset DMs are to be used for the manual diagnosis when the extended address range is used, enter the module numbers in the DM255 (BF_GLOBA) as follows:

Manual diagnostic data	ST1	DM no. in DM255/D250
	ST2	DM no. in DM255/D252
	ST3	DM no. in DM255/D254
	ST4	DM no. in DM255/D256

4.3 Data content of the diagnosis data modules

Information on the existing first value errors of a step cascade is stored automatically in the data modules.

The data modules must be created with full length (512 bytes).

4.4 Explanation of terms

First value errors

A system runs without errors when all of the step cascades involved in the sequence (maximum 64) run without errors in automatic mode. If an error occurs in a step cascade, the control system detects this error. As this error is the first sequence error to occur on the system, it is designated the first value error.

Subsequent errors

If there is a first value error on the system, other step cascades generally return errors. These errors are defined as subsequent errors. The subsequent errors in general are of subordinate significance, as the system can often be returned to error-free operation solely by remedying the first value error.

4.5 Criteria for an error entry

There are two possibilities to trigger an error entry for the step cascade.

Monitoring period

A function is stored for each step in a step cascade. This function can be a movement of the system, but also a preparation for other movements. Each function has a measurable duration. The monitoring period is now used to check this duration and if the time elapses an error entry is triggered.

Error flags

In the case of time-critical faults, e.g. opening a protective door, it makes no sense to use the monitoring period. In this case, the fault flag is reset directly as soon as the fault occurs. This triggers an immediate error entry.

4.6 Diagnosis data module entries

4.6.1 If the “small” address range is used

DB for automatic diagnosis (first value errors) and manual diagnosis

	DW	Content of high byte	Content of low byte
	D0	Control flags	
Range of the automatic Diagnosis (First value message)	D2	Day	Month
	D4	Year	Hour
	D6	Minute	Second
	D8	Weekday (0=Sunday)	Maximum number of steps
	D10	Chain number	Step number
	D12	Station code	Module number
	D14	Chain state	Number of messages
	D16	1. Opcode	
	D18	2. Opcode	
	:	:	
	:	:	
	D140	63. Opcode	
	D142	64. Opcode	
	D144	Reserve	
	D146	Reserve	
	D148	Reserve	
Chain info	D150	Chain 1	
	:	:	
	:	:	
	D276	Chain 64	
Range of the manual Diagnosis	D278	Chain number	Step number
	D280	Module type	Module number
	D282	Chain state	Number of messages
	D284	1. Opcode	
	:	:	
	:	:	
	D408	63. Opcode	
	D410	64. Opcode	
	D412	used internally	
	:	:	
Station list (not ICL700)	D420	Station 1: last cascade	First cascade
	:	:.	:
	:	:.	:
	D438	Station 10: last cascade	First cascade
	D440	used internally	
	:	:	
	D510	used internally	

4.6.2 If the “large” address range is used (only CL550 and PCL)

DM for automatic diagnosis (first value errors)

	DW	Content of high byte	Content of low byte
	D0	Control flags	
Range of the automatic Diagnosis (First value message)	D2	Day	Month
	D4	Year	Hour
	D6	Minute	Second
	D8	Weekday (0=Sunday)	Maximum number of steps
	D10	Chain number	Step number
	D12	Station code	Module number
	D14	Chain state	Number of messages
	D16	1. Opcode	
	D18	Operand address 1. Opcode	
	:	:	
	:	:	
	:	:	
	:	:	
	D268	64. Opcode	
	D270	Operand address 64. Opcode	
	D272	Reserve	
	D274	Reserve	
	D276	Reserve	
Chain info	D278	Chain 1	
	:	:	
	:	:	
	D404	Chain 64	
Station list (not ICL700)	D406	Station 1: last cascade	First cascade
	:	:	:
	:	:	:
	D424	Station 10: last cascade	First cascade
	D426	used internally	
	:	:	
	D510	used internally	

DM for manual diagnosis

	DW	Content of high byte	Content of low byte
Range of the manual Diagnosis	D0	Chain number	Step number
	D2	Station code	Module number
	D4	Chain state	Number of messages
	D6	1. Opcode	
	D8	Operand address 1. Opcode	
	:	:	
	:	:	
	:	:	
	:	:	
	D258	64. Opcode	
	D260	Operand address 64. Opcode	
	D262	used internally	
	:	:	
	D510	used internally	

⇒ **The use of the standard software BTMADAP for the CL550 and/or PCL excludes the use of the extended address range.**

4.6.3 Control flags

The control flags are stored in the data word D0. Here, the individual data bits have been assigned different functions.

D0.0
The data bit is set by the diagnosis module “DIAGxxx” to the value “1” if a first value error has been entered. After the first value error has been read out, you **must** reset this data bit **(clearance)**. This data bit has a functional relationship to data bit D0.1.

D0.1
Data bit D0.1 controls the characteristics if there is a first value error

D0.1 = 0	D0.1 = 1
The first value error is always entered. If the data module contains an uncleared first value error, this is overwritten by the new first value error.	A new first value error can only be entered when the clearance of a previous first value error has been performed with D0.0. If this is not the case, the new first value error is lost

D0.0
The data bit is set by the diagnosis module “DIAGxxx” to the value “1” if there is a first value error. If this is not the case, the bit is automatically reset.

D1.2
If the states of the diagnosed conditions change or if an error message comes or goes, the bit goes to the value “1” for one PLC cycle.

4.6.4 Range of automatic diagnosis

In the event of an error, the module "DIAGxxx" automatically enters the diagnostic data in the subsequent data words. You can read these data words and use them for diagnosis purposes.

Date format
The time and date of a first value error are stored in the data words **D2** to **D8** in HEX format. The weekdays are allocated as follows:

0 = Sunday
1 = Monday
2 = Tuesday
3 = Wednesday
4 = Thursday
5 = Friday
6 = Saturday

Chain number
This data byte contains the cascade number of the faulty cascade.

Step number
This data byte contains the step number of the faulty cascade.

Station code
This data byte specifies the station number of the faulty cascade.

Module number
You program each step cascade in an allocated program module. The number of this program module is stored in this data byte.

Chain state
This data byte specifies the operating mode of the faulty cascade at the time of the first value error.
Bit 0 (value 1) = cascade in manual mode
Bit 1 (value 2) = cascade in inch mode
Bit 2 (value 4) = cascade in automatic mode

Number of messages
The number of conditions relating to the current first value error is entered here. Only the first 64 conditions are stored in the data module.

If the BEFA or WSB branch consists of more than 64 conditions, the number of messages is set to **65 (41_H)**.

If a non-permitted operation is found in the diagnosed branch, the number of messages is set to **255 (FF_H)**.

4.6.5 Range of manual diagnosis

The range of the manual diagnosis corresponds to the function content of the automatic diagnosis. However, the date and time of an entry are not stored.

4.6.6 Distribution of the cascade information

The cascade information is created for each cascade.

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Z					Oper. mode			Step no.							
						0 0 1 = manual 0 1 0 = inch 0 1 1 = automatic										
	State of the cascade: 0 = error-free 1 = faulty															

4.7 Specifications of the module "DIAGxxx"

Number of processed cascades:	max. 64
Number of steps per cascade:	max. 128
Number of relaying conditions per step:	max. 64

5. Ordering data sequence control and diagnosis

for CL350/CL400 and CL500	Order no..: 1070 077 508
for CL550 and PCL	Order no.: on request
for ICL700	Order no.: 1070 077 509

The following software packages contain the FCs KETTExxx and DIAGxxx

BTMADAP for CL350/CL400 and CL500	Order no.: 1070 077 814
BTMADAP for CL550 and PCL	Order no.: on request
MMIMADAP for CL350/CL400 and CL500 and for CL550 and PCL	Order no.: on request

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