Application example:

C3 I20 T11 ControlManager

PROFIBUS DP, DP Master system (1)

PROFIBUS DP

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1 introduction

1.1 Product liability

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1.2 Device assignment

1.2.1 This manual applies to the following devices:
- Compax3S025V2 + supplement
- Compax3S063V2 + supplement
- Compax3S100V2 + supplement
- Compax3S025V2 + supplement
- Compax3S063V2 + supplement
- Compax3S100V2 + supplement
- Compax3S150V2 + supplement
- Compax3S015V4 + supplement
- Compax3S038V4 + supplement
- Compax3S075V4 + supplement
- Compax3S150V4 + supplement
- Compax3S300V4 + supplement
- Compax3H050V4 + supplement
- Compax3H090V4 + supplement
- Compax3H125V4 + supplement
- Compax3H155V4 + supplement

1.2.2 With the supplement:
- F10 (Resolver)
- F11 (SinCos©)
- F12 (linear and rotary direct drives)
- I20
- T11
1.2.3 and the Master plc:
- SIMATIC S7-300 or
- SIMATIC S7-400
- with integrated PROFIBUS DP Master (e.g. CPU315-2DP)

2 purpose of the Block

2.1 overview

2.2 restrictions and application

This block simplifies the control of a C3 T11 (with PROFIDrive profile) with the S7. The block needs the commands and set values. The block distributes messages and actual values from the drive. The channels PZD and PKW are used in both directions.

This block is only usable with PPO13 others are strictly forbidden.

2.3 history of modifications

1. V0.1 2004-04-26 09:31:13 PM
- At change from positioning to manual (JOG) is no longer necessary to choose Stop first (STW1.4 = false and STW1.5 = false).
- If <bStartPositioning> is not possible to be done, the block will save the reason.
- <bStartPositioning> (InOut Bit) is resettled in any case
- Relative positioning is now possible without having done homing first.
- Correction of Timer for Watchdog this was not stopped during a movement was not possible (e.g. „not energised“).

2. V0.2 2006-12-19 03:37:48 PM
- Rising edge deception was corrected at positioning
- <bStartPositioning>: is only possible if the actual movement has react the target
- <bChangeSetImmediate>: can interrupt actual move (new target without stop)

3. V0.3 2007-06-28 04:24:21 PM
- Rising edge deception was corrected at positioning
- <bStartPositioning>: is only possible if the actual movement has react the target
- <bChangeSetImmediate>: can interrupt actual move (new target without stop)

3 adjustments

3.1 Compax3 configuration

With C3ServoManager few following adjustments:
At folder:
\ Communication \ PROFIBUS DP - node settings
[PROFIBUS – operation mode]
Positioning

[PLC -> Compax3]
CW 1
Commanded positioning value (XCOMMANDED_A)
Commanded motion speed D (32 Bit)
Commanded acceleration B (32 Bit)

[Compax3 -> PLC]
SW 1
Actual position value XACTUAL_A
Actual speed value NACTUAL_B (32 Bit)

[Operation Mode Settings]
Acyclic process data channel / Parameter channel
Select with "PKW"

Error response on fieldbus failure is up to user.

\ I20T11 drive configuration \ I/O - assignment
Selection:
- free
- Fixed assignment

It is recommend to select „free“. With „Fixed assignment“ are used some Binary connections between control word and digital inputs (E0 ... E3), that cases if there is no plug at X12 the C3 is not possible to be controlled.

3.2 Compax3 Hardware
DIP Switch: Bus address
Bus plug: ``ON / OFF`` Bus termination resistance

3.3 SIMATIC - HW Config
Correlated to PPO-Type which is shown in the C3 configuration it is needed to select at SIMATIC - HW Config this type:
pic 1: SIMATIC - HW Config

Edit the Start address of PKW (here 256) in Instance Variable <nLaddr> (DB45.DBW6).

3.4 Application interface of "C3ControlManager"

3.4.1 Schematic drawing for in- and output

Areas of FB45 / DB45

<table>
<thead>
<tr>
<th>In</th>
<th>input</th>
<th>out</th>
<th>output</th>
<th>In_out</th>
<th>In- and Output</th>
<th>stat</th>
<th>Static Memory</th>
</tr>
</thead>
<tbody>
<tr>
<td>DBX0.0</td>
<td>bEnable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DBX0.1</td>
<td>bAbsoluteRelative</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DBX0.2</td>
<td>bPositionResetMode</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DBX0.3</td>
<td>bHold</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DBX0.4</td>
<td>bStop</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DBX0.5</td>
<td>bFaultReset</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DBX0.6</td>
<td>bJogP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DBX0.7</td>
<td>bJogN</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DBX1.0</td>
<td>bExDataTransfer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DBX4.0</td>
<td>bStartPositioning</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### 3.4.2 Declaration of In- and Output

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Declaration</th>
<th>Data type</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>bAbsoluteRelative</td>
<td>IN</td>
<td>BOOL</td>
<td>=0 absolute, =1 relative movement</td>
</tr>
<tr>
<td>bEnable</td>
<td>IN</td>
<td>BOOL</td>
<td>=1 energise, =0 disenergise with AUS3 - Ramp (Not-Stop)</td>
</tr>
<tr>
<td>bExDataTransfer</td>
<td>IN</td>
<td>BOOL</td>
<td>=1 internal DP interface with SFC14/15 (internal Master in S7 CPU), =1 external DP interface with FC2/FC1 (external Master CP 342-5)</td>
</tr>
<tr>
<td>bFaultReset</td>
<td>IN</td>
<td>BOOL</td>
<td>Acknowledge with rising edge, after that it is necessary to activate energise &lt;bEnable&gt; (caused by the edge detection it is needed to be set to 0 first)</td>
</tr>
<tr>
<td>bHold</td>
<td>IN</td>
<td>BOOL</td>
<td>=1 Temporary stop (the movement function is still available), =0 continue</td>
</tr>
<tr>
<td>bJogN</td>
<td>IN</td>
<td>BOOL</td>
<td>manual negative: JOG – movement within positioning end limits as long as true</td>
</tr>
<tr>
<td>bJogP</td>
<td>IN</td>
<td>BOOL</td>
<td>manual positive: JOG – movement within positioning end limits as long as true</td>
</tr>
<tr>
<td>bPositionResetMode</td>
<td>IN</td>
<td>BOOL</td>
<td>=0 Normal-, =1 Reset mode selected (in C3Mgr \ I20T11 drive Configuration ‘units...’ positioning reset distance and positioning reset distance denominator is different from 0)</td>
</tr>
<tr>
<td>bStop</td>
<td>IN</td>
<td>BOOL</td>
<td>=1 Stop (movement function cancelled)</td>
</tr>
<tr>
<td>bChangeSetImmediate</td>
<td>IN_OUT</td>
<td>BOOL</td>
<td>With the Rising edge, a new position profile is activated; &lt;bChangeSetImmediate&gt; is reseted from the block itself. This command is acknowledged from the block with &lt;bPosRunning&gt;. A new command is also accepted if the actual movement is not finished (&lt;bInPosition&gt; =1).</td>
</tr>
<tr>
<td>bStartHoming</td>
<td>IN_OUT</td>
<td>BOOL</td>
<td>rising edge starts referencing movement, if permitted, neg. edge stops referencing movement, bStartHoming may only be reseted with &lt;bHomingAttained&gt;.</td>
</tr>
<tr>
<td>bStartPositioning</td>
<td>IN_OUT</td>
<td>BOOL</td>
<td>With the Rising edge a new position profile is activated, &lt;bChangeSetImmediate&gt; is reseted from the block itself. This command is acknowledged from with &lt;bPosRunning&gt;. A new command is not accepted if the actual movement is not finished (&lt;bInPosition&gt;=1).</td>
</tr>
<tr>
<td>bCommErr</td>
<td>OUT</td>
<td>BOOL</td>
<td>=1 Communication failure wit C3 (Failure from SFC14 / SFC15) (all other messages are invalid)</td>
</tr>
</tbody>
</table>
### Parameter Declaration

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Declaration</th>
<th>Data type</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>bDriveErr</td>
<td>OUT</td>
<td>BOOL</td>
<td>=1 failure from C3 (device / Motor)</td>
</tr>
</tbody>
</table>
| bEnabled           | OUT         | BOOL      | =1 Axis energised  
|                    |             |           | =0 Axis nit energised |
| bHomingAttained    | OUT         | BOOL      | =1 Reference ok. |
| bHomingErr         | OUT         | BOOL      | =1 watchdog/ timeout for Reference -run (occasionally TonTimer2 correct) |
| bHomingRunning     | OUT         | BOOL      | =1 Reference run active |
| bInPosition        | OUT         | BOOL      | =1 Axis in target position |
| bPosErr            | OUT         | BOOL      | =1 watchdog timeout for Position -order (occasionally. TonTimer1 correct) |
| bPosRunning        | OUT         | BOOL      | =1 position or active |
| bTransErr          | OUT         | BOOL      | =1 Format-, cmdmando failure at transfer from / to C3 |
| iAcceleration      | STATIC      | DINT      | acceleration in U32 -Format (integer) |
| iDeceleration      | STATIC      | DINT      | deceleration in U32 -Format (integer) |
| iInPosWindowAbs    | STATIC      | DINT      | Position window in C4_3 Format (3 decimal places in two word integer), 
|                    |             |           | additional monitoring of <bInPosition> with absolute positioning, the actual position value is compared with the position set value. That is only possible with absolute positioning (<bAbsoluteRelative> = false) and position Reset mode (<bPositionResetMode> = false) is not activated (e.g. default value = 1000 equal 1 u; u = dimension at C3 Mgr Increments, mm, Degrees, Inch). |
| iParameterValue    | STATIC      | DINT      | ProfiDrive Parameter Transfer value (source and destination) - write-/read value of the Parameters, with INT-/WORD -Format only one word used. |
| iPosition          | STATIC      | DINT      | target position / Distance in C4_3-Format (3 decimal places) |
| iVelocity          | STATIC      | DINT      | speed in C4_3-Format (3 decimal places) |
| stRd.iPositionValue| STATIC      | DINT      | actual position in C4_3-Format (3 decimal places) |
| stRd.iVelocityValue| STATIC      | INT       | Istgeschwindigkeit in C4_3-Format (3 decimal places) |
| nCmd               | STATIC      | INT       | ProfiDrive-Parameter Transfer: command:  
|                    |             |           | 1 read  
|                    |             |           | 2 write WORD  
|                    |             |           | 3 write DWORD |
| nPNUIndex          | STATIC      | INT       | ProfiDrive-Parameter Transfer: PNU-Index |
| nPNUSubindex       | STATIC      | INT       | ProfiDrive-Parameter Transfer: PNU - Subindex (incremented by one for DPV0 done) |
| TonTimer1          | STATIC      | TIME      | time value for timeout of Positioning |
| TonTimer2          | STATIC      | TIME      | time value for timeout Reference run |
| nLaddr             | STATIC      | WORD      | = 0100h (=256dez) Start address C3-Slave out of SIMATIC HW Config, if <bExDataTransfer> = true here it is required: 0000hex (=0dez). |
| stRd.nActualError  | STATIC      | WORD      | Actual Failure (see C3 - Manual ) in WORD - Format  
|                    |             |           | =1 no Error! |
| stC3PKWInDint.nPKE | STATIC      | Word 4    | Local PKW - input area for external CP |
| stC3PKWOutDint.nPKE| STATIC      | Word 4    | Locals PKW - output area for external CP |
| stC3PZDIn.nStatus  | STATIC      | Word 7    | Localise PZD - input area for external CP |
| stC3PZDOut.nControl| STATIC      | Word 7    | Locales PZD - output area for external CP |

### 3.4.3.1 sequence of process data

#### 1. <nLaddr>
- Parameter from *HW Config*: the first Start address of the C3 -Slave at the PROFIBUS.
- The Block calculates itself the areas for in- and output, with the Lengths of PPO13.
- the Addresses for in- and output need to have equal values. There must not be holes between PZD and PKW.
- There must to be first PKW- and second PZD.
- Example

<table>
<thead>
<tr>
<th></th>
<th>E-Address</th>
<th>A-Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>PKW</td>
<td>256 .. 263</td>
<td>256 .. 263</td>
</tr>
<tr>
<td>PZD</td>
<td>264 .. 277</td>
<td>264 .. 277</td>
</tr>
</tbody>
</table>

- Here must transferred the value „256“ to <nLaddr>.

2. <bPositionResetMode>
- needs to set if there’s reset a “position reset distance” defined in C3-configuration

3. <bExDataTransfer>
- Low: settings for CPU with integrated PROFIBUS DP Master
- High: settings for CPU with external PROFIBUS DP Master

4. <inPosWindowAbs>
- additional control window for the message <bInPosition>

5. <TonTimer1>
- Time value for watchdog positioning, if this time is too short there is shown the error message <bPosError>.

6. <TonTimer2>
- Time value for watchdog homing, if this time is too short there is shown the error message <bHomingErr>.

### 3.4.3.2 Settings of dynamic Operands at the Block

1. **Switch on**
   - Set <bEnable>: the block notifies <bEnabled>
   - Set <bStartHoming>, the block notifies <bHomingRunning>. If the homing finished, the block notifies <bHomingAttained>.
   - Now reset <bStartHoming>.
   - At reaching home position, the message <bInPosition> is set.
   - With some home modes (e.g. MN-M 35) and high velocity <bHomingRunning> is set so short, that is not visible.
   - If there is a motor with absolute position feedback (SinCos©), it is only one time needed to activate homing. <bHomingAttained> remains at True even if the drive is switch off and on again. Attention: with activating the homing from C3– Optimisation <bHomingAttained> is not set.

2. **Positioning**
   - Set Parameters for Positioning
     - <bAbsoluteRelative>
     - <iPosition>
     - <iVelocity>
     - <iAcceleration>
     - <iDeceleration>
   - start the positioning with activating: <bStartPositioning>
   - <bStartPositioning> is reseted by the block itself
   - the block notifies <bPosRunning>
With reaching the target position, the message `<b>InPosition>` is set.

- A new target position is only possible after `<b>InPosition>` was set.
- For dynamic positioning, the input `<b>ChangeSetImmediate>` is usable
- It has the same conditions as `<b>StartPositioning>` but here is a new command possible during a movement.

### 3.4.3.3 other Operands at Block

- `<b>FaultReset>` acknowledgement of failures of Function block (watchdog) or drive (C3).
- `<b>Stop>` stops a positioning with rising edge
- `<b>Hold>` interrupt of Positioning command, as long as Bit it is `true`; Positioning will be finished when the bit is `false` again.
- `<b>JogN>` manual mode negative direction, as long as Bit it is `true`.
- `<b>JogP>` manual mode positive direction, as long as Bit it is `true`.

### 3.4.3.4 Messages and display

- `<b>CommErr>` communication with C3 not possible
- `<b>DriveErr>` C3 is in failure status
- `<stRd.nActualError>` actual Failure number of C3 (see C3 Help)
- `<stRd.iPositionValue>` actual position
- `<stRd.iVelocityValue>` actual velocity

### 3.4.3.5 read and write Parameters

- there are Parameters to be read or changed over bus. These are listed in the table „Objects for the Parameter channel“ (see C3 Help). Here is the correlating between Objects (C3) and PNU (PROFIdrive-Profile).
- the Parameters are selected with `<nPNUNIndex>` and `<nPNUSubindex>`
- the value is at `<iParameterValue>`
- `nCmd` is the command for the transfer
  - 1 command for read
  - 2 command for write Word parameter (16 Bit)
  - 3 command for write double word Parameter (32 Bit)
  - if you have a Parameter with 16 Bit or 32 Bit is shown in the table „Objects for the Parameter channel“: look at column „Bus format“.
- `<b>TransErr>` shows if there is failure with the data transfer.

### 3.5 settings for external Master

1. The function block is only possible with S7 PLC with integrated PROFIBUS DP Master: Without the block is not useable.

2. If this interface is used for another purpose and the connection to C3 should be realised with an external communication processor (CP342-5) the function block is possible to be used with following settings:
   - For running the CP 342-5 there are to functions: FC1 / FC2 (DP_SEND / DP_RECV, out of SIMATIC Standard library).
   - Put at DP_SEND the global output area, and at DP_RECV the global input area.
   - Attention! This global areas included the data's of all bus slaves.
   - The local field of C3 must be transferred to the field at DB45 (e.g. via SFC20 BLKMOV).
4 Application example

4.1 Overview of the connection:

Connection between one plc SIMATIC S7 300 as PROFIBUS DP Master and one drive C3 I20 T11 as PROFIBUS DP Slave.

4.2 cyclic channel (PZD)

The In- and output parameters are selected in the C3 servo manager wizard (folder communication). All tags are either word or double word format. The settings are instructed in the following order to assure the FB is working.

4.3 Acyclic channel (PKW)

Via the 8 Byte PKW interface the user is able to transfer additional parameter to or from C3. The block is using this interface to transfer deceleration and Failure number.
4.4 Application Positioning

In the S7 Program the FB45 is call up with all necessary parameters for positioning. The sequence is shown in following picture:
The sequence is done in FC400. With setting of

\[
M \quad 0.4 \quad \text{"start"}
\]

to TRUE The sequence is started with

\[
M \quad 0.5 \quad \text{"reset"}
\]
The sequence could be stopped.
4.5 Parameter channel

The PLC (HMI) is asking for the value of actual torque [683.1]
Also the value of stiffness [2100.2] should be changed. The procedure is explained with help of SIMATIC Variable table.

4.5.1 Used area

| DBW28 | nCmd | FB45 |
| DBW30 | nPNUIndex |
| DBW32 | nPNUSubindex |
| DBD34 | ParameterValue | DBX3.1 |

4.5.2 procedure for reading the value of actual torque [683.1]

1. look for “status of actual current value” in the Table „Object overview sorted by object name“

2. Open Object description:

pic 3
Status of actual current value (Object)

<table>
<thead>
<tr>
<th>Profibus No.</th>
<th>PNIU:112</th>
<th>Object No.</th>
<th>S83.1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Object name</strong></td>
<td><strong>C3.StatusDevice_ActualCurrent</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Unit of Travel</th>
<th>Access:</th>
<th>Read only</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bus format:</th>
<th>Valid after:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>E2 6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Minimum value</th>
<th>Maximum value</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0 n/a</td>
<td></td>
<td>n/a</td>
</tr>
</tbody>
</table>

**Remark:**
Actual current value (actual torque value)
The reference is the rated motor current

3. With this table you get the data for following parameters:

- nPNUIndex <112>
- nPNUSubindex <0>

4. Edit this two values and “activate modify values” (look in “variable”).

5. Next edit the commando for "read" (1) !

- nCmd <1>

6. “activate modify values” once more!
7. The Bus format is \textbf{E2.6} (see pic 4) that means we need to divide this value by 64. The result is in per cent rated to nominal value current.

\[ \frac{1199}{64} = 18.7 \]

8. To verify this result we use the status of the optimisation window:
4.5.3 sequence for changing value of stiffness

1. search for necessary Parameters
   
<table>
<thead>
<tr>
<th>Name:</th>
<th>Stiffness (control loop dynamics / Stiffness)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Object number:</td>
<td>C3.ControllerTuning_Stiffness</td>
</tr>
<tr>
<td>Bus format:</td>
<td>U16</td>
</tr>
<tr>
<td>unit</td>
<td>%</td>
</tr>
<tr>
<td>nPNUIndex</td>
<td>&lt;402&gt;</td>
</tr>
<tr>
<td>nPNUSubindex</td>
<td>&lt;2&gt;</td>
</tr>
</tbody>
</table>

2. transfer values via variable table

   
   | nPNUIndex | <402> |
   | nPNUSubindex | <2> |

   the default value for stiffness is 100 % increased by 10 % you get the value „110“:

   iParameterValue <110>

   „activate modify values“ (see “Variable”).

3. Activate the commandos:
   
   The Bus format is „U16“ a Word Format. So the command for write is „2“ (for Double Word Format is it „3‟).
nCmd <1>
“activate modify values” (see “Variable”).

4. The Object now is transferred, but you need to activate it by VP validate parameter.

5. For this reason you need to write the Object "ValidateParameter" (VP Object 210.10 C3.ValidateParameter_Global). The sequence is similar like stiffness.

6. Now the values are validated but not flashed. (with next power on the former value are reloaded). To write them to the Flash there’s the command Write Flash (WF Object 20.1 “C3.ObjectDir_Objekts-->FLASH”).

caution:
VP and WF use system resources, which decrease the effectiveness of internal communication. This may have the effect that there occur error messages like „cycle time overrun“. So you should use this two commands not too often. Try to use them during the axis is not energised. It would be better to change first a couple of parameters and activate them together by writing VP only one time.