SIMATIC NET Profibus with SIMATIC S5 FDL-Protocol

Hints for Configuration

Release, January 1999
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1 General Information

The “L2 FDL Connection” can be used in conjunction with the 95U, 115U, 135U and 155U model PLCs.

To facilitate the communication on the PLC side, various files, depending on the PLC model, are supplied. These files contain PLC blocks necessary for the connection, which must be loaded into the PLC. The user must call these blocks and set their parameters. An example is provided in the files. The examples also mention the VC6 and VC7 connections. These connections have not been implemented in WinCC.

The 115U, 135U and 155U model PLCs also require the configuration of the L2 communication processor. This processor and the associated SINEC NCM configuration package are not part of this shipment. A suggestion for the configuration can be found in the "Examples" chapter.

The connection employs the unused “Layer 2” services of the L2 bus on both, the OS and PLC, sides. The service used is SDA with low priority.

The baud rate of the OS can be set from the “PG/PC Interface” of the Windows Control Center and be configured for the 115U, 135U and 155U model PLCs using the SINEC NCM. For the 95U model PLC, the baud rate is set in DB1.

**The default SAP is 2 and must not be used as the connection SAP.**

Permitted value ranges of the OS-PLC connection in the L2 network:

- **L2 User Address = Station Number:** 1-31
- **SAP-Number OS:** 3 - 54
- **SAP-Number AG1x5U:** 3 - 54
- **SAP-Number AG95U:** 33 - 54

The following connections have been implemented: VC3, VC4 and VC5 (for the 95U model PLC only VC3 and VC4). Except for the 95U model PLC, these connections can also be turned off by changing the parameters.

The data of the Layer 2 telegrams consists of reduced length H1 telegrams (WRITE connection, 16 Byte header, max. 226 byte user data, raw data tag max. 220 byte) that are sent via VC3, VC4 and VC5. Only DB and/or DX data blocks can be sent.

Additional information about the application and error messages of the L2 connection can be found in the “SIMATIC S5” or your communication processor manuals.
2 Blocks in the PLC

At the PLC there are a maximum of nine blocks provided for the “L2 FDL Connection” that by default handle all data traffic. The numbers listed below are the numbers at the time of shipment.

All blocks can be renamed in case the FB or DB number is already in use.
In addition to DB/FB, DX/FX is also permitted. Also, the DB/DX can be generated in the PLC startup before the “FB L2 STARTUP” is called.

Certain data blocks are used by the operating system of the PLC and must not be employed as process DB/DX.
For the 95U model PLC these are: DB 0, DB 1 (DX not available)

115U model PLC: DB 0 (CPU 943-944: DX not available, CPU 945: DX possible)
135U model PLC: DB 0, DB 1, DB 2, DX 0
155U model PLC: DB 0, DB 1, DX 0, DX 1

The default handling blocks (HTB) are not part of the shipment.

For the 115U, 135U and 155U model PLCs, the HTB SYNCHRON, CONTROL, SEND-direct and RECEIVE-direct must be available. For the 95U model PLC, the HTB L2-SEND and L2-REC must be available.

<table>
<thead>
<tr>
<th>PLC 95U</th>
<th>BIB. No.</th>
<th>PLC 115U (CPU944)</th>
<th>BIB. No.</th>
<th>PLC 115U (CPU945)</th>
<th>BIB. No.</th>
<th>PLC 15U</th>
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<tr>
<td>FB 9</td>
<td>90911</td>
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<td>FB 11</td>
<td>31121</td>
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<td>DB 9</td>
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<tr>
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For the OB 20, 21 and 22 startup (115U model PLC only OB 21 and 22):

FB L2 STARTUP (FB 9)

For the cyclical operation of OB 1:

FB L2 SNDRCV (FB 10)

As subprogram of the FB L2 SNDRCV (only 135U model PLC):

FB CONNECT (FB11)

As internal process data blocks for both FBs: 95U model PLC:

DB CONNECT (DB 9) Length: 32 DW
DB L2 DBVC3 (DB 10) " 145 DW
DB L2 DBVC4 (DB 11) " 145 DW

All blocks must be available.
115U, 135U and 155U model PLCs:

- DB CONNECT (DB 9) Length: 14 DW (only 135U model PLC)
- DB L2 DBVC3 (DB 10) " 330 DW
- DB L2 DBVC4 (DB 11) " 330 DW
- DB L2 DBVC5 (DB 12) " 330 DW

If the VCx is not used, no DB L2 DBVCx is necessary. DB CONNECT must always be available for the 135U model PLC.

Shortening the DB/DX:

If the data blocks are shortened, you might not be able to easily recognize all cases of errors, e.g. a reversal of the VC3 and VC4 connections. Therefore, apply a shortening only when necessary and only after the commissioning phase.

95U model PLC:

If it has been assured that only net data amounts < 113 DWs are sent via VC3, the DB L2 DBVC3 can be shortened. The same holds true for VC4 and DB L2 DBVC4. The length of the data record sent by the OS depends on the configuration of the operations (number of simultaneously adjusted values). The net data record starts at DW 32 for both DBs. DB CONNECT can not be shortened. It can be extended to 145 DWs if there are connection problems in order to achieve acceptance of misdirected telegrams.

115U, 135U and 155U model PLCs:

The DB L2 DBVC3 and DB L2 DBVC5 can be shortened to 217 DWs. The DB L2 DBVC4 has been configured to receive net data records that are 113 DWs long. If fewer data is sent from the OS to the PLC, the DB can be shortened accordingly. This depends on the configuration of the OS (number of simultaneously adjusted values).

3 Interruption via Time and Process Alarms (OB)

The FB L2 SNDRCV in the cyclical OB 1 can be interrupted by alarm and time controlled organization blocks (OB). The startup OBs can also be interrupted at the command limits. This creates the danger of overwriting the storage flags internally used in the FB L2 SNDRCV, if the same flags are also used in the interrupting block. The same danger also exists for interruptions at the block limits, since the FB L2 SNDRCV in the 135U model PLC calls the FB CONNECT.

If such organization blocks are employed, the flag range used (recommendation: MW200 - MW254) should first be saved into a data block (DB) and be restored before exiting the OB.

4 Additional Connection

For an additional connection to a second OS, additional data blocks (DB CONNECT, DB L2 DBVC3, DB L2 DBVC5, DB L2 DBVC5) are needed (depending on the type of connection: VC3/VC4 or VC5/VC4), which must be preset during startup by calling FB L2 STARTUP. Besides that, this connection requires a modified copy of the FB CONNECT for the 95U and 135U model PLCs.
5 Description of the Function Blocks (FB)

5.1 FB L2STARTUP, Startup Block

The startup FB presets the data blocks, which allows them to be processed by the cyclical FB. The L2 CP interface of the 115U, 135U and 155U model PLCs will be synchronized, if at least one VC has not been turned off. The turn off is accomplished by entering DB0 in the DBX3-7 parameters (not 95U model PLC).

Internally used flags:

- 95U model PLC:
  MB 200 - MB 205 (storage flags)

- 115U model PLC:
  MB 200 - MB 233

- 135U model PLC:
  MB 200 - MB 235

- 155U model PLC:
  MB 200 - MB 233

- 95U model PLC:
  DBX3 : Specify the DB L2 DBVC3 here, which is used internally. Format: KY x,y  x=0: DB selected (must equal zero). Invalid for the 95U model PLC: DB 0, DB 1, DB 10.
  DBX4 : Specify the DB L2 DBVC4, same as DBX3. Must not be identical to DBX3!
  DBVB : Specify the DB CONNECT here. Specification is the same as for the DBX3, however, the value y must be unequal to zero! Must not be identical to DBX3 or DBX4!

  SBR3 : Number of the receive status byte for VC3, as in DB1.
  SBS3 : Number of the send status byte for VC3, as in DB1.
  SBR4 : Number of the receive status byte for VC4, as in DB1.
  SBS4 : Number of the send status byte for VC4, as in DB1.
  TIM3 : Timeout duration of the OS reply for the VC3 connection.
  RADR : User number of the partner OS on the L2 bus. Corresponds to the OS address set in the PG/PC interface.
  RVC3 : SAP of the OS for the VC3. Corresponds to the number set in the OS.
  RVC4 : Same as RVC3, only for the VC4.
  ANR3 : Job number (=SAP) for the VC3 connection. As in DB1.
  ANR4 : Same as ANR3, only for the VC4 connection.
- 115U, 135U and 155U model PLCs:

SSNR : The interface number set in the L2 CP must be specified here.
TIM3 : Timeout duration of the OS reply for the VC3 connection. If VC3 is turned off, this parameter can be set arbitrarily.
TIM7 : KT= 0.0, not used.
RADR : User number of the partner OS on the L2 bus. Corresponds to the L2 CP address set in the OS.
RVC3 : SAP of the OS for the VC3. Corresponds to the number set in the OS. If VC3 is turned off, this parameter can be set arbitrarily.
RVC4 : Same as RVC3, only for the VC4.
RVC5 : Same as RVC3, only for the VC5.
RVC6 : KF=0, not used.
RVC7 : KF=0, not used.
ANR3 : Job number for the VC3 connection. Corresponds to the job number set in the L2 CP. If VC3 is turned off, this parameter can be set arbitrarily.
ANR4 : Same as ANR3, only for the VC4 connection.
ANR5 : Same as ANR3, only for the VC5 connection.
ANR6 : KF=0, not used.
ANR7 : KF=0, not used.
DBX3 : Specify the DB L2 DBVC3 here, which is used internally. Format: KY x,y
  x=0: DB selected; x<>0: DX selected
  y=DB/DX Number
  y=0: this VC is turned off
  Invalid for the
  115U model PLC (-CPU944) are: DB 0, all DX
  115U model PLC (CPU945) are: DB 0
  135U model PLC are: DB 0, DB 1, DB 2, DX 0
  135U model PLC are: DB 0, DB 1, DB 2, DX 0
  155U model PLC are: DB 0, DB 1, DX 0, DX 1

DBX4 : DB L2 DBVC4, same as DBX3. Must not be identical to DBX3!
DBX5 : DB L2 DBVC5, same as DBX3. Must not be identical to DBX3 or DBX4!
DBX6 : KY= 0.0 not used.
DBX7 : KY= 0.0 not used.
DBVB : (only for the 135U model PLC) Specify the DB CONNECT here. Specification is the same as for the
  DBX3, however, the value y must be unequal to zero! Must not be identical to DBX3, DBX4 or
  DBX5!
S/R3 : Switch for VC3 between the write and send/receive connection. If KF +1 is entered, the
  send/receive connection will be selected. If > <1, the write connection will be selected.
5.2 FB L2 SNDRCV, cyclical Block

In the cyclical FB, the telegram traffic is processed.

Connection Channels of the 95U model PLC:

VC3 : Telegrams to be sent are entered into the DB L2 DBVC3 by the user. The source is specified according to the default handling blocks. After the transmission has concluded, a positive or negative feedback response is sent.

VC4 : Received telegrams are entered in the DB L2 DBVC4 and the target is specified. If an error occurs, the telegram is discarded and an error message is generated.

Connection Channels of the 115U, 135U and 155U model PLCs:

VC3 : Telegrams to be sent are specified by the user according to the default handling block. After the transmission has concluded, a positive or negative feedback response is sent.

VC4 : Received telegrams are entered in the target data block. If an error occurs, the telegram is discarded, an error message is generated and an error telegram is sent at VC3.

VC5 : Requested data telegrams are combined and sent. If errors occur, an error telegram is sent and an error message is generated.

Internally used flags:

95U model PLC MB 224 - MB 255 (storage flags)
115U model PLC MB 238 - MB 255 (""
135U model PLC MB 232 - MB 255 ("
155U model PLC MB 238 - MB 255 ("

Flags from this range must not be specified as parameters!

- 95U model PLC:

STR3 : Flag bit; activation of transmission VC3. Is set by the user, after the data and the data source have been entered into the working DB L2 DBVC3. At the start of the transmission, the flag is reset. As long as the previous send job is running, i.e. the RDY3 flag has not been set, a start will not be accepted. The flag must not originate from the RDY or FAIL bytes.

RDY : Flag byte, job completed. The bit numbers 3/4 (RDY3/RDY4) are assigned to the VC3/4. The remaining bit numbers should not be used, since the entire byte is read and written.

RDY3 : Sending VC3 completed. Is reset at the start of the transmission together with STR3. The bit is set after the startup of the PLC.

RDY4 : Receive VC4 completed. Is only pending for one cycle, after the telegram has been entered into the DB L2 DBVC4. An evaluation and transmission of the data must be performed during the same cycle.

FAIL : Flag byte, job completed with error. The bit numbers 3/4 (FAIL3/FAIL4) are assigned to the VC3/4. The remaining bit numbers should not be used. The error is broken down in the corresponding DB L2 DBVC3/4.

FAIL3 : Sending VC3 completed with error. Where appropriate, appears simultaneously with RDY3. Is reset at the start of the transmission together with STR3.

FAIL4 : Error while receiving VC4. Is pending as long as an error is detected or until a telegram is accepted without error.

TVC3 : Timer for monitoring the duration until an OS reply is given to a telegram sent via VC3.

DBVB : The same DB CONNECT must be specified here as for the call of the FB L2 STARTUP. See there for parameter specifications.

FBVB : The sub-program block FB CONNECT is specified here, which is called by the FB L2 SNDRCV. Format: KY x,y x=0 (fixed); y=FB Number
- 115U, 135U and 155U model PLCs (depending on the PLC type, some parameters can be missing):

**STR3** : Flag bit; activation of transmission VC3. Is set by the user, after the data source has been entered into the working DB L2 DBVC3. At the start of the transmission, the flag is reset. As long as the previous send job is running, i.e. the RDY3 flag has not been set, a start will not be accepted. The flag must not originate from the RDY or FAIL bytes.

**RDY** : Flag byte, job completed. The bit numbers 3-7 (RDY3-RDY7) are assigned to the VC3-7. The bit numbers 0-2 should not be used, since the entire byte is read and written.

**RDY3** : Sending VC3 completed. Is reset at the start of the transmission together with STR3. The bit is set after the startup of the PLC.

**RDY4** : Receive VC4 completed. Is only pending for one cycle, after the telegram has been entered into the target DB/DX. An evaluation is normally not required.

**RDY5** : Fetch VC5 completed. Is only pending for one cycle, after the sent data telegram has been acknowledged by the OS CP. An evaluation is normally not required.

**FAIL** : Flag byte, job completed with error. The bit numbers 3-5 (FAIL3-FAIL5) are assigned to the VC3-5. The bit numbers 0-2 should not be used. The error is broken down in the corresponding DB L2 DBVC3-7.

**FAIL3** : Sending VC3 completed with error. Where appropriate, appears simultaneously with RDY3. Is reset at the start of the transmission together with STR3.

**FAIL4** : Error while receiving VC4. Is pending as long as an error is detected or until a telegram is accepted without error.

**FAIL5** : Fetch VC5 error. Is pending as long as an error is detected or until a data telegram is accepted by the OS without error.

**TVC3** : Timer for monitoring the duration until an OS reply is given to a telegram sent via VC3. If VC3 is turned off, the timer will not be used.

**DBX3** : The same DB L2 DBVC3 must be specified here as for the call of the FB L2 STARTUP. See therefor parameter specifications. It is possible to turn the VC3 off. However, it must be performed, if it has been turned of in the startup.

**DBX4** : DB L2 DBVC4, parameters according to DBX3.

**DBX5** : DB L2 DBVC5, parameters according to DBX3.

**DBVB** : The same DB CONNECT must be specified here as for the call of the FB L2 STARTUP. See there for parameter specifications.

**FBVB** : The sub-program block FB CONNECT is specified here, which is called by the FB L2 SNDRCV (only 95U and 135U model PLCs).

Format: KY x,y

x=0: FB selected; x<>0: FX selected

y=FB/FX Number
5.3 FB CONNECT, Sub-Program of the FB L2 SNDRCV (95U and 135U model PLCs)

The FB CONNECT is only available for the 95U and 135U model PLCs. In the FB CONNECT, two parameters of the handling blocks called there must be entered by the user. These are the DBNR parameters for the L2 REC and L2 SEND blocks. The DB CONNECT must be entered here, which has also been configured in the calling FB L2 SNDRCV (see provided example in the PLC program).

Format: KY x,y
x=0: DB selected; x<0: DX selected
y=DB/DX Number

6 DB/DX User Interface

During startup, the working DB/DX are preset by the FB L2 STARTUP, if the corresponding VC has not been turned off. Without these preset values, the cyclical FB L2 SNDRCV can not operate correctly. Also, overwriting the working DB/DX during cyclical operations can lead to errors. Therefore make sure that VC4 is not used to write to the working DB/DX.

6.1 Internal Working DB 95U model PLC

- Data words to be written by the user (only VC3):

Specification of the data record to be sent in the DB L2 DBVC3

DW 11: DBNR; Number of the source DB in KF format.
DW 12: QANF; Number of the first data word to be sent in KF format.
DW 13: QLAE; Quantity of the data words to be sent in KF format.
Only the QLAE specification will be checked!

Entry of the data to be transmitted

DW 32 to DW 144: The user data to be transmitted is stored starting with DW 32.

This data must be entered before setting the STR3 start flag of the FB L2 SNDRCV and must remain unchanged until the RDY3 flag appears again.

- Data words to be evaluated by the user (only VC4):

Specification of the data record to be accepted in the DB L2 DBVC4

DW 11: DBNR; Number of the target DB in KF format.
DW 12: ZANF; Number of the first data word to be written in KF format.
DW 13: ZLAE; Quantity of the data words to be accepted in KF format.

These specifications originate from the telegram received and are not checked!

Data to be accepted

DW 32 to DW 144: The user data received is stored starting with DW 32.

With the appearance of the RDY4 flag (impulse), the user can copy the user data to the target location. Afterwards, the user data can be destroyed by another telegram.
- Data words that can be evaluated by the user (error messages VC3-4):

If an error flag (FAIL3-4) of the FB L2 SNDRCV appears, the error can be more closely identified via the error words of the corresponding DB L2 DBVC3/4. If applicable, a reference to the error location is given there.

**DR 2 : Error Bits Receive Confirmation VC3/4**

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Receive telegram not accepted.</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>PAFE receive confirmation.</td>
<td>DL 5</td>
</tr>
<tr>
<td>2</td>
<td>Status byte ready with error receive confirmation.</td>
<td>DL 7, DR 7</td>
</tr>
<tr>
<td>3</td>
<td>Illegal user is sending.</td>
<td>DL 15, DR 15</td>
</tr>
<tr>
<td>4</td>
<td>Free</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Free</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>L2 link status error message.</td>
<td>DL 14</td>
</tr>
<tr>
<td>7</td>
<td>Free</td>
<td></td>
</tr>
</tbody>
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**DR 3 : Error Bits Receive Indication VC3/4**

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<th>Description</th>
<th>Reference</th>
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<tbody>
<tr>
<td>0</td>
<td>Receive telegram not accepted.</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>PAFE receive indication.</td>
<td>DR 5</td>
</tr>
<tr>
<td>2</td>
<td>Status byte ready with error receive indication.</td>
<td>DR 16</td>
</tr>
<tr>
<td>3</td>
<td>Illegal user is sending.</td>
<td>DL 15, DR 15</td>
</tr>
<tr>
<td>4</td>
<td>Free</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Free</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Received H1 header contains errors.</td>
<td>DW 17 (VC3)</td>
</tr>
<tr>
<td>7</td>
<td>Partner is acknowledging with H1 error.</td>
<td>DL 16 (VC3)</td>
</tr>
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**DR 4 : Error Bits Send Request VC3/4**

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<tr>
<td>0</td>
<td>Group error of DR 2, DR 3 and DR 4.</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>PAFE send.</td>
<td>DL 4</td>
</tr>
<tr>
<td>2</td>
<td>Status byte ready with error send request.</td>
<td>DL 7</td>
</tr>
<tr>
<td>3</td>
<td>Timeout, confirmation or H1 acknowledgment not received.</td>
<td>VC3</td>
</tr>
<tr>
<td>4</td>
<td>Free</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Free</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Free</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>QLAЕ from the parameter set not valid.</td>
<td>DW 13</td>
</tr>
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**Data Words for Identifying Errors VC3/4**

| DL 4 | PAFE send                                    |
| DL 5 | PAFE receive                                 |
| DL 7 | Status byte confirmation                     |
| DW11 | DBNR data source/target, entered by/for the user |
| DW12 | QANF/ZANF data source/target, entered by/for the user |
| DW13 | QLAЕ/ZLAЕ data source/target, entered by/for the user |
| DL 14 | Link status display (at confirmation)        |
| DL 15 | Source user address (from partner)           |
| DR 15 | Source SAP (from partner)                    |
| DR 16 | Status byte confirmation                     |
| DW17 | 3rd H1 header (correct VC3: KH 0304, VC4: KH 0303) |

If an error bit appears, it is only guaranteed for the first cycle that the corresponding data word for the error identification contains the correct information. These data words are written cyclically.
6.2 Internal Working DB/DX 115U, 135U and 155U model PLCs

- Data words to be written by the user (only VC3):

Specification of the data record to be sent in the DB L2 DBVC3

- DW 30: QTYP; Type of the data source in KC format, “DB” or “DX” (for the 115U model PLC up to CPU944 only “DB”, with CPU945 also “DX”).
- DW 31: DBNR; Number of the source DB or DX in KF format. Invalid for the 115U model PLC are: DB 0
  135U model PLC: DB 0, DB 1, DB 2, DX 0
  155U model PLC: DB 0, DB 1, DX 0, DX 1.
- DW 32: QANF; Number of the first data word to be sent in KF format.
- DW 33: QLAE; Quantity of the data words to be sent in KF format.

This data must be entered before setting the STR3 start flag of the FB L2 SNDRCV and must remain unchanged until the RDY3 flag appears again.

- Data words that can be evaluated by the user (error messages VC3-5):

If an error flag (FAIL3-5) of the FB L2 SNDRCV appears, the error can be more closely identified via the error words of the corresponding DB L2 DBVC3-5. If applicable, a reference to the error location is given there.

**DW 11 : Error Bits Receive and Send VC3-5**

<table>
<thead>
<tr>
<th>Bit</th>
<th>Error Description</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Group error DW 11/12</td>
<td>DL 7</td>
</tr>
<tr>
<td>1</td>
<td>PAFE synchron, FB L2 SNDRCV locked.</td>
<td>DW 9/10</td>
</tr>
<tr>
<td>2</td>
<td>PAFE control, send and receive locked.</td>
<td>DW 9/10</td>
</tr>
<tr>
<td>3</td>
<td>PAFE receive</td>
<td>DL 8</td>
</tr>
<tr>
<td>4</td>
<td>PAFE rend</td>
<td>DR 8</td>
</tr>
<tr>
<td>5</td>
<td>ANZW ready with error at send job.</td>
<td>DW 207, DL 208</td>
</tr>
<tr>
<td>6</td>
<td>ANZW ready with error at receive job.</td>
<td>DL 206</td>
</tr>
<tr>
<td>7</td>
<td>Illegal user is sending</td>
<td>DL 205</td>
</tr>
<tr>
<td>8</td>
<td>No SDA identification in telegram.</td>
<td>DL 206</td>
</tr>
<tr>
<td>9</td>
<td>Received L2 telegram type is not “confirmation”</td>
<td>DL 205</td>
</tr>
<tr>
<td></td>
<td>(for VC3-VC5 also not “indication”).</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>L2 link status error message.</td>
<td>DL 206</td>
</tr>
<tr>
<td>11</td>
<td>Confirmation has different user ID than previous job.</td>
<td>DR 205: User ID confirmation, DR 75:</td>
</tr>
<tr>
<td></td>
<td>User ID request</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Telegram received simultaneously with send activation.</td>
<td>DR 206</td>
</tr>
<tr>
<td>13</td>
<td>Received H1 header contains errors.</td>
<td>DW 209-216</td>
</tr>
<tr>
<td>14</td>
<td>Partner is acknowledging with H1 error.</td>
<td>DL 213</td>
</tr>
<tr>
<td>15</td>
<td>Timeout, confirmation or H1 acknowledgment not received.</td>
<td></td>
</tr>
</tbody>
</table>
SIMATIC PLC L2 Connection to WinCC

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**DW 12 : Error Bits Telegram Format VC3**
- Bit 0 : free
- Bit 1 : free
- Bit 2 : QTYP source type identification invalid in the parameter set, only KC DB or KC DX (for the 115U model PLC up to CPU944 only “DB”, with CPU945 also “DX”) -> DW 30
- Bit 3 : Source DB/DX number from the parameter set of the PLC is not available or invalid. -> DW 31
- Bit 4 : QANF or QLAE from the parameter set are not located in the source DB/DX. -> DW 32/33
- Bit 5 : free
- Bit 15 : free

**DW 12 : Reconfiguring Error Bits of the Received Data VC4**
- Bit 0 : free
- Bit 1 : free
- Bit 2 : ZTYP target type ORG identification in the H1header invalid, only DB=01H or DX=0AH (for the 115U model PLC up to CPU944 only “DB”, with CPU945 also “DX”) -> DL 213
- Bit 3 : Target DB/DX number from the H1 header of the PLC is not available or invalid. -> DR 213
- Bit 4 : ZANF or ZLAE from the H1 header is incorrect. Data does not fit into the target DB/DX. -> DW 214/215
- Bit 5 : free
- Bit 15 : free

**DW 12 : Error Bits Telegram Evaluation and Format VC5**
- Bit 0 : free
- Bit 1 : free
- Bit 2 : QTYP source type ORG identification in the H1header is invalid, only DB=01H or DX=0AH (for the 115U model PLC up to CPU944 only “DB”, with CPU945 also “DX”) -> DL 213
- Bit 3 : Source DB/DX number from the H1 header of the PLC is not available or invalid. -> DR 213
- Bit 4 : QANF or QLAE from the H1 header is incorrect. Data record is incomplete in the source DB/DX. -> DW 214/215
- Bit 5 : free
- Bit 15 : free
Data Words for Identifying Errors VC3-5

**DL** 7 : PAFE synchron
**DR** 7 : PAFE control
**DL** 8 : PAFE receive
**DR** 8 : PAFE send
**DW** 9 : ANZW standard handling blocks HTB
**DW** 10: ANZW length of the data HTB
**DW** 30: QTYP/ZTYP data source/target, entered by the user.
**DW** 31: DBNR data source/target, entered by the user.
**DW** 32: QANF/ZANF data source/target, entered by the user.
**DW** 33: QLAE/ZLAE data source/target, entered by the user.
**DR** 75: User ID (telegram number) request block.
**DL** 205: L2 telegram type (FDL identification receive, confirmation: 1, indication: 2)
**DR** 205: User ID (telegram number) confirmation block of the request.
**DL** 206: L2 service identification. (SDA: 0)
**DR** 206: Link status display (for Confirmation)
**DR** 207: Source SAP (from the partner)
**DL** 208: Source user address (from the partner)
**DW** 209: H1 header VC3-5 (correct KC S5)
**DW** 210: H1 header VC3-5 (correct KY 16,1)
**DW** 211: H1 header VC3-5 (correct VC3: KH 0304, VC4: KH 0303, VC5: KH 0305)
**DW** 212: H1 header VC3-5 (correct VC3: KH 0F03, VC4-5: KH 0308)
**DL** 213: H1 header VC3-5 VC3: H1 error message number, VC4/VC5: target/source DB/DX ORG identification (DB: KP 1, DX: KP 10)
**DR** 213: H1 header VC3-5 (correct VC3: KH FF), VC4/VC5: target/source DB/DX number.
**DW** 214: H1 header VC3-5 (correct VC3: KH 07xx, x=any), VC4/VC5: ZANF/QANF start address in the target/source DB/DX.
**DW** 215: H1 header VC3-5 VC3: any, VC4/VC5: ZLAE/QLAE quantity of the data words to be entered/sent.
**DW** 216: H1 header VC3-5 VC3: any (correct VC4-5: KH FF02)
7 Examples

7.1 Example of an OS Connection to a 95U model PLC

Data of the L2 Connection

<table>
<thead>
<tr>
<th>PLC:</th>
<th>OS:</th>
<th>Value Range:</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>L2 User Address</td>
<td>3</td>
</tr>
<tr>
<td>33</td>
<td>SAP VC3</td>
<td>5</td>
</tr>
<tr>
<td>34</td>
<td>SAP VC4</td>
<td>6</td>
</tr>
<tr>
<td>33</td>
<td>Job Number VC3</td>
<td>-</td>
</tr>
<tr>
<td>34</td>
<td>Job Number VC4</td>
<td>-</td>
</tr>
</tbody>
</table>

PLC Connections

DB 1:

0: KC = 'DB1 OBA: AI 0 ; OBI: `; 
12: KC = ` ; OBC: CAP N CBP `; 
24: KC = N ;#SL1: SLN 1 SF `; 
36: KC = 'DB2 DW0 EF DB3 DW0 `; 
48: KC = ' KBE MB100 KBS MB1`; 
60: KC = '01 PGN 1 ;# SDP: N`; 
72: KC = 'T 128 PBUS N ; TFB: OB13`; 
84: KC = '100 ;#CLP: STW MW10`; 
96: KC = '2 CLK DB5 DW0 `; 
108: KC = ' SET 3 01.10.91 12:00:00`; 
120: KC = '00 OHS 000000:00:00 `; 
132: KC = ' TIS 3 01.10. 12:00:00 `; 
144: KC = ' STP Y SAV Y CF 00 `; 
156: KC = '# SL2: TLN 4 STA AKT`; 
168: KC = ' BDR 187.5 HSA 10 TRT`; 
180: KC = '5120 SET 80 ST 400 `; 
192: KC = ' SDT 1 80 SDT 2 360 ST`; 
204: KC = ' BS 33 MB50 STBR 33 MB52 `; 
216: KC = ' STBS 34 MB54 STBR 34 `; 
228: KC = ' MB56 ; ERT: ERR MW70 ; `; 
240: KC = 'END`; 

Remote parameters are not specified for free layer 2 connections.

In this example, the control bytes occupy the flag bytes MB50 to MB57 (including).
OS Connections

PG/PC Interface:
(own) L2 Network Address: 3

WinCC Control Center:
L2 PLC Station Number (=user address): 4
VC3 Connection Type: Write

VC Values:

<table>
<thead>
<tr>
<th>SAP OS</th>
<th>SAP PLC</th>
</tr>
</thead>
<tbody>
<tr>
<td>VC3</td>
<td>5   33</td>
</tr>
<tr>
<td>VC4</td>
<td>6   34</td>
</tr>
</tbody>
</table>

PLC Startup

OB 21
: SPA FB  9
NAME : L2 STARTUP
SBR3 : KF +52 No. of the status byte send VC3
SBS3 : KF +50 No. of the status byte receive VC3
SBR4 : KF +56 No. of the status byte send VC4
SBS4 : KF +54 No. of the status byte receive VC4
TIM3 : KT 005.2 Timeout of the OS reply if sent via VC3
RDR  : KF +3 L2 user address of the OS
RVC3 : KF +5 SAP number of the OS VC3
RVC4 : KF +6 SAP number of the OS VC4
ANR3 : KF +33 Job number HTB VC3 (=SAP VC3)
ANR4 : KF +34 Job number HTB VC4 (=SAP VC4)
DBX3 : KY 0,10 DB 10 is an internal working DB for VC3
DBX4 : KY 0,11 DB 11 is an internal working DB for VC4
DBVB : KY 0,9 DB 9 is an internal connection DB

Cyclical Call of the FB L2 SNDRCV

OB 1
:SPA FB 10
NAME :L2 SNDRCV
STR3 : M 10,0 Send activation VC3
RDY  : MB 11 Job completed VC3/4
FAIL : MB 12 Job completed with error VC3/4
TVC3 : T 10 Timer for send monitoring VC3
DBVB : KY 0,9 DB 9 is an internal connection DB
FBVB : KY 0,11 FB 11 contains the HTB calls

FB CONNECT (FB11) must be available in the PLC. It must be adapted to the FB10 call.
FB 11

NETWORK 1
NAME : RECVSEND
  : SPB =SEND
  : SPA FB 253
NAME : L2-REC
A-NR : KY 0,0
ZTYP : KC YY
DBNR : KY 0,9 <-- same value as DBVB (FB 10)
ZANF : KF +3
ZLAE : KF +0
  : BEA
SEND : SPA FB 252
NAME : L2-SEND
A-NR : KY 0,0
QTYP : KC YY
DBNR : KY 0,9 <-- same value as DBNR above
QANF : KF +3
QLAE : KF +0
  : BE

For the image update, the PLC is supposed to transmit (VC3) the data words DW 3 to DW 6 from the DB 100.

- Enter the data source into the DB L2 DBVC3

  The RDY3 flag (M 11.3) should be “1”, i.e. the previous data transfer has been completed.

  You can now enter the data and the data source into the DB L2 DBVC3.

  DB 10
  DW 11: KF +100
  DW 12: KF +3
  DW 13: KF +4
  DW 32: DW 3 from DB 100
  DW 33: DW 4 from DB 100
  DW 34: DW 5 from DB 100
  DW 35: DW 6 from DB 100

- Send Activation

  Set the STR3 flag M 10.0 to “1”.
  After the transfer has initiated, the STR3 flag will be reset. At the latest after the timeout duration TIM3 (5 sec.) of the startup FB has expired, the transfer is complete or has aborted. The RDY3 flag is set to “1”. If an error occurred, the FAIL3 flag (M 12.3) will be set as well.
The PLC is supposed to receive (VC4) data from an operation of the OS.

- The call of the FB L2 SNDRCV remains the same. An additional call is not required.

- If a telegram is received and has been entered into the DB L2 DBVC4, the RDY4 flag (M 11.4) will be set for one cycle. If the telegram can not be entered or was received with errors, the FAIL4 flag (M 12.4) is set until a telegram can be entered without errors.

- If the RDY4 flag is “1”, the data target and the data can be evaluated.

DB 11
DW 11: KF +101
DW 12: KF +5
DW 13: KF +2
DW 32: DW 5 for DB 101
DW 33: DW 6 for DB 101
### 7.2 Example of an OS Connection to a 115U, 135U, 155U model PLC

#### Data of the L2 Connection

<table>
<thead>
<tr>
<th>PLC:</th>
<th>OS:</th>
<th>Value Range:</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Interface Number</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>L2 User Address</td>
<td>3</td>
</tr>
<tr>
<td>10</td>
<td>SAP VC3</td>
<td>5</td>
</tr>
<tr>
<td>11</td>
<td>SAP VC4</td>
<td>6</td>
</tr>
<tr>
<td>12</td>
<td>SAP VC5</td>
<td>7</td>
</tr>
<tr>
<td>134</td>
<td>Job Number VC3</td>
<td>-</td>
</tr>
<tr>
<td>135</td>
<td>Job Number VC4</td>
<td>-</td>
</tr>
<tr>
<td>136</td>
<td>Job Number VC5</td>
<td>-</td>
</tr>
</tbody>
</table>

#### Connections on the L2 CP of the PLC

- **CP Init:**
  - L2 Address: 4
  - Active/Passive: ACTIVE
  - Basic SSNR: 0

- **Network Parameters:**
  - Baud Rate: 187500 Baud
  - Default SAP: 2

The other bus parameters depend on the bus configuration.

- **Free Layer 2 Connections:**
  - PRIO: L L L L
  - SSAP: 10 11 12
  - SSNR: 0 0 0
  - ANR: 134 135 136

Remote parameters are not specified for free layer 2 connections.
OS Connections

PG/PC Interface:
Baud Rate: 187.5 kBaud
(own) L2 Network Address: 3

WinCC Control Center:
L2 PLC Station Number (=user address): 4
VC3 Connection Type: Write
VC Values:

<table>
<thead>
<tr>
<th>VC</th>
<th>SAP OS</th>
<th>SAP PLC</th>
</tr>
</thead>
<tbody>
<tr>
<td>VC3</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>VC4</td>
<td>6</td>
<td>11</td>
</tr>
<tr>
<td>VC5</td>
<td>7</td>
<td>12</td>
</tr>
</tbody>
</table>

PLC Startup

OB 21
: SPA FB 9
NAME : L2 STARTUP
SSNR : KF +0 Interface Number L2 CP
TIM3 : KT 005.2 Timeout of the OS reply if sent via VC3
TIM7 : KT 000.0 not used
RADR : KF +3 L2 user address of the OS
RVC3 : KF +5 SAP number of the OS VC3
RVC4 : KF +6 SAP number of the OS VC4
RVC5 : KF +7 SAP number of the VC5
ANR3 : KF +134 Job number HTB VC3
ANR4 : KF +135 Job number HTB VC4
ANR5 : KF +136 Job number HTB VC5
ANR6 : KF +0 not used
ANR7 : KF +0 not used
DBX3 : KY 0,10 DB 10 is an internal working DB for VC3
DBX4 : KY 0,11 DB 11 is an internal working DB for VC4
DBX5 : KY 0,12 DB 12 is an internal working DB for VC5
DBX6 : KY 0,0 not used
DBX7 : KY 0,0 not used
DBVB : KY 0,9 DB 9 is an internal connection DB
S/R3 : KF +0 VC3 has write connection

(For the 115U and 155U model PLCs, the parameter DBVB is omitted.)

Cyclical Call of the FB L2 SNDRCV in the 135U model PLC:

OB 1
: SPA FB 10
NAME : L2 SNDRCV
STR3 : M 10.0 Send activation VC3
STR7 : M 10.1 Occupy with log 0 or free flag
RDY : MB 11 Job completed VC3-5
FAIL : MB 12 Job completed with error VC3-5
TVC3 : T 10 Timer for send monitoring VC3
TVC7 : T 11 Cleared timer
DBVB : KY 0,9 DB 9 is an internal connection DB
FBVB : KY 0,11 FB 11 contains the HTB calls

FB CONNECT (FB11) must be available in the PLC. It must be adapted to the FB10 call.
FB 11
NETWORK 1
NAME : RECVSEND
   : LW  =SEND
   : L  KB 1
   : !=F
   : SPB =SEND
   : SPA FB 121
NAME : RECEIVE
SSNR : KY 255,3
A-NR : KY 0,0
ANZW : MW 0
ZTYP : KC XX
DBNR : KY 0,9  <-- same value as DBVB (FB 10)
ZANF : KF +6
ZLAE : KF +0
PAFE : MB 241
   : BEA
SEND : SPA FB 120
NAME : SEND
SSNR : KY 255,3
A-NR : KY 0,0
ANZW : MW 0
QTYP : KC XX
DBNR : KY 0,9  <-- same value as DBNR above
QANF : KF +10
QLAE : KF +0
PAFE : MB 241
   : BE

Cyclical Call of the FB L2 SNDRCV in the 115U and 155U model PLCs:

OB 1
   : SPA FB 10
NAME : L2SNDRCV
STR3 : M 10.0  Send Activation VC3
STR7 : M 10.1  Occupy with log 0 or free flag
RDY : MB 11  Job completed VC3-5
FAIL : MB 12  Job completed with error VC3-5
TVC3 : T 10  Timer for send monitoring VC3
TVC7 : T 11  Cleared timer
DBX3 : KY 0,10  DB 10 is an internal working DB for VC3
DBX4 : KY 0,11  DB 11 is an internal working DB for VC4
DBX5 : KY 0,12  DB 12 is an internal working DB for VC5
DBX6 : KY 0,0  not used
DBX7 : KY 0,0  not used

FB11 is not required in the 115U and AG155U model PLCs.
For the image update, the PLC is supposed to transmit (VC3) the data words DW 3 to DW 6 from the DB 100.

- Enter the data source into the DB-L2DBVC3

  The RDY3 flag (M 11.3) should be “1”, i.e. the previous data transfer has been completed.

  You can now enter the data source into the DB L2 DBVC3.

  DB 10
  DW 30: KC DB
  DW 31: KF +100
  DW 32: KF +3
  DW 33: KF +4

- Send Activation

  Set the STR3 flag M 10.0 to “1”.
  After the transfer has initiated, the STR3 flag will be reset. At the latest after the timeout duration TIM3 (5 sec.) of the startup FB has expired, the transfer is complete or has aborted. The RDY3 flag is set to “1”. If an error occurred, the FAIL3 flag (M 12.3) will be set as well.

The PLC is supposed to receive (VC4) data from an operation of the OS.

- The call of the FB L2 SNDRCV remains the same. An additional call is not required.

- The target DB/DX should be available. Otherwise the OS telegram will be acknowledged with an error.

- If a telegram is received and has been entered into the DB L2 DBVC4, the RDY4 flag (M 11.4) will be set for one cycle. If the telegram can not be entered or was received with errors, the FAIL4 flag (M 12.4) is set until a telegram can be entered without errors. In normal cases, it is not necessary to evaluate these flags.

The OS requests data from the PLC (VC5).

- The call of the FB L2 SNDRCV remains the same. An additional call is not required.

- The source DB/DX should be available. Otherwise the OS request will be acknowledged with an error. At the same time, the FAIL5 flag (M 12.5) will be set in the PLC.

- If an OS request can be completed correctly, the RDY5 flag (M 11.5) will be set for one cycle. If the request is incorrect or the source block is not available in the required length, the FAIL5 flag will be set. It will remain pending, until a request can be completed without errors. In normal cases, it is not necessary to evaluate these flags.
7.3 Notes if there are more than one Connection to the same OS

The following connections are possible:

- VC5 and VC4  WinCC requests data from the PLC (PLC is passive, WinCC is active)

and/or*

- VC3 and VC4  Data is sent from the PLC to WinCC (PLC is active, WinCC is passive)

*For the connections VC3/VC4 and VC5/VC4 to one OS, two connections must be configured in the OS and PLC. The L2 STARTUP must therefore be called and configured twice in the OB21 (1 x for VC5/VC4 and 1 x for VC3/VC4). In the cyclical program (OB1), the L2 SNDRCV and L2 RECSSEND must also be called and configured twice (1 x for VC5/VC4 and 1 x for VC3/VC4).