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1. About this manual

1.1. Copyrights

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1.2. Trademarks

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1.3. General

This manual provides thorough information on the CDC-II Slave protocol and its configuration in MicroSCADA. The focus is on connecting COM 500 to the Network Communication Center by using the CDC-II Slave protocol.

1.4. Use of symbols

This publication includes caution and information icons that point out safety related conditions or other important information. The corresponding icons should be interpreted as follows:

- The caution icon indicates important information or warning related to the concept discussed in the text. It might indicate the presence of a hazard which could result in corruption of software or damage to equipment or property.

- The information icon alerts the reader to relevant facts and conditions.
Although caution hazards are associated with equipment or property damage, it should be understood that operation of damaged equipment. Therefore, comply fully with all warning and caution notices.

1.5. Document conventions

The following conventions are used for the presentation of material:

- The words in names of screen elements (for example, the title in the title bar of a dialog, the label for a field of a dialog box) are initially capitalized.
- Capital letters are used for the name of a keyboard key if it is labeled on the keyboard. For example, press the CTRL key. Enter key is an exception, e.g. press Enter.
- Lowercase letters are used for the name of a keyboard key that is not labelled on the keyboard. For example, space bar, comma key and so on.
- Press CTRL+C indicates that you must hold down the CTRL key while pressing the C key (to copy a selected object in this case).
- Press ESC E C indicates that you press and release each key in sequence (to copy a selected object in this case).
- The names of push and toggle buttons are boldfaced. For example, click OK.
- The names of menus and menu items are boldfaced. For example, the File menu.
- The following convention is used for menu operations: Menu Name > Menu Item > Cascaded Menu Item. For example: select File > Open > New Project.
- The Start menu name always refers to the Start menu on the Windows Task Bar.
- System prompts/messages and user responses/input are shown in the Courier font. For example, if you enter a value out of range, the following message is displayed:

  Entered value is not valid. The value must be 0 to 30.

You may be told to enter the string MIF349 in a field. The string is shown as follows in the procedure:

  MIF349

- Variables are shown using lowercase letters:

  sequence name
1.6. Terminology

The following is a list of terms associated with CDC-II Protocol that you should be familiar with. The list contains terms that are unique to ABB or have a usage or definition that is different from standard industry usage.

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LRU</td>
<td>Logical Remote (Terminal) Unit. A subset of input or output points, belonging to the same RTU, which are assigned distinct unit address and are seen as a separate RTU from SCADA point of view.</td>
</tr>
<tr>
<td>RTU</td>
<td>Remote terminal unit. A piece of equipment located at a distance from a central control station to monitor and control the status of outlying equipment, and to communicate the information back to the control station (master or host)</td>
</tr>
<tr>
<td>STA</td>
<td>Station An addressable entity in MicroSCADA NET (NOD) object</td>
</tr>
</tbody>
</table>

1.7. Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPI</td>
<td>Communication Programming Interface</td>
</tr>
<tr>
<td>CPU</td>
<td>Central Process Unit</td>
</tr>
<tr>
<td>NCC</td>
<td>Network Communication Centre</td>
</tr>
<tr>
<td>PRS</td>
<td>Product Requirement Specification</td>
</tr>
<tr>
<td>PPU</td>
<td>Peripheral Process Unit</td>
</tr>
<tr>
<td>SA</td>
<td>Substation Automation</td>
</tr>
<tr>
<td>SOE</td>
<td>Sequence of events</td>
</tr>
<tr>
<td>SN</td>
<td>Sequence number</td>
</tr>
</tbody>
</table>
## 1.8. Related documents

<table>
<thead>
<tr>
<th>Name of the manual</th>
<th>MRS number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Status Codes</td>
<td>1MRS751850-MEN</td>
</tr>
<tr>
<td>System Objects</td>
<td>1MRS751847-MEN</td>
</tr>
<tr>
<td>COM 500 *4.2 User’s Guide</td>
<td>1MRS751858-MEN</td>
</tr>
<tr>
<td>Communication Programming Interface (CPI)</td>
<td>1MRS751859-MEN</td>
</tr>
</tbody>
</table>

## 1.9. Document revisions

<table>
<thead>
<tr>
<th>Version</th>
<th>Revision number</th>
<th>Date</th>
<th>History</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>9.1</td>
<td>09.03.2005</td>
<td>Document created</td>
</tr>
</tbody>
</table>
2. **Safety information**

This chapter gives information about the prevention of hazards.

2.1. **Backup copies**

We suggest that you take backup copies before making any changes, especially the ones that might have side effects. Software and data need to be copied to another place, usually to a CD or a backup tape. A writable CD and DAT tape are commonly used.

Backup copying makes it easier to restore application software in case of a disk crash or any other serious failure when the stored data is lost. It is therefore recommended that backup copies are taken regularly.

There should be at least two system backup copies and two application copies. A new backup is copied over the oldest backup. This way the latest version is always available, even if the backup procedure fails.

Detailed information on how to take backup copies should be delivered to the customer with the application.

**System backup**

Usually a system backup is taken after the application is made. A backup should be taken again when changes are made to the MicroSCADA system. For example, if the driver configuration or the network set-up is changed.

**Application backup**

An application backup is taken simultaneously with the system backup after the application is made. A backup should be taken again when changes are made to the application. For example, if pictures or databases are edited or new pictures are added.

2.2. **Fatal errors**

A fatal error is an error that causes a break-down or a locked situation in the MicroSCADA program execution.

**Handling**

In case of a fatal error:

1. Write down the possible MicroSCADA error messages.
2. Shut down the MicroSCADA main program. If this cannot be done in the MicroSCADA Control Panel, try to end the task in Windows Task Manager.

! Shutting down the base system computers by switching off the power might damage the files.
3. In Windows, the data kept in the main memory at the moment of a fatal error is placed in the drwtsn32.log file. It is placed in a system folder, for example, WINNT. Analyse and copy the data in this file.

4. Restart the system.

Report the program break-down together with the possible MicroSCADA error messages and the information from the drwtsn32.log file to the MicroSCADA supplier.

**Status codes**

Error messages in SCIL are called status codes. A list of status codes and short explanations can be found in the Status Codes manual.
3. Instructions

3.1. Product overview

CDC-II Slave Emulator is a gateway program, which enables connection between MicroSCADA and NCC. The communication between CDC-II Slave Emulator and NCC is done through the CDC-II Slave protocol. The CDC-II Slave protocol is a NET object, which has eight station object connections. The COM 500 signal engineering and the COM 500 procedures are suitable for the CDC-II Slave protocol with minimal changes.

3.1.1. Software requirements

Following softwares are required:

- MicroSCADA SYS 600 *9.1 or newer
- COM 500 *4.2 or newer

3.2. Configuration

The configuration can be divided into following parts:

- Base system configuration
- Communication system configuration
- CDC-II Slave configuration
3.2.1. Base system configuration

Each base system has a set of objects that specify the base system and its environment, hardware and software, as well as the physical and logical connections of the base system and its applications.

The base system objects are defined with SCIL commands in the SYS_BASCON.COM file, which is executed every time the base system is started. With a few limitations, you can also define and modify the base system objects any time when MicroSCADA is running. During the operation, the base system objects are in the primary memory of the base system computer.

The CDC-II Slave protocol is implemented in the CDC-II Slave Emulator software, which means that an LAN link must be used. The CDC-II Slave protocol uses from one to eight stations for the CDC-II Logical Remote Units (LRU).

![Diagram showing the connection between MicroSCADA and CDC-II Slave protocol]

Fig. 3.2.1.-1 CDC-II Slave protocol communication emulates the communication between the NCC and the MicroSCADA base system.

Configuration steps

Add the CDC-II Slave protocol connectivity option to the base system:

1. Define a LAN link.

**Example**

```
#CREATE LIN:V = LIST(LT = "LAN")
#CREATE LIN2:B = %LIN
```

2. Define a NOD object.

**Example**

```
#CREATE NOD:V = LIST(LI = 2, SA = 202)
#CREATE NOD2:B = %NOD
```
3. Define from one to eight stations for CDC-II Logical Remote Units (LRU).

Example

```plaintext
#CREATE STA:V = LIST(-
   TT = "EXTERNAL",-
   ST = "RTU",-
   ND = 2,-
   TN = 1)
#CREATE STA1:B = %STA
```

4. To enable COM 500 for the application, add or uncomment the following line to the application definitions:

```plaintext
QD = (1,1,0,0,0,0,1,1,1,1,1,1,1,1,1),-
;Parallel queue dedication/
;Needed in COM 500 Applications
```

5. SYS_BASCON.COM starts the CDC-II Slave protocol with the following command:

```plaintext
@ss = ops_process("\sc\prog\cdc_slave\cdcslave.exe","\sc\prog\cdc_slave")
```
You only have to uncomment the command line from the SYS_BASCON.COM file.

6. Use the MicroSCADA Control Panel to prepare the application for COM 500.

### 3.2.2. Communication system configuration

The CDC-II Slave protocol interacts with MicroSCADA system by using the attribute messages. For more information about the attribute interface description, refer to the System Objects manual. Supported attributes are listed in the following sections.

#### 3.2.2.1. Station object attributes

The station object takes care of the application level communication with the master. A STA object created in the NET unit performs the functions of the station object. Several STA objects of the RTU device type are not allowed on the same line. Some station object attributes are used for configuring the station, others are used for device communication. The following attributes can be used for configuring the CDC-II Slave stations in MicroSCADA.

**AL Allocation**

The CDC-II Slave Emulator CPI application is always reserved for a particular MicroSCADA application, therefore the AL attribute is always 1.

| Data type: | Integer |
| Value: | 1 |
| Access: | Read |
AS Allocation application
The CDC-II Slave Emulator configuration file provides an application number. The application number is reported to the base system. All the LRUs’ station objects are allocated to the same application.
Data type: Integer
Access: Read-only

IU In Use
Sets in use flag to CDC-II Slave Emulator. Any LRU can be set in or out of use.
Data type: Integer
Value: 0 or 1
Access: Read/Write

LI Line Number
This attribute is supported, but setting it on does not have an effect on CDC-II Slave Emulator.
Data type: Integer
Value: 1..12
Access: Read/Write

MI Message Identification
Default value 1000 + station number
Access: Read-only

MS Message System
Data type: Integer
Access: Read-only

SA Station Address
The value 1 corresponds to offset 0 etc. The station objects’ initial set is read from the configuration file.
Value: 1..4
Access: Read-only

3.2.2.2. Data transfer attributes

AV Analog Value
COM 500 sends the AV attribute to CDC-II Slave Emulator that passes a re-routed Analog Value.
Data type: Vector
Index range: 128...255
Access: Read/Write

DD **Double inDication**
COM 500 sends the DD attribute to CDC-II Slave Emulator that passes a re-routed Double Indication Signal. Only values 0 and 1 are reported to CDC-II Master.

Data type: Vector
Index range: 0...63
Access: Read/Write

ID **InDication**
COM 500 sends the ID attribute to CDC-II Slave Emulator that passes a re-routed Indication Signal.

Data type: Vector
Index range: 0...63
Access: Read/Write

PC **Pulse Counter**
COM 500 sends the PC attribute to CDC-II Slave Emulator that passes a re-routed Pulse Accumulator Value.

Data type: Vector
Index range: 64...95
Access: Read/Write

### 3.2.2.3. Control Attributes

**DI Database initialized**
If the value is 1, COM 500 starts the system. After starting, COM 500 updates all the values in the NET database. The Emulated Logical RTU does not respond to the Master SCADA polls until the DI attribute is set to a corresponding STA object and all the configured indications are initialized.

Data type: Integer
Value: 0...1
Access: Read/Write
ET  
**Execute Command Timeout**

Maximum timeout (milliseconds) between Select and Execute messages from the Master SCADA system.

- **Data type:** Integer
- **Access:** Read/Write

### 3.2.2.4. Special Attributes

**SY**

**Synchronization settings**

Each bit corresponds with a link to the master system. The bits are combined via logical OR operation.

- **Data type:** Integer
- **Value:** 0..3
  - By choosing value 1, the time synchronization command sets the system clock.
  - By choosing value 0, the time synchronization command has no effect on the system clock.

- **Access:** Read/Write

**NC**

Returns the Master NCC name as specified in the configuration file cdcslave.ini (See Table 3.2.3.4-2 Master_Name).

- If a parameter is left out, an empty string will be returned.

- **Data type:** Character string
- **Index Range:** 1...N
  - (N = number of Master NCCs)

- **Access:** Read

### 3.2.3. CDC-II Slave configuration

The application takes only one command line parameter that is the path to the configuration file. The program command line parameter is optional, and if the path is not given, the application defines the configuration file in the default directory.

When the application starts, it reads the configuration file (.ini). The configuration file is a normal Windows configuration file, which has the following parts:

- Logging parameters (LOG)
  - Specifies the logging parameters.
  - For more information about LOG part, refer to Section 3.2.3.1. Logging parameters (LOG).
- MicroSCADA connection parameters (CPI)
Specifies the MicroSCADA connection parameters.
For more information about CPI part, refer to Section 3.2.3.2. MicroSCADA connection parameters (CPI).

• RTU emulation parameters
  Specifies the basic RTU emulation parameters.
  For more information about RTU part, refer to Section 3.2.3.3. RTU emulation parameters.

• Communication links
  Specifies the communication links.
  For more information about LINKS part, refer to Section 3.2.3.4. Communication links.

• Various parameters
  Specifies various parameters for tuning CDC-II Slave behaviour.
  For more information about Compliance part, refer to Section 3.2.3.5. Various parameters.

Each part has a header in a square brackets and variable = value pairs zero or more, which are on one line. Use semicolons for commenting.

3.2.3.1. Logging parameters (LOG)

The CDC-II Slave protocol LOG facilities are extensive.

COM 500 generates two types of log files: run log and debugging log. If the run log files have new messages, they are rotated every day, see Fig. 3.2.3.1.-1. The debugging log file is created when COM 500 starts. COM 500 produces a lot of printouts to the debugging log file. The debugging log file is meant only for configuration or troubleshooting, see Fig. 3.2.3.1.-2.

Fig. 3.2.3.1.-1 Run.log
### Debug.log

Following parameters are included in the log file control:

#### Table 3.2.3.1-1 Logging parameters

<table>
<thead>
<tr>
<th>Parameter Name</th>
<th>Mandatory</th>
<th>Parameter Type</th>
<th>Default Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>log_all</td>
<td>No</td>
<td>Y/N</td>
<td>N</td>
<td>Y - enables all the printouts. N - disables all the printouts. Printouts can be replaced, if you allow printouts for a specific subsystem.</td>
</tr>
<tr>
<td>log_conf_ini</td>
<td>No</td>
<td>Y/N</td>
<td>No default</td>
<td>Prints the values from the configuration file (.ini).</td>
</tr>
<tr>
<td>log_conf_xref_point</td>
<td>No</td>
<td>Y/N</td>
<td>No default</td>
<td>Prints the LOG_CONF_XREF results.</td>
</tr>
<tr>
<td>log_storage_al</td>
<td>No</td>
<td>Y/N</td>
<td>No default</td>
<td>Enables printouts during the CDC II Master request.</td>
</tr>
<tr>
<td>log_comm</td>
<td>No</td>
<td>Y/N</td>
<td>No default</td>
<td>Enables printouts in communication procedures working directly with communication port.</td>
</tr>
<tr>
<td>log_dl</td>
<td>No</td>
<td>Y/N</td>
<td>No default</td>
<td>Enables printouts in Data Link layer procedures.</td>
</tr>
<tr>
<td>log_al</td>
<td>No</td>
<td>Y/N</td>
<td>No default</td>
<td>Enables printouts in Application layer procedures.</td>
</tr>
</tbody>
</table>

If the LOG_ALL parameter value is No, all the following subparameters’ value is No.

- log_conf_ini
- log_conf_xref_point
- log_storage_al
- log_comm
- log_dl
- log_al

The following parameters are needed, if there is a need to supervise the CDC-II functionality in a more accurate level. If the LOG_ALL parameter value is set to Yes, all the following parameters’ value is Yes.

- log_main
- log_conf_xref

LOG_MAIN prints printouts for the start-up or shut down procedures and the main loop. Main loop restarts dying threads.

Prints the signal cross-reference after COM 500 has parsed the Signal Cross-References tool export files.
Table 3.2.3.1-1 Logging parameters (Continued)

<table>
<thead>
<tr>
<th>Parameter Name</th>
<th>Mandatory</th>
<th>Parameter Type</th>
<th>Default Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>log_storage</td>
<td>No</td>
<td>Y/N</td>
<td>No default value</td>
<td>Enables general storage printouts: creating, destroying, locking, etc.</td>
</tr>
<tr>
<td>log_storage_lru</td>
<td>No</td>
<td>Y/N</td>
<td>No default value</td>
<td>Enables printouts during the CDC II Master request and processing the MicroSCADA messages on the logical RTU level.</td>
</tr>
<tr>
<td>log_storage_msi</td>
<td>No</td>
<td>Y/N</td>
<td>No default value</td>
<td>Enables printouts during processing the MicroSCADA messages.</td>
</tr>
<tr>
<td>log_cpi</td>
<td>No</td>
<td>Y/N</td>
<td>No default value</td>
<td>Enables printouts during processing the ACP messages from the MicroSCADA system.</td>
</tr>
<tr>
<td>log_comm_thread</td>
<td>No</td>
<td>Y/N</td>
<td>No default value</td>
<td>Enables printouts in communication threads.</td>
</tr>
<tr>
<td>log_keep</td>
<td>No</td>
<td>Number</td>
<td>30</td>
<td>Defines how long the daily log files are stored.</td>
</tr>
</tbody>
</table>

3.2.3.2. **MicroSCADA connection parameters (CPI)**

Table 3.2.3.2-1 MicroSCADA connection parameters

<table>
<thead>
<tr>
<th>Parameter Name</th>
<th>Mandatory</th>
<th>Parameter Type</th>
<th>Default Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>own_node_number</td>
<td>Yes</td>
<td>number</td>
<td></td>
<td>NOD object node number.</td>
</tr>
<tr>
<td>own_station_number</td>
<td>Yes</td>
<td>number</td>
<td></td>
<td>NOD object SA attribute.</td>
</tr>
<tr>
<td>base_ip_addr</td>
<td>No</td>
<td>IP address</td>
<td>127.0.0.1</td>
<td>MicroSCADA system IP address.</td>
</tr>
<tr>
<td>base_node_number</td>
<td>Yes</td>
<td>number</td>
<td></td>
<td>Base system node number.</td>
</tr>
<tr>
<td>base_station_number</td>
<td>Yes</td>
<td>number</td>
<td></td>
<td>Base system SA attribute.</td>
</tr>
<tr>
<td>application_number</td>
<td>Yes</td>
<td>number</td>
<td></td>
<td>Defines the application number to which CDC-II Slave Emulator is connected to.</td>
</tr>
</tbody>
</table>
### 3.2.3.3. RTU emulation parameters

#### Table 3.2.3.3-1  RTU emulation parameters

<table>
<thead>
<tr>
<th>Parameter Name</th>
<th>Mandatory</th>
<th>Parameter Type</th>
<th>Default value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>XREF_PATH</td>
<td>Yes</td>
<td></td>
<td></td>
<td>Directory path. The Signal Cross-References tool's export files or print files with signal engineering cross-reference are saved here.</td>
</tr>
<tr>
<td>COM500_VERSION</td>
<td>No</td>
<td>Values: 2, 3, 3M, 3N, 4</td>
<td>4</td>
<td>2 - outdated 3 - COM 500 (version 3.0) standard Xref tool 3M - COM 500 (version 3.0) Xref tool 3N - COM 500 (version 4.0) Xref tool, original version 4 - COM 500 (version 4.1 or newer) Xref tool</td>
</tr>
<tr>
<td>SOE_BUFFER_SIZE</td>
<td>No</td>
<td></td>
<td>4096</td>
<td>Specifies the SOE buffer size in each LRU.</td>
</tr>
<tr>
<td>BISTABLE_TIMEOUT</td>
<td>No</td>
<td></td>
<td>0</td>
<td>Use this parameter to specify the maximal timeout between the Select and the Operate requests. Default value 0 disables the timeout control.</td>
</tr>
<tr>
<td>IGNORE_FEEDBACKS</td>
<td>No</td>
<td>Y/N</td>
<td>Y</td>
<td>Default value Y disables feedback control. Choose value N, if you want to enable feedback control. For more information about the feedback explanations, refer to Section 4.1. Signal Engineering.</td>
</tr>
</tbody>
</table>

### 3.2.3.4. Communication links

#### Table 3.2.3.4-1  Communication link parameters

<table>
<thead>
<tr>
<th>Parameter Name</th>
<th>Mandatory</th>
<th>Parameter Type</th>
<th>Default value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MASTER_LINKS</td>
<td>Yes</td>
<td>Number</td>
<td></td>
<td>Specifies number of master systems that are expected to connect to CDC-II Slave.</td>
</tr>
<tr>
<td>Link_Status_timeout</td>
<td>No</td>
<td>Number</td>
<td>30</td>
<td>Defines timeout in seconds that is reported to MicroSCADA as a communication loss.</td>
</tr>
<tr>
<td>Link_Status_address</td>
<td>No</td>
<td>Number</td>
<td></td>
<td>Specifies CPI station correspondent address to the first CDC-II LRU, which reports the communication status. Value is a bitmap, where each bit represents a COM-port.</td>
</tr>
</tbody>
</table>
Table 3.2.3.4-1 Communication link parameters (Continued)

<table>
<thead>
<tr>
<th>Parameter Name</th>
<th>Mandatory</th>
<th>Parameter Type</th>
<th>Default value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lru_reset_timeout</td>
<td>No</td>
<td>Number</td>
<td>900</td>
<td>Specifies time in seconds after communication loss that is a permanent lack of communication.</td>
</tr>
<tr>
<td>CTS_Timeout</td>
<td>No</td>
<td>Number</td>
<td>16</td>
<td></td>
</tr>
</tbody>
</table>

Master_X_link
Master_X_link is required for each link.

X indicates the link number in Master_X_link.

Table 3.2.3.4-2 Master_X_link parameters

<table>
<thead>
<tr>
<th>Parameter Name</th>
<th>Mandatory</th>
<th>Parameter Type</th>
<th>Default value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number_of_Lines</td>
<td>Yes</td>
<td>Number</td>
<td></td>
<td>Number of physical communication lines that are connected to the Master station. Each line is</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>described in the corresponding subsection [Master_X_Line_Y].</td>
</tr>
<tr>
<td>Xref_Numbers</td>
<td>Yes</td>
<td>List of comma</td>
<td></td>
<td>For more information about, refer to Correspondence between NCC numbers and LRU numbers.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>separated values</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LRU_Numbers</td>
<td>Yes</td>
<td>List of comma</td>
<td></td>
<td>For more information, refer to Correspondence between NCC numbers and LRU numbers.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>separated values</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permit_Time_sync</td>
<td>No</td>
<td>Y/N</td>
<td>N</td>
<td>Controls the CDC-II Master time synchronization.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>If you choose default value No, synchronization sequence is accepted, but it does not cause</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>any effects on the system clock.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>If you choose the value Yes, CDC-II Slave computer's time is synchronized according to the</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CDC-II Master station's commands</td>
</tr>
<tr>
<td>Master_Name</td>
<td>No</td>
<td>Character string</td>
<td></td>
<td>Master system name.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>It reports to MicroSCADA.</td>
</tr>
</tbody>
</table>
**Master_X_Line_Y**

Master_X_Line_Y describes the communication parameters and the parameters are required for each link.

X indicates the link number, and Y indicates the line number in Master_X_Line_Y.

### Table 3.2.3.4-3  **Master_X_Line_Y parameters**

<table>
<thead>
<tr>
<th>Parameter Name</th>
<th>Mandatory</th>
<th>Parameter Type</th>
<th>Default value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Port</td>
<td>Yes</td>
<td>String</td>
<td></td>
<td>Com-port name Example: COM3</td>
</tr>
<tr>
<td>Speed</td>
<td>No</td>
<td>Number</td>
<td>1200</td>
<td>Baud rate</td>
</tr>
</tbody>
</table>
| Rx_carrier     | No        | Constant       | Prior character is received | String format can be switched or constant.  
**Switched**  
Received characters are processed only when:  
- CD is on  
- Character is received  
- The prior character is received.  
**Constant**  
Input characters are processed regardless of the CD state. |
| Tx_carrier     | No        | Constant       |               | String format can be switched, constant or noCTS.  
**Switched**  
The driver sets RTS before sending the message. It drops RTS when the message is sent. CTS must be present before the message is sent.  
**Constant**  
The driver outputs mark idle characters permanently.  
**NoCTS**  
The driver sets RTS before sending the message. Driver drops RTS when the message is sent. |
Correspondence between NCC numbers and LRU numbers

You can define mapping between the NCC numbers and the LRU numbers. The NCC numbers are defined in the Signal Cross-References tool, and you can see LRU numbers from the CDC-II Master station.

Mapping is defined on per link basis with the XREF_Numbers and LRU_Numbers parameters, see Table 3.2.3.4-2. The XREF_Numbers’ parameter values are NCC numbers (1-4) and the LRU_Numbers’ parameter values are corresponding LRU addresses. Both parameters’ list of values are separated with a comma (,).

Example

You have configured COM 500 with 1, 2 and 4 NCCs and they are mapped to CDC-II LRUs 4, 5 and 6. NCC 3 is configured with the DNP Slave protocol. Any LRU address range number is possible, because it is not required to number LRUs sequentially.

The configuration is defined in the following way:

Example link number is 0.

XREF_Numbers = 1, 2, 4
LRU_Numbers = 4, 5, 6

NCC1 is mapped to the LRU address 4,
NCC2 is mapped to the LRU address 5 and
NCC4 is mapped to the LRU address 6
NCC3 is not mapped to any LRU address.

<table>
<thead>
<tr>
<th>Parameter Name</th>
<th>Mandatory</th>
<th>Parameter Type</th>
<th>Default value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Idle_char</td>
<td>No</td>
<td>Hexadecimal</td>
<td>FF</td>
<td>Idle characters are transmitted during the pre-mark and post-mark idle times. In a raw bit mode idle the characters are transmitted during all idle time when the continuous carrier is defined.</td>
</tr>
<tr>
<td>Rx_squelch</td>
<td>No</td>
<td>Number</td>
<td>0</td>
<td>Number of milliseconds after CD is detected, during which the input is ignored.</td>
</tr>
</tbody>
</table>
### 3.2.3.5. Various parameters

Parameters are the most troubled, but COM 500 is provided with the reasonable default values.

Parameters misuse can cause serious protocol violations and COM 500 can work unpredictably.

<table>
<thead>
<tr>
<th>Parameter name</th>
<th>Parameter type</th>
<th>Default value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOE_DUMP_CPU_REPORT</td>
<td>NEVER</td>
<td></td>
<td>Sets the program behaviour when reporting the SOE PPUs status or enable/disable status.</td>
</tr>
<tr>
<td></td>
<td>BIT_C</td>
<td>NEVER</td>
<td>Do not report to CPU (PPU 0).</td>
</tr>
<tr>
<td></td>
<td>BIT_C_STATUS</td>
<td></td>
<td>Report if bit C is set in request. Status is dumped.</td>
</tr>
<tr>
<td></td>
<td>BIT_C_ENABLE_DUMP</td>
<td>ALWAYS</td>
<td>Report, if bit C is set in request. Only in enable or disable dump (default).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Report despite of bit C value.</td>
</tr>
<tr>
<td>SOE_READ_TEST_POINTS</td>
<td>Y/N</td>
<td>N</td>
<td>Default value N prevents emulator reading PPU test point values. Test point values are reported as 0.</td>
</tr>
<tr>
<td>SOE_EVENT_INACTIVE</td>
<td>Y/N</td>
<td>N</td>
<td>Value Y allows SOE event to record when LRU is inactive.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Default value N allows SOE event to record only when LRU is active.</td>
</tr>
<tr>
<td>Parameter name</td>
<td>Parameter type</td>
<td>Default value</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-----------------------------</td>
<td>---------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>CD_BIT_SET</td>
<td>ANY</td>
<td>POINT_SCAN</td>
<td>Specifies the behaviour of Change-Detect points, specifically the Change-Detect bit.</td>
</tr>
<tr>
<td></td>
<td>Change is detected always in whatever state the point and LRU are.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>INITIALIZED</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Change is detected after the point is initialized.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ACTIVE</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Change is detected when LRU is active.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LRU_SCAN</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Change is detected after the LRU's first scan.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>POINT_SCAN</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Change is detected after the point is scanned.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TIME_TUNE</td>
<td>Number</td>
<td></td>
<td>Positive or negative number. The number is added to the CDC-II Master timestamp value during the reporting back to the CDC-II Master system. The response is send to the Time Retrieval command.</td>
</tr>
<tr>
<td>SCAN_13_REPORT_TYPE</td>
<td>DEFINED_POINTS</td>
<td></td>
<td>These parameters affects program’s behaviour, if the configuration is incomplete.</td>
</tr>
<tr>
<td></td>
<td>Reports only to the last defined point in each type. If the point is not defined for a particular type, this type is left out.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>DEFINED_TYPES</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reports all the points for each defined type. If the point is not defined for particular type, this type is left out.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TO_LAST_SEQ_NO</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reports all the points up to the last defined sequence number.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ALL</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reports all the requested sequence numbers in range.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMPENSATE_RECV_ERRORS</td>
<td>Y/N</td>
<td>N</td>
<td>This parameter may sometimes reduce the number of lost frames.</td>
</tr>
</tbody>
</table>

Table 3.2.3.5-1 Compliance parameters (Continued)
## Compliance parameters (Continued)

<table>
<thead>
<tr>
<th>Parameter name</th>
<th>Parameter type</th>
<th>Default value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RESET_BIT</td>
<td>Mem3</td>
<td>Mem3</td>
<td>Specifies the event that the Reset bit in the CDC-II Slave response status byte sets to zero. Mem3 The Write Memory message receives number three (3). Time_sync_and_Mem3 Both the Write Memory message and the time synchronization message have been received. Time_Sync Time synchronization message is received. Zero Reset bit is always 0.</td>
</tr>
<tr>
<td>LONG_SELECT_RESPONSE</td>
<td>Y/N</td>
<td>Y</td>
<td>It was found out that the commonly used Master Station requires the CDC-II Slave to respond with both the header and data parts of 'Select' control messages. In order to match expected behaviour, this parameter is set to default 'Yes'. In order to keep compatibility with CDC-II standard, the original behaviour is also supported - set this parameter to 'No' to get the original behaviour. However, this change is not a requirement.</td>
</tr>
</tbody>
</table>
MicroSCADA Pro
CDC-II Slave Protocol
User’s Guide

3.3. CDC-II Slave Monitoring Tool

The CDC-II Slave Monitoring tool shows the Scan3X, SOE and SOE size CDC-II emulator dump files (.dmp). The tool scans the file folder, reads the files and updates the displayed data. To open the CDC-II Slave Monitoring tool, select the System Configuration tab from the Tool Manager and click the appropriate button, see Fig. 3.3.-1.

![CDC-II Monitor](image)

**Fig. 3.3.-1  CDC-II Slave Monitoring tool**

CDC-II Slave Emulator creates the dump files (.dmp) and replaces the files whenever. The CDC-II emulator dump file names’ are SCAN3X_X_Y.DMP, SOE_X_Y.DMP and SOESIZE_X_Y.DMP, see Table 3.3.-1.

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCAN3X_X_Y.DMP</td>
<td>Contains the current SCAN3X tables.</td>
</tr>
<tr>
<td>SOE_X_Y.DMP</td>
<td>Contains the SOE enable status.</td>
</tr>
<tr>
<td>SOESIZE_X_Y.DMP</td>
<td>Contains the SOE size setup.</td>
</tr>
</tbody>
</table>

---

**Table 3.2.3.5-1  Compliance parameters (Continued)**

<table>
<thead>
<tr>
<th>Parameter name</th>
<th>Parameter type</th>
<th>Default value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>WAIT_ALL_POINTS</td>
<td>Y/N</td>
<td>N</td>
<td>For various reasons, it might not be desired to wait until all the database points are initialized before CDC-II Slave starts responding to the Master SCADA requests. For example, some of them might not be initialized at all due to 'non-sampled' status in the MicroSCADA database. This parameter allows instructing the CDC-II Slave to wait or not to wait until MicroSCADA sends point values to all the defined points.</td>
</tr>
</tbody>
</table>
Modifiers of the dump file names:

X  Link line number to the NCC.
   Scan3X, SOE and SOE size setups are link-based.
   CDC-II Slave communicates normally with two NCCs, while in fact it
   communicates only with one NCC at a time.

Y  Number of COM 500 NCCs (from 1 to 8).

The dump files are overwritten when CDC-II Master receives new Scan3X, SOE
and SOE size setup commands. If the communication is disconnected to
CDC-II Master, the corresponding dump files are removed. The CDC-II emulator
dump files are removed also, if you exit CDC-II Slave Emulator.

It is recommended that the dump files are saved on prog\cdc_slave directory,
where the CDC-II Slave protocol is installed.

When the CDC-II Slave Monitoring tool is started, the first available connection to
CDC-II Master is selected, see Fig. 3.3.1.-1. You can select another available
connection to CDC-II Master by selecting the corresponding link from the Choose
CDC-II Master list. The available connection list can change, when the CDC-II
Slave Monitoring tool refreshes its status.

If the application does not contain the cross-reference files for the CDC-II Slave
protocol, the CDC-II Monitoring tool displays an appropriate notification dialog, see
Fig. 3.3.-2. Click OK button to close the dialog.

![Cross-reference file not found - CDC-II Monitor]

---

If none of the CDC-II Master connection are available, the CDC-II Monitoring tool
dialog has only the text: No CDC-II Masters are connected, see Fig. 3.3.-3.
The CDC-II Slave Monitoring tool’s status can be refreshed automatically or you can refresh the status manually. Select the Automatic refresh check box to refresh status automatically. Clear the Automatic refresh check box and click the Refresh now button regularly to refresh status manually, see Fig. 3.3.1.-1.

On each tab, the corresponding LRU and NCC numbers are shown on the NCC(LRU) subtab, see Fig. 3.3.1.-1.

The current CDC-II Master connection number and the last status refresh time are displayed on the status bar, see Fig. 3.3.1.-1.

3.3.1. Scan3X

The first column is for the Scan3X table number. The next two columns are reference tables. The fourth column is for sequence numbers, see Fig. 3.3.1.-1.

The CDC-II emulator dump files include a LRU number corresponding to COM 500 NCC on the first row. The next 15 rows contains comma-separated values, see Fig. 3.3.1.-1.
Fig. 3.3.1.-1  Scan3X

To review sequence information, double-click the appropriate row or select the appropriate row and click the **Sequences** button, see Fig. 3.3.1.-1, to open the Sequences dialog, see Fig. 3.3.1.-2. The Number column shows the sequence number, and the Type column shows the related process object type. The Process objects column identifies the actual process objects, which are related to the appropriate sequence number.

---

**Fig. 3.3.1.-2  Scan3X sequences dialog**

Since the Process objects column can contain from zero to eight process objects for one sequence number, the process objects are displayed in a separate dialog. To have more information about process objects, double-click the appropriate row or select the appropriate row and click the **Show** button, see Fig. 3.3.1.-2., to open the Process Object dialog, see Fig. 3.3.1.-3.
Fig. 3.3.1.-3  Process Objects dialog

Table 3.3.1-1 shows the displayed process object attributes.

**Table 3.3.1-1  Process object attributes**

<table>
<thead>
<tr>
<th>Column</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LN</td>
<td>Logical Name</td>
</tr>
<tr>
<td>IN</td>
<td>Index</td>
</tr>
<tr>
<td>OI</td>
<td>Object Identifier</td>
</tr>
<tr>
<td>OX</td>
<td>Object Text</td>
</tr>
<tr>
<td>CX</td>
<td>Comment Text</td>
</tr>
</tbody>
</table>

### 3.3.2.  Sequence of Events (SOE)

The PPU num. column shows the PPU number of SOE information. The Points count column shows the total number of SOE Points for each PPU. To have more information about points, double-click the appropriate row or select the appropriate row and click the **Points** button, see Fig. 3.3.2.-1.
Each point corresponds to one process object in the program, and the process objects are shown directly in the SOE points dialog, see Fig. 3.3.2.-2. The attribute list is the same as in the process objects dialog, see Fig. 3.3.1.-3.

The Type column shows the type of the point. There are two kinds of points: Test Points and Input points.

The SOE size tab displays how many SOE report records are attached to the particular data messages. The number of records is set by Set SOE Size request from the master NCC. The left column shows the message types and the Number of records column shows the number of the SOE records, which are related to the message on the same row. See Fig. 3.3.3.-1.
Fig. 3.3.3.-1   SOE size tab
4. Technical Description

4.1. Signal Engineering

The term signal engineering means the engineering needed to establish the communication to the NCC station.

CDC-II Slave does not work as an external NCC, but uses COM 500 Signal Cross-Reference tool NCC to define LRU.

Signals are divided into indications and commands, that is input and output process objects. Indications are sent from process units to COM 500 where they are re-routed to one or several NCCs. Usually there are single indications, double indications and measurements that need to be forwarded to the NCCs.

Commands are sent from the NCC to COM 500 where they are re-routed to process units. Secured commands, direct commands and setpoints are typical commands that are sent.

Logical Remote Units (LRU) and signals for each LRU are defined with the COM 500 Signal Cross-References tool. The CDC-II Slave protocol parses the COM 500 Signal Cross-References tool files and uses these files as a signal configuration information.

The program reads three variants of Signal Cross-References tool output:

- COM 500 *2.0 export files
- COM 500 *3.0 export files
- COM 500 *3.0 (or newer) print files

It is possible to configure BINARY INDICATION as both the status point and SOE point with COM 500 *3.0 (or newer). You have to specify two addresses for a point in each NCC.

The following steps are taken when making signal engineering for a NCC:

1. Define the NCCs.

Marking NCC as a CDC-II LRU is easy. The CDC-II slave protocol handles all the NCCs as CDC-II LRUs, if a string CDC-II is either in the name field or in the comment field.

The string CDC-II can be included in a longer and more descriptive file name or comment.

2. Define the points.

To define the non-SOE (Sequence Of Events) points, define the sequence number and possibly the bit number of the CDC-II address in the address field.

Defining the SOE points in COM 500 *2.0.
Since the CDC-II SOE addressing differs significantly from the block addressing, the specified addresses must be calculated, if these are specified in COM 500 *2.0 or in COM 500 *3.0 (or newer).

Specified addresses:

- \( \text{SOE\_test\_point\_block} = 96 + \text{PPU\_number} \)
- \( \text{SOE\_test\_point\_bit} = \text{bit\_number} \)
- \( \text{SOE\_point\_block} = 130 + \text{PPU\_number} + \text{bit\_number} / 16 \)
- \( \text{SOE\_point\_bit} = \text{bit\_number} \mod 16 \)

Defining the SOE points in COM 500 *3.0 (or newer).

If the SOE points share a signal with another indication, they are defined in the SOE address fields. Otherwise the SOE points are defined the same way as COM 500 *2.0.

3. Make the configuration visible for the CDC-II Slave protocol.

Export the cross-reference for COM 500 *2.0.

Print NCC, indications and commands to files: NCC.TXT, IND.TXT and CMD.TXT for COM 500 *3.0 (or newer), see Fig. 4.1.-1, Fig. 4.1.-2 and Fig. 4.1.-3. The comma (,) is a field separator for the print function, see Fig. 4.1.-4.

---

Fig. 4.1.-1 Print NCC to the NCC.TXT file.

Fig. 4.1.-2 Print indications to the IND.TXT file.
Fig. 4.1.-3 Print NCC to the CMD.TXT file.

Fig. 4.1.-4 Comma is a field separator in the Print function
### 4.1.1. Signal addressing, indications

**Table 4.1.1-1 Signal addressing, indications**

<table>
<thead>
<tr>
<th>CDC-II Point type</th>
<th>Sequence number range</th>
<th>Number of points per sequence number</th>
<th>Corresponding MicroSCADA process object type</th>
<th>Corresponding block number</th>
<th>Number of points per block</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-bit Change Detect Status</td>
<td>0x00-0x1F (0-31)</td>
<td>8</td>
<td>Binary Indication</td>
<td>0-31</td>
<td>8(0-7)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Double Indication</td>
<td>0-31</td>
<td>8(0-7)</td>
</tr>
<tr>
<td>1-bit Change Detect Status</td>
<td>0x20-0x2F (32-47)</td>
<td>16</td>
<td>Binary Indication</td>
<td>32-47</td>
<td>16(0-15)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Double Indication</td>
<td>32-47</td>
<td>16(0-15)</td>
</tr>
<tr>
<td>Simple Status</td>
<td>0x30-0x3F (48-63)</td>
<td>16</td>
<td>Binary Indication</td>
<td>48-63</td>
<td>16(0-15)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Double Indication</td>
<td>48-63</td>
<td>16(0-15)</td>
</tr>
<tr>
<td>Pulse Accumulators</td>
<td>0x40-0x5F (64-95)</td>
<td>1</td>
<td>Pulse Counters</td>
<td>64-95</td>
<td>1</td>
</tr>
<tr>
<td>Analog Input</td>
<td>0x80-0xFF (128-255)</td>
<td>1</td>
<td>Analog Input</td>
<td>128-255</td>
<td>1</td>
</tr>
</tbody>
</table>

### 4.1.2. Signal addressing, commands

**Table 4.1.2-1 Signal addressing, commands**

<table>
<thead>
<tr>
<th>CDC-II Point type</th>
<th>Sequence number range</th>
<th>Number of points per Seq.No.</th>
<th>Corresponding MicroSCADA Process Object Type</th>
<th>Corr. Block Number</th>
<th>Number of points per block</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bistable Controls</td>
<td>0x00-0xDF (0-223)</td>
<td>1</td>
<td>Binary Output</td>
<td>0-223</td>
<td>1</td>
</tr>
<tr>
<td>Analog Output</td>
<td>0x00-0x0F (0-15)</td>
<td>1</td>
<td>Analog Output</td>
<td>0-15</td>
<td>1</td>
</tr>
<tr>
<td>Pulse Accumulator reset points</td>
<td>0x40-0x5F (64-95)</td>
<td>1</td>
<td>Binary Output</td>
<td>224-255</td>
<td>1</td>
</tr>
</tbody>
</table>
4.1.2.1. **Bistable Controls**

The CDC-II Bistable Control point corresponds with the MicroSCADA Binary Output and Object Command objects. Since one physical control (e.g. breaker) can represent from one to four binary output process objects in MicroSCADA, the CDC-II Slave protocol translates the CDC-II control requests to the appropriate form, which is defined in the Signal Cross-References tool.

If an indication is connected to a bistable control, the CDC-II Slave protocol handles it as a feedback indication and expects signal 1 after controlling the Binary Output point. The signal is handled as a positive acknowledge to the control operation. If the CDC-II Slave program does not receive the signal, the CDC-II master station does not allow any further operation, until either timeout expires or the CDC-II master station resets the bistable control point. Feedback processing is disabled by default.

4.1.2.2. **Specifying Accumulator’s Reset Points**

When the CDC-II Slave protocol receives the Accumulator Reset command, it does not change specified accumulator’s internal cached value. Instead, it sends a signal 1 to the Binary Output point that is defined in a signal cross-reference. The program processes this signal. It resets Pulse Counter in the connected device and sends a new value to the CDC-II Slave protocol.

It is the user’s responsibility to reserve the accumulator, for example in scil procedures tied to the correspondent BO output event channels.
### 4.1.3. Signal addressing, SOE

#### Table 4.1.3-1  Signal addressing, Sequence of Events (SOE)

<table>
<thead>
<tr>
<th>PPU Number</th>
<th>SOE Point Numbers</th>
<th>Block Number</th>
<th>Bits</th>
</tr>
</thead>
<tbody>
<tr>
<td>0&lt;sup&gt;1&lt;/sup&gt;</td>
<td>Test points: 0-7&lt;sup&gt;2&lt;/sup&gt;</td>
<td>96</td>
<td>0-7</td>
</tr>
<tr>
<td>0-15</td>
<td>130</td>
<td>0-15</td>
<td></td>
</tr>
<tr>
<td>16-31</td>
<td>131</td>
<td>0-15</td>
<td></td>
</tr>
<tr>
<td>32-47</td>
<td>132</td>
<td>0-15</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Test points 0-7&lt;sup&gt;2&lt;/sup&gt;</td>
<td>97</td>
<td>0-7</td>
</tr>
<tr>
<td>0-15</td>
<td>133</td>
<td>0-15</td>
<td></td>
</tr>
<tr>
<td>16-31</td>
<td>134</td>
<td>0-15</td>
<td></td>
</tr>
<tr>
<td>32-47</td>
<td>135</td>
<td>0-15</td>
<td></td>
</tr>
<tr>
<td>...</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>Test Points 0-7&lt;sup&gt;2&lt;/sup&gt;</td>
<td>96 + N</td>
<td>0-7</td>
</tr>
<tr>
<td>0-15</td>
<td>130 + 3 • N</td>
<td>0-15</td>
<td></td>
</tr>
<tr>
<td>16-31</td>
<td>131 + 3 • N</td>
<td>0-15</td>
<td></td>
</tr>
<tr>
<td>32-47</td>
<td>132 + 3 • N</td>
<td>0-15</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Test Points 0-7&lt;sup&gt;2&lt;/sup&gt;</td>
<td>120</td>
<td>0-7</td>
</tr>
<tr>
<td>0-15</td>
<td>202</td>
<td>0-15</td>
<td></td>
</tr>
<tr>
<td>16-31</td>
<td>203</td>
<td>0-15</td>
<td></td>
</tr>
<tr>
<td>32-47</td>
<td>204</td>
<td>0-15</td>
<td></td>
</tr>
</tbody>
</table>