Design Guide

Anybus®-IC

Doc.Id. HMSI-168-7
Rev. 2.01

Connecting Devices™

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Important User Information

This document is intended to provide a good understanding of the software interface as well as the mechanical and electric properties of the Anybus-IC platform. It does not cover any of the network specific features offered by the various incarnations of the product; this information is instead available as separate documents (Fieldbus Appendix).

The reader of this document is expected to be familiar with hardware design and communication systems in general.

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Warning: This is a class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

ESD Note: This product contains ESD (Electrostatic Discharge) sensitive parts that may be damaged if ESD control procedures are not followed. Static control precautions are required when handling the product. Failure to observe this may cause damage to the product.

Anybus-IC Design Guide
Rev 2.01

Feb 2013 Doc Id HMSI-168-7

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Appendix D Technical Specification

P. About This Document

For more information, documentation etc., please visit the HMS website, 'www.anybus.com'.

P.1 Related Documents

Document	Author
Anybus-IC Profibus DP Appendix	HMS
Anybus-IC DeviceNet Appendix	HMS
Anybus-IC EtherNet/IP Appendix	HMS
Anybus-IC Profinet IO Appendix	HMS
Anybus-IC CANopen Appendix	HMS
Modbus Protocol Reference Guide	Modicon
-	-

P.2 Document History

Summary of Recent Changes (2.00... 2.01)

Change	Page(s)
Added note about byte sized parameters	51
Added FBBR bit to Configuration Bits (#8)	57
Altered output signal level from 3.3V to 5V in signal level picture	94

Revision List

Revision	Date	Author	Chapter(s)	Description
<1.50	-	-	-	(See previous revisions)
1.50	2006-08-10	PeP	-	Major rewrite
1.51	2007-01-09	PeP	-	Minor update
1.52	2007-04-02	PeP	5, 8, 9, C	Minor corrections
1.53	2008-04-14	PeP	3, 4, 8, 7, B	Minor update
-	-	-	-	-
1.58	2008-11-06	HeS	3, 4, 9, B, C	Minor updates
1.59	2008-11-17	HeS	7	Minor update
1.60	2011-03-18	KeL	P, 1, 3, 6, 7, C	Minor update
2.00	2012-05-22	KaD	2, 8	New template, new chapter and updates
2.01	2013-02-20	KaD	8, D	Minor update

P.3 Document Conventions

The following conventions are used throughout this manual:

- Numbered lists provide sequential steps
- Bulleted lists provide information, not procedural steps
- The term 'Anybus' or 'module' is used when referring to the Anybus-IC.
- The terms 'application' is used when referring to the hardware that hosts the Anybus-IC
- Hexadecimal values are written in the format 0xNNNN, where NNNN is the hexadecimal value.
- Measurements expressed in this document have a tolerance of ±0.20 mm unless otherwise stated.
- Signals which are "pulled to NN" are connected to NN via a resistor.
- Signals which are "tied to NN" are directly connected to NN.
- Modbus register numbers are specified using the protocol convention (base 0), i.e. there is a 1:1 correlation between the register number specified in this document and the actual register value in the message frame.

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1. About the Anybus-IC

1.1 General

The Anybus-IC network communication module is a high performance, low cost communication solution for industrial field devices. Typical applications include I/O blocks, temperature controllers, measuring devices, and other devices where size is an issue.

A flexible application interface enables the module to operate either standalone or controlled by a microcontroller. A range of communication channels allows fieldbus data exchange as well as internal discrete I/O. In addition, data can be mapped between the various channels in a flexible manner without any intervention by the host system.

The Anybus-IC software interface is designed to be network protocol independent, making it possible to support several networking systems using the same software driver. The host communication is based on Modbus RTU, a proven protocol which is easy to implement yet flexible enough to provide room for future expansion. This also allows for multidrop configurations where multiple Anybus-IC modules are interfaced to the same microcontroller.

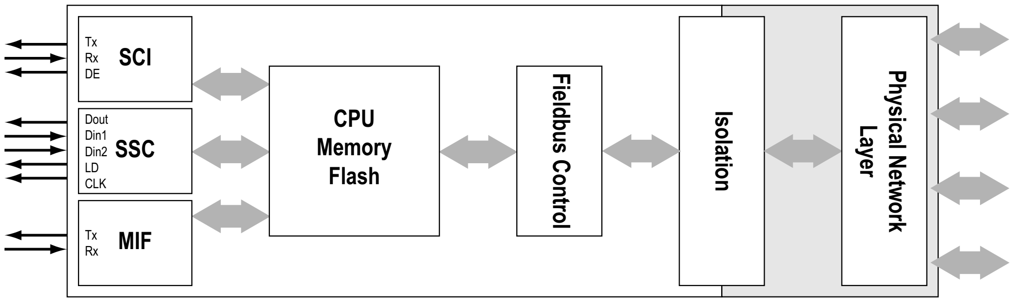
1.2 Features

- Standard 32-pin dual in line footprint
- Requires only a single 5 V power supply
- Galvanically isolated fieldbus electronics
- Serial Communications Interface (SCI)
- Synchronous Serial Channel (SSC)
- Text based configuration- and monitoring interface (MIF)
- Up to 144 bytes of fieldbus I/O in each direction
- Up to 128 bytes of serial I/O in each direction (SCI)
- Up to 128 bits of I/O in each direction (SSC)
- Flexible mapping of data
- Standalone or microcontroller operation

1.3 Overview

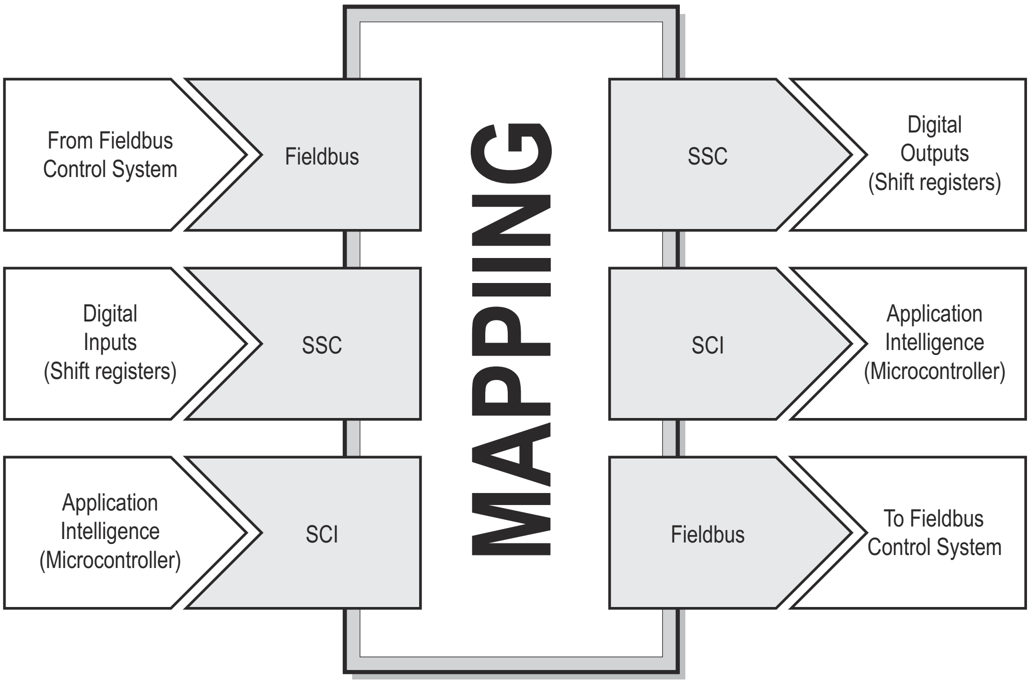
Internals

The figure below illustrates the basic properties of the Anybus-IC, on-board I/O, fieldbus interface etc.



Data Mapping

The module features a flexible data mapping scheme; data received on one communication channel can be mapped (i.e copied) to the other, and vice versa. This allows for not just fieldbus connectivity, but also for internal I/O in the application, by mapping SSC I/O to the SCI channel. By mapping fieldbus I/O to the SSC channel, SSC I/O can be accessed directly from the fieldbus.



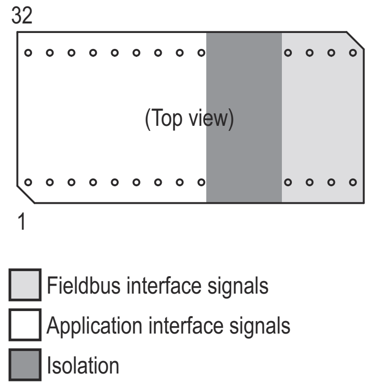
1.4 Application Connector

The application connector is based on a standard DIL-32 footprint.

See also...

- "Measurements" on page 87
- "MIF Interface" on page 21
- "SCI Channel" on page 25
- "SSC Channel" on page 31
- "Technical Specification" on page 93

Note: Pins 13... 20 are reserved for the fieldbus interface. Consult each separate fieldbus appendix for further information.



Pin	Signal	Description	Direction	Page
1	Vcc	+5 V Power Supply	Input	D.2
2	/SSC_Reset_Out	SSC Reset signal (Active Low)	Output	5.
3	/SSC_LD	SSC Load signal (Active Low)	Output	5.
4	SSC_DO	SSC Data Output	Output	5.
5	SSC_DI2	SSC Data Input 2	Input	5.
6	SSC_DI1	SSC Data Input 1	Input	5.
7	SSC_CLK	SSC Clock	Output	5.
8	/RESET	Module reset (Active Low)	Input	9.2
9	Vcc	+5 V Power Supply	Input	D.2
10... 12	NC	-	-	-
13	FB1	Fieldbus interface signals (consult the fieldbus appendix for further information about the fieldbus interface)	(fieldbus specific)	-
14	FB2			
15	FB3			
16	FB4			
17	FB7			
18	FB8			
19	FB5			
20	FB6			
21... 23	NC	-	-	-
24	GND	GND Power Supply	-	D.2
25	NC	-	-	-
26	/INT [BLE]	Interrupt (Active Low) [Boot loader enable switch]	Output [Input][a]	9.1
27	MIF_Tx	MIF Transmit signal	Output	3.
28	MIF_Rx	MIF Receive signal	Input	3.
29	SCI_DE [AUTO]	SCI Data Enable [Autoinitialization]	Output [Input]	4.
30	SCI_Tx	SCI Transmit signal	Output[a]	4.
31	SCI_Rx	SCI Receive signal	Input	4.
32	GND	GND Power Supply	-	D.2

a. Maximum drainable current: ± 2 mA.

2. Tutorial

2.1 Introduction

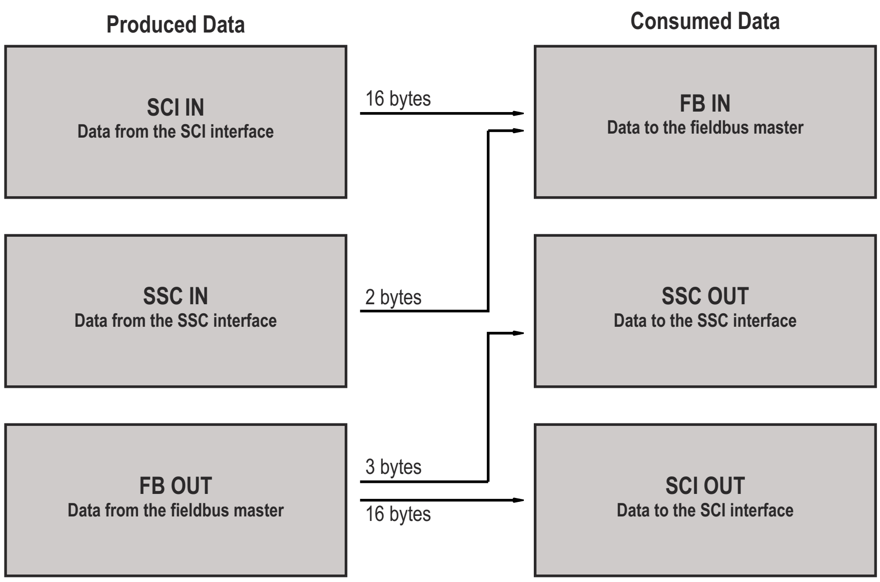
This tutorial will describe how to map data between the three different communication channels (Fieldbus, SSC, SCI) and how to communicate with the Anybus-IC using the SCI interface and a Modbus master. It is assumed that the Anybus-IC is socketed and ready, and that all pins and connectors are connected and ready for use.

The Anybus-IC has three possible modes of operation. For a detailed description of each operation mode, see “Initialization” on page 43. This tutorial will describe how to set up normal mode communication, e.g. where the module shall be controlled by a microcontroller via the SCI channel.

As said above, the Anybus-IC features three possible communication channels:

- **SSC (Synchronous Serial Channel)**
  Data to and from the digital outputs/inputs of the application, e.g. LEDs and switches.
- **SCI (Serial Communications Interface)**
  Data coming from and going to the Modbus master of the host application.
- **FB (Fieldbus)**
  Data coming from and going to the fieldbus side of the application. Data from the fieldbus to the Anybus-IC is called FB OUT, and data from the Anybus-IC to the fieldbus is called FB IN.

This tutorial will feature an example using all three communication channels, with 19 bytes of input data and 18 bytes of output data, mapped according to the picture below:

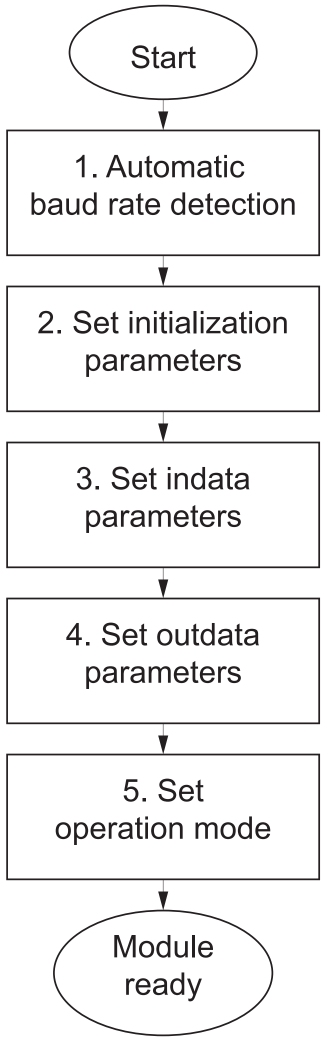


There are 19 bytes coming from the fieldbus (FB OUT). The first 3 bytes are sent to the SSC interface (SSC OUT), and the remaining 16 bytes to the SCI interface (SCI OUT).

Two bytes of data will be sent from the SSC interface (SSC IN) and 16 bytes from the SCI interface (SCI IN) to the fieldbus (FB IN). A total of 18 bytes.

2.2 Step by Step Guide

To implement the application presented above, follow this step by step guide.



1. Detect the baud rate of the SCI channel. See "Automatic Baud Rate Detection" on page 17.

2. Set the initialization parameters. See "Set Initialization Parameters" on page 17.

3. Set the indata parameters. See "Set Indata Parameters" on page 18.

4. Set the outdata parameters. See "Set Outdata Parameters" on page 19.

5. Set operation mode. See "Set Operation Mode" on page 20.

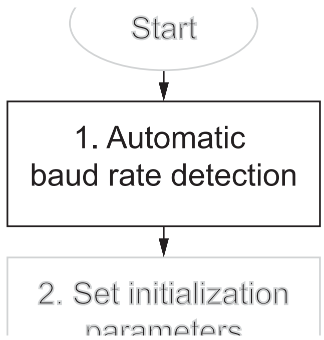
The Anybus-IC module is now configured and should be running smoothly, exchanging data between the three communication interfaces.

2.3 Automatic Baud Rate Detection

By default, the Anybus-IC will try to detect the baud rate of the SCI communication channel automatically.

In order to do that, the Modbus server must repeatedly issue “read holding registers”-requests to the module at start-up.

See “Baud Rate” on page 27 for more information.



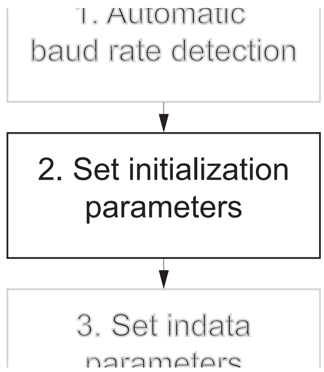
2.4 Set Initialization Parameters

The Anybus-IC will now be prepared for operation in normal mode.

To configure the Anybus-IC for normal mode operation, two parameters must be set.

- Parameter “Configuration Bits (#8)” involves setting initialization values for different operation scenarios. For a complete description, see “Configuration Bits (#8)” on page 57.

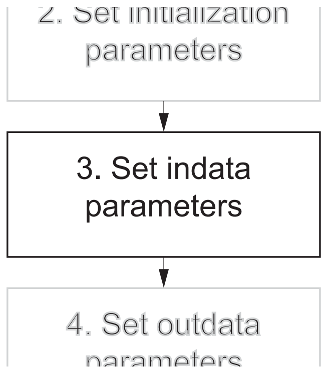
- Parameter “SCI Rate Config (#14)” is used to set the baud rate for the communication on the SCI channel. The value 0x00 that will be used in this example keeps the default behavior, which is to use automatic baud detection.



The parameters in the Anybus-IC are set using write register calls issued from the Modbus master. The parameters and their respective values to use are presented in the table below:

Parameter	Modbus Address	Setting	Description
Configuration Bits (#8)	0x5008	FBLP=1	The Fieldbus Specific Output Register will be used for normal data exchange. See “Fieldbus Specific Output Register (Output Register 0)” on page 34.
		SSCI=1	The SSC Input size will be configured manually. The size will be set using the SSC In Config parameter (#51).
		SSCO=1	The SSC Output size will be configured manually. The size will be set using the SSC Out Config parameter (#54).
SCI Rate Config (#14)	0x500E	0x00	Use automatic baud rate detection. The default value is 0x00.

2.5 Set Indata Parameters



Indata is data coming from any of the three possible communication channels (Fieldbus, SCI, SSC) to the Anybus-IC module's incoming data buffers.

When setting the indata parameters, the only thing that needs to be done is to define the amount of data coming from each channel. This is done using the three parameters in the table below.

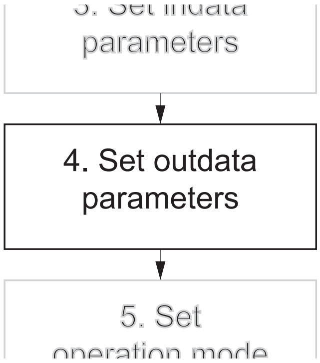
Parameter	**Modbus Address**	**Setting**	**Description**
FB Out Config (#41)	0x6001	0x0013	The size of the FB Output area. Data coming from the fieldbus.
SSC In Config (#51)	0x600B	0x0002	The size of the SSC Input area. Data coming from the SSC interface.
SCI In Config (#64)	0x6018	0x0010	The size of the SCI Input area. Data coming from the SCI interface.

2.6 Set Outdata Parameters

Each of the three communication channels' incoming data buffers can transfer data to the outgoing data buffers of the two other channels.

Hence, since every incoming data buffer can contain data that should be transferred to two other outgoing data buffers, two things must be set using the outdata parameters:

- the amount of data bytes to be transferred.
- the location of the data in the incoming data buffer (the offset).

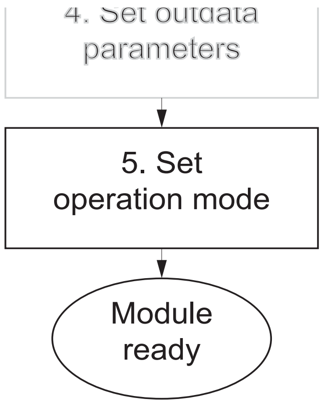


Since the SSCO bit (Configuration Bits #8) was set in the initialization phase above, the SSC Out Config-parameter is used to manually set the size of the SSC output data area.

In this example, data comes from both the SSC and the SCI interfaces to the FB input area. SSC data will always be mapped before SCI data.

Parameter	Modbus Address	Setting	Description
FB In SSC Offset (#44)	0x6004	0x0000	The source location of the data in the SSC Input area going to the FB Input area.
FB In SSC Size (#45)	0x6005	0x0002	The amount of data going from the SSC Input area to the FB Input area.
FB In SCI Offset (#46)	0x6006	0x0000	The source location of the data in the SCI Input area going to the FB Input area.
FB In SCI Size (#47)	0x6007	0x0010	The amount of data going from the SCI Input area to the FB Input area.
SSC Out Config (#54)	0x600E	0x0003	The size of the SSC Output area. Data going to the SSC interface.
SSC Out FB Offset (#57)	0x6011	0x0000	The source location of the data in the FB Output area going to the SSC Output area.
SSC Out FB Size (#58)	0x6012	0x0003	The amount of data going from the FB Output area to the SSC Output area.
SCI Out FB Offset (#67)	0x601B	0x0003	The source location of the data in the FB Output area going to the SCI Output area.
SCI Out FB Size (#68)	0x601C	0x0010	The amount of data going from the FB Output area to the SCI Output area.

2.7 Set Operation Mode



After all parameters are set in the steps above, the operation mode for the application needs to be specified.

There are three possible operation modes for the Anybus-IC. See “Initialization” on page 43 for more information. This tutorial describes the setup for normal mode operation, e.g. where the SCI interface is used to provide intelligence to the application.

To start normal operation, set parameter #1 (“Module Mode”) to 0x0001. It is not possible to set this value until the baud rate has been detected. See “Automatic Baud Rate Detection” on page 17.

Parameter	Modbus Address	Setting	Description
Module Mode (#1)	0x5001	0x0001	Normal operation. See “Module Mode (#1)” on page 53.

Module Ready

When normal operation has been started, the Anybus-IC will automatically calculate memory areas, using the parameter values set above, and initiate the communication between the fieldbus and the application.

3. MIF Interface

3.1 General Information

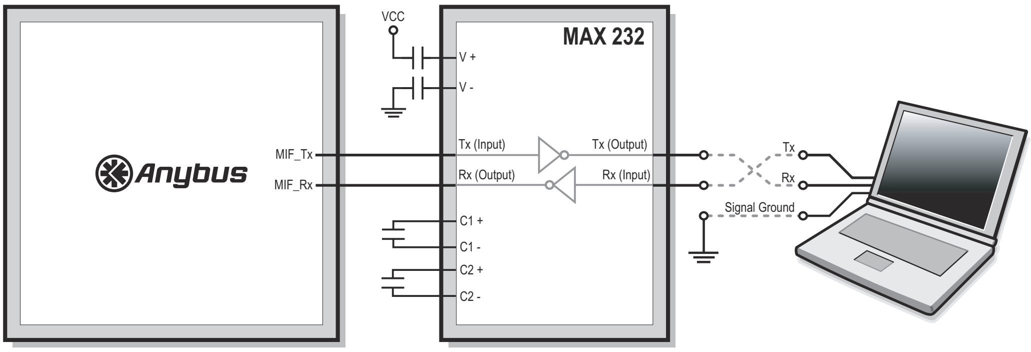
The MIF interface provides an easy way to monitor data and access parameters through a terminal-based user interface.

This interface uses the following signals:

- **MIF_Tx (Pin 27)**
  Asynchronous serial output; carries data from the Anybus module to the terminal.
  (If not used, leave this signal unconnected).

- **MIF_Rx (Pin 28)**
  Asynchronous serial input; carries data from the terminal to the Anybus module.
  (If not used, leave this signal unconnected).

In the following example, the MIF interface is connected to a PC via a MAX232 transceiver and a crossed (a.k.a. "null modem") cable.



It is important not to confuse the MIF interface with the SCI-channel. Although theoretically possible, it is strongly discouraged to use the MIF interface as a configuration channel for the application, since menu entries may be added, changed, or even removed, in future software revisions.

Note: Implementation of this interface is optional. It is however highly recommended to at least implement rudimentary support by adding dedicated solder pads or similar, since the use of this interface may provide valuable clues during development and testing.

See also...

- "Application Connector" on page 14
- "SCI Channel" on page 25

3.2 Communication Settings

3.2.1 Baud rate

The MIF interface supports baud rates from 4.8 kbps to 57.6 kbps (default is 38.4 kbps). Unlike the SCI interface, automatic baud rate detection is not supported.

See also...

- "MIF Rate Config (#18)" on page 68
- "MIF Rate Actual (#19)" on page 69

3.2.2 Communication Properties

The interface supports 1 or 2 stop bits, none, odd or even parity. Default is 1 stop bit, no parity. The number of data bits is fixed to 8.

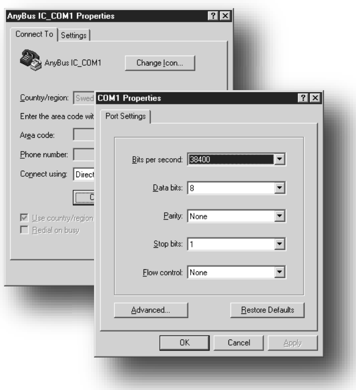
See also...

- "MIF Settings Config (#20)" on page 70
- "MIF Settings Actual (#21)" on page 71

Terminal Configuration

The following example describes the configuration procedure when using the Windows HyperTerminal. The procedure should be similar when using other terminal emulation software.

1. Start the Windows HyperTerminal.
2. Open a new connection. Name the new connection.
3. Specify the COM-port used for the MIF interface.
4. Specify the baud rate and port settings. Ensure that these settings match the ones specified in the Anybus module. Please note that flow control is not supported.



3.3 User Interface

3.3.1 General Information

The MIF interface features a menu-based user interface as follows:

- To enter a submenu or parameter, type the corresponding digit and press <Enter>.
- To enter a parameter value, enter the value and press <Enter>.
- To return to a previous menu, or cancel a parameter input, press <ESC>.
- To redraw the current menu, press <Enter>.

3.3.2 Main Menu

The main menu provides access to the various submenus. It also displays the fieldbus type.

```
------------------------------------------
 Anybus-IC - Main Menu
 Profibus-DP
------------------------------------------
  1 - Module Information
  2 - Parameters
  3 - Monitor
  4 - Firmware Upgrade
------------------------------------------
>
```

See also...

- "'Module Information'-menu" on page 23
- "'Parameters'-menu" on page 24
- "'Monitor'-menu" on page 24
- "'Firmware Upgrade'-menu" on page 24

3.3.3 'Module Information'-menu

This menu features two additional submenus; 'Software Versions', which provides information about the current Anybus-IC firmware, and 'Product Information', which provides manufacturing information such as serial number and production date.

```
------------------------------------------
 Anybus-IC - Information
------------------------------------------
  1 - Software Versions
  2 - Product Information
------------------------------------------
>
```

3.3.4 ‘Parameters’-menu

This menu provides access to all parameters in the module.

```
-----------------------------------------
Anybus-IC - Parameters
-----------------------------------------
  1 - Anybus-IC
  2 - FB I/O Settings
  3 - SSC I/O Settings
  4 - SCI I/O Settings
  5 - Fieldbus Specific
-----------------------------------------
>
```

See also...

- “Register Map” on page 26
- “Parameters” on page 51

3.3.5 ‘Monitor’-menu

All active I/O buffers can be monitored in this menu.

```
-----------------------------------------
 Anybus-IC - I/O Areas
-----------------------------------------
  1 - Fieldbus Out
  2 - SSC In
  3 - SCI In
  4 - Fieldbus In
  5 - SSC Out
  6 - SCI Out
-----------------------------------------
>
```

Example:

Monitoring of ‘Fieldbus In’-area (submenu #4):

```
-------------------------------
 Anybus-IC - Fieldbus In
-------------------------------
 Byte #
   0     1100 0011   0xc3
   1     0000 0000   0x00
-------------------------------
>
```

Note: The information is not refreshed automatically. Press <Enter> to update the screen.

See also...

- “SCI Channel” on page 25
- “SSC Channel” on page 31

3.3.6 ‘Firmware Upgrade’-menu

This menu is used when upgrading the firmware of the module.

See also “Firmware Upgrade” on page 88.

4. SCI Channel

4.1 General Information

The SCI channel is a typical asynchronous serial interface and can be used for configuration and data exchange. The communication protocol is based on a subset of the Modbus-RTU standard.

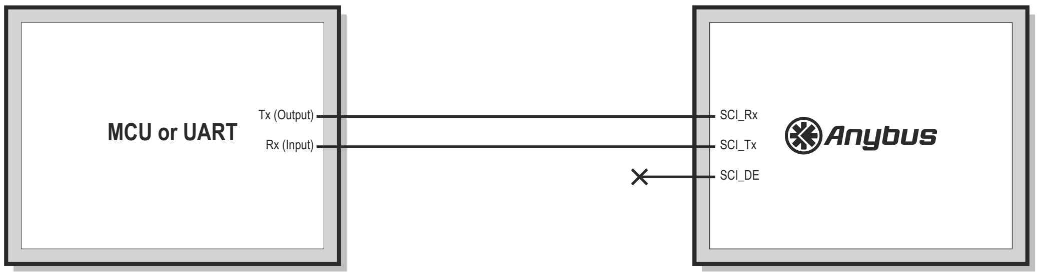
This interface uses only three signals:

- **SCI_Tx (Output, pin 30)**
  Asynchronous serial output; carries data from the Anybus module to the application.
  (If not used, leave this signal unconnected).

- **SCI_Rx (Input, pin 31)**
  Asynchronous serial input; carries data from the application to the Anybus module.
  (If not used, leave this signal unconnected).

- **SCI_DE (Input & Output, pin 29)**
  This signal enables data output on half duplex (e.g. RS-485) networks. Connecting this signal to GND disables the SCI channel altogether and causes the module to initialize automatically (i.e. for standalone operation).
  (If not used, leave this signal unconnected).

In the example below, the SCI_Tx and SCI_Rx signals are interfaced directly to an asynchronous serial interface on a microcontroller. SCI_DE has intentionally been left unconnected.



See also...

- Modbus Protocol Reference Guide
- “Application Connector” on page 14
- “I/O Mapping” on page 39

4.2 Modbus Implementation

4.2.1 Functions Codes

The following function codes are implemented in the Anybus-IC module.

#	Name	No. of simultaneous register R/W	Comments
3	Read Multiple Registers[a]	125/-	Reads the contents of a sequence of registers.
4	Read Input Registers[a]	125/-	
6	Write Single Register		Writes to a single register[b]
16	Write Multiple Registers	-/123	Writes to a sequence of registers[b]
23	Read / Write Registers	125/121	Writes to a sequence of registers and returns their previous values
91	Object Messaging		See “Object Messaging (0x5B)” on page 89

a. These functions are identical in this implementation
b. The module supports broadcast in multidrop configurations

Note: All function codes share the same register map.

4.2.2 Register Map

Parameters and data are mapped to Modbus registers as follows:

Register no. (Hex)	Description	Comments
0000h... 003Fh	SCI IN buffer	128 bytes (64 registers) in each direction; see also “I/O Mapping” on page 39
1000h... 103Fh	SCI OUT buffer	
5001h... 5033h	General Parameters	See “General Parameters” on page 52
6000h... 6020h	I/O Parameters	See “I/O Parameters” on page 73
7000h...	Fieldbus Specific	Consult each separate fieldbus appendix

Note 1: Unmapped register regions are reserved for future use.

Note 2: In this document, register numbers are specified using the protocol convention (base 0), i.e. there is a 1:1 correlation between the register number specified in this document and the actual register value in the message frame.

4.2.3 Exception Codes

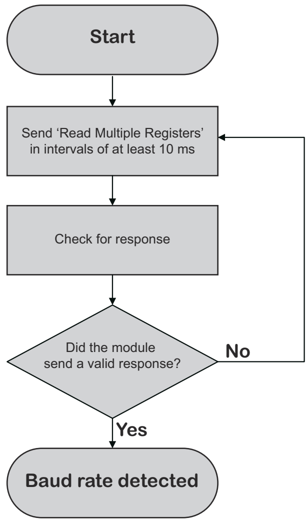
The following exception codes are used by the Anybus module.

#	Name	Comments
1	Illegal Function	Illegal (unsupported) function code in query
2	Illegal Data Address	Illegal Modbus register address in query
3	Illegal Data Value	Register value specified in query is not valid
4	Slave Device Failure	An unrecoverable error occurred while processing the requested action

4.3 Communication Settings

4.3.1 Baud Rate

The SCI channel supports baud rates from 4.8 kbps to 57.6 kbps. By default, the module attempts to detect the baud rate automatically. This is not part of the Modbus RTU specification, and requires a special startup sequence (see flowchart).



- During start-up, the application must repeatedly issue 'Read Holding Registers'-requests to slave address 0x01. Wait at least 10 ms before reissuing the request.

  Example: read data from Modbus register 0x5001 by issuing "01h 03h 50h 01h 00h 01h C4h CAh".
- The module responds when the correct baud rate has been established.
- Generally the module detects the baud rate within 20 attempts.
- In order for this functionality to work, the module must be configured to use slave address 0x01. This means that it is not possible to use automatic baud rate detection in multidrop systems.

Note: Some Anybus IC modules support further baud rates. Please see "SCI Rate Config (#14)" on page 64".

See also...

- "SCI Rate Actual (#15)" on page 65

4.3.2 Timeout

Under normal circumstances the Anybus-IC module will start to send a response within 50 ms of the receipt of a correct message. This time should be considered as a minimum timeout value.

4.3.3 Communication Properties

The number of data bits on the SCI channel is fixed to 8. The number of stop bits depends on the parity setting, which is accessed through parameter #16. Flow control is not supported.

Default settings are no parity / 2 stop bits.

See also...

- "SCI Settings Config (#16)" on page 66
- "SCI Settings Actual (#17)" on page 67

Note: If using automatic baud rate detection, these settings are detected by the module automatically.

4.3.4 Modbus RTU Address

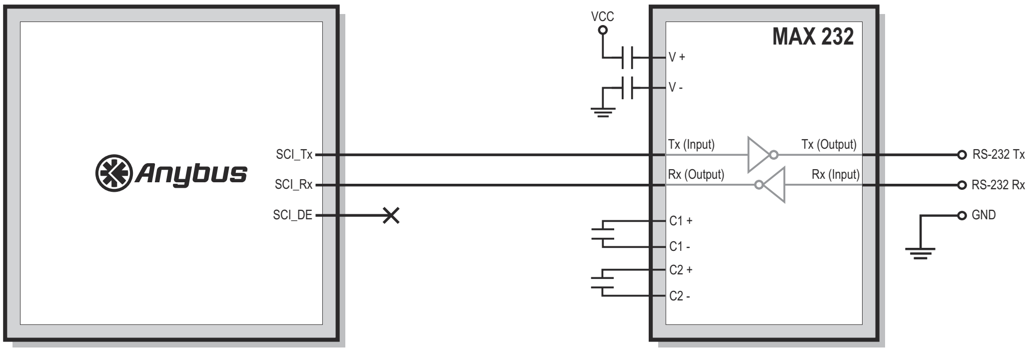
The communication protocol allows multiple Anybus modules to be interfaced to the same microcontroller (e.g. using a multi-drop RS-485 network). In such cases, each module must be assigned a unique Modbus RTU address.

See also...

- “Interfacing to RS-485 (Multidrop)” on page 30
- “Modbus RTU Address (#22)” on page 71

4.4 Interfacing to RS-232

In the example below, the MAX232 transceiver from Maxim is used to convert the SCI-signals to RS-232 levels. The SCI_DE-signal is intentionally left unconnected.



Cable Considerations

The cable length and quality have great impact on the maximum possible data rate. This is a limitation in the RS-232 standard itself, rather than a limitation in the Anybus module.

The maximum cable length depends on a number of factors, including how well the sender and receiver are implemented regarding rise times, cable capacitance and inductance etc. The original RS-232 specification states a maximum cable length of 15.25 metres at data rates up to 20.0 kbps, however in most real-life situations, the Anybus module can be used well outside these limitations.

The external environment has a large impact on the maximum cable lengths when using unshielded cables. In electrically noisy environments, even very short cables can pick up stray signals.

General Recommendations

For best operation, be sure to follow the guidelines below.

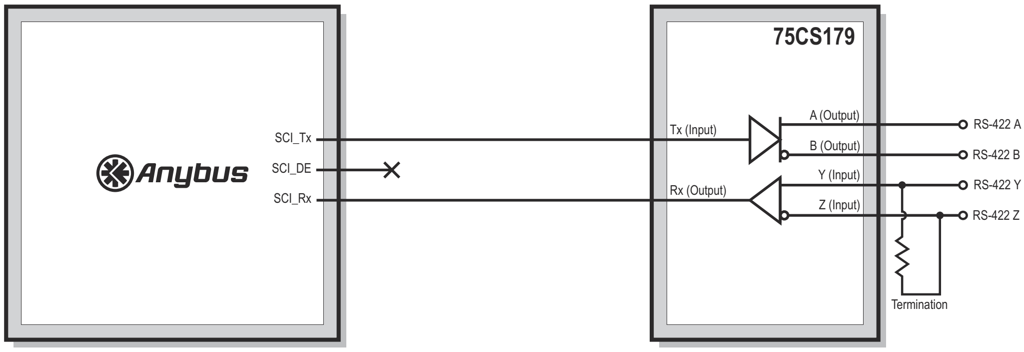
- Always use good quality shielded RS-232 cable
- Do not let the RS-232 cable run parallel to and close to power cables for more than 0.5 m.
- Do not wrap the RS-232 cable around other signal cables.
- For longer distances, use RS-422 or RS-485.

See also...

- “General Information” on page 25
- “Interfacing to RS-422” on page 30
- “Interfacing to RS-485 (Multidrop)” on page 30

4.5 Interfacing to RS-422

RS-422 uses balanced signals for data transmission, offering greater noise immunity compared to RS-232. In the example below, a 75CS179 transceiver is used to convert the SCI-signals to RS-422 levels. Again, the SCI_DE-signal is intentionally left unconnected.



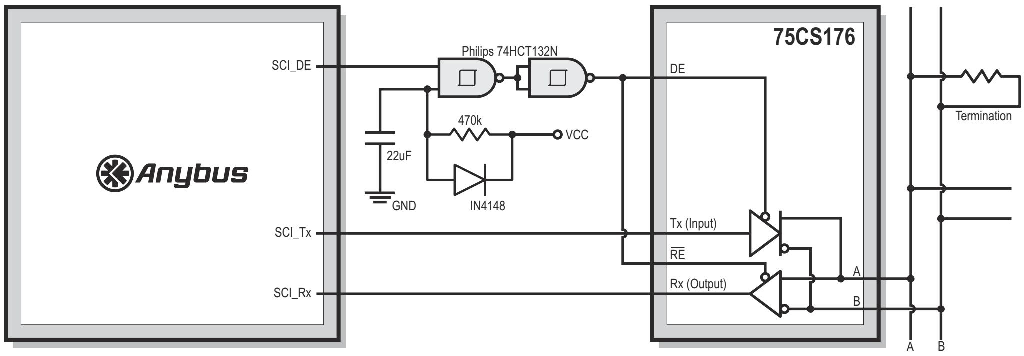
Note: It is recommended to use termination resistors to avoid reflections on the serial line.

See also...

- "General Information" on page 25
- "Interfacing to RS-232" on page 29
- "Interfacing to RS-485 (Multidrop)" on page 30

4.6 Interfacing to RS-485 (Multidrop)

RS-485 is similar to RS-422 and is used for multipoint communications, allowing multiple Anybus modules to be interfaced to the same microcontroller. In the example below, a 75CS176 transceiver is used to convert the SCI-signals to RS-485 levels.



The SCI_DE-signal requires a special circuit, which prevents the Anybus module from sending undefined data to the RS-485 network during startup (the circuit prevents the module from accessing the RS-485 network for approximately 4 seconds after power on).

Note: It is recommended to use termination resistors to avoid reflections on the serial line.

See also...

- "General Information" on page 25
- "Interfacing to RS-232" on page 29
- "Interfacing to RS-422" on page 30

5. SSC Channel

5.1 General Information

The SSC channel uses a synchronous serial interface similar to the Motorola SPI, intended for discrete I/O and fieldbus-specific input/output signals such as node address and LED indications.

The Anybus-IC expects that any circuitry that is wired to the SSC is 100% sequence- and timing-compatible to the chain of 165/594 discrete shift registers mounted on the same circuit board as the module. The application designer using the SSC interface must make sure that their circuitry is, from a sequence and timing viewpoint, identical to a 165/594 shift register chain.

This interface uses 6 signals:

- **/SSC_Reset_Out (Pin 2)**
  Active low signal used to reset the shift registers. The use of this signal is optional.
  Note that this signal must not be confused with /RESET (pin 8).
  If not used, leave this signal unconnected.

- **/SSC_LD (Pin 3)**
  Shift register load. Loads the value of the shift register inputs on transition to low.
  If not used, leave this signal unconnected.

- **SSC_DO (Pin 4)**
  Serial data output. Valid on the falling edge of SSC_CLK.
  If not used, leave this signal unconnected.

- **SSC_DI2 (Pin 5)**
  Serial data input 1 from shift registers. Sampled on the rising edge of SSC_CLK.
  If not used, leave this signal unconnected.

- **SSC_DI1 (Pin 6)**
  Serial data input 2 from shift registers. Sampled on the rising edge of SSC_CLK.
  - If only using Input Registers, connect this signal to SCC_DO.
  - If only using Output Registers, connect this signal to SCC_DI2.
  - If using both Input- and Output Registers, connect this signal to the serial data line between the Input- and Output Registers.

  If not used, leave this signal unconnected.

- **SSC_CLK (Pin 7)**
  Clock output.
  If not used, leave this signal unconnected.

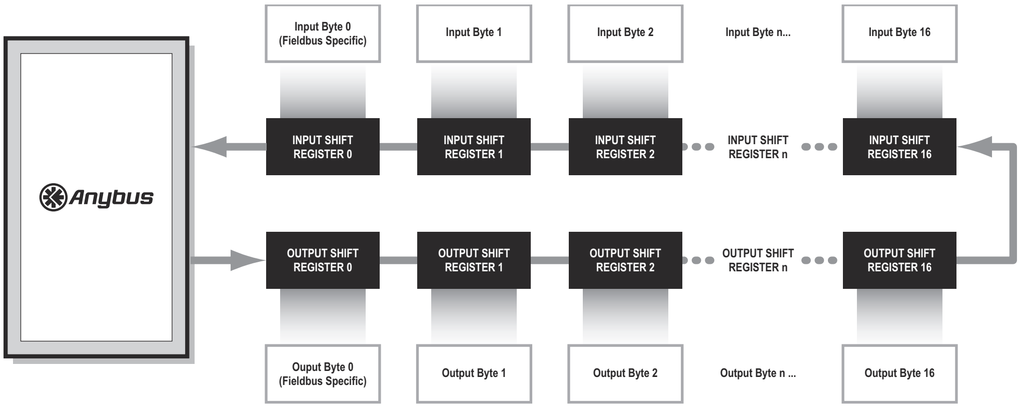
See also...

- "Application Connector" on page 14
- "I/O Mapping" on page 39

5.2 The Shift Register Loop

The SSC channel is intended to be used with an external shift register loop to form discrete inputs and outputs. It supports up to 17 registers (136 bits) in each direction, out of which 16 (128 bits) can be used for data exchange.

As illustrated below, the first Input- and Output Registers in the shift register loop are by default reserved for fieldbus specific functions. It is possible to disable this functionality and use those registers for data exchange instead. The maximum total amount of data is however still limited to 16 registers (128 bits) in each direction.



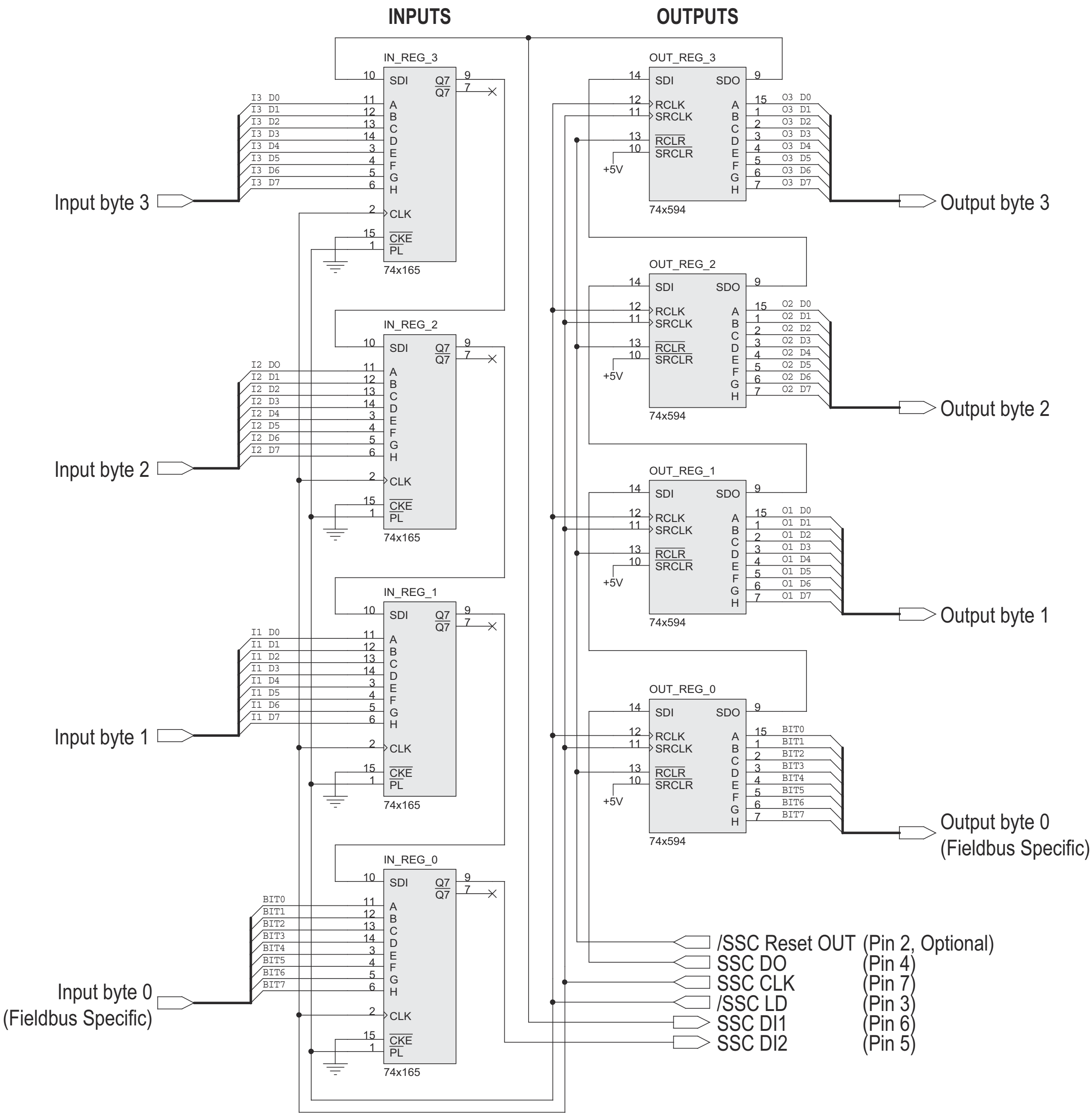
The module detects the number of shift registers automatically during startup. If needed, the number of registers can be specified through parameters #51 and #54. Parameter #8 ('Configuration Bits') determines whether to use manual or automatically detected settings.

See also...

- "Sequence Diagrams" on page 37
- "Configuration Bits (#8)" on page 57
- "SSC In Config (#51)" on page 77
- "SSC In Auto (#52)" on page 78
- "SSC Out Config (#54)" on page 78
- "SSC Out Auto (#55)" on page 79

5.3 Basic Shift Register Circuit

The following schematic illustrates a basic shift register loop.



5.4 Fieldbus Specific Output Register (Output Register 0)

5.4.1 General

The fieldbus specific output register (Output Register 0), is used for fieldbus specific status indications (LEDs).

As mentioned previously, this functionality can be disabled by setting the 'FBLP'-bit in parameter #8 ('Configuration Bits'). In such a case, this register will be used for normal data exchange instead. Note however that this does not extend the number of possible outputs available for data exchange.

See also...

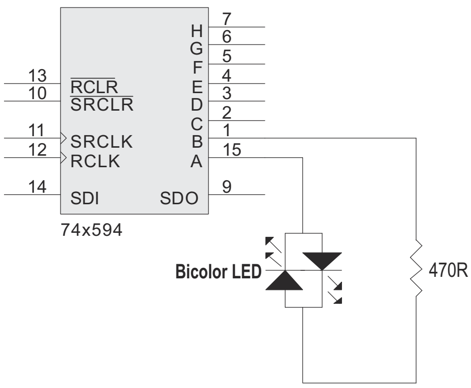
- "Configuration Bits (#8)" on page 57

Note: The Fieldbus Specific Output register can be used even if no SSC I/O data is present, e.g. if all data exchange is made through the SCI channel and only the LEDs are used on the SSC channel.

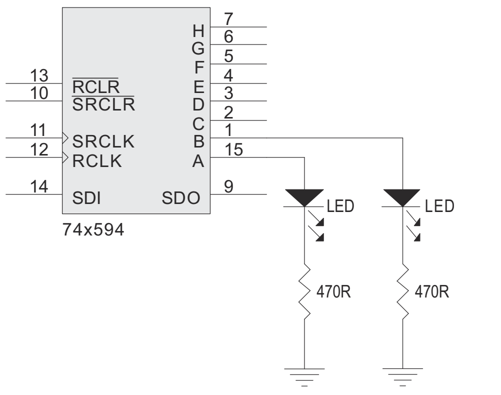
5.4.2 LEDs (no External Drivers)

This type of circuit requires shift registers of sufficient current capacity to drive the LEDs directly, e.g. 74x594 or equivalent.

Bicolor



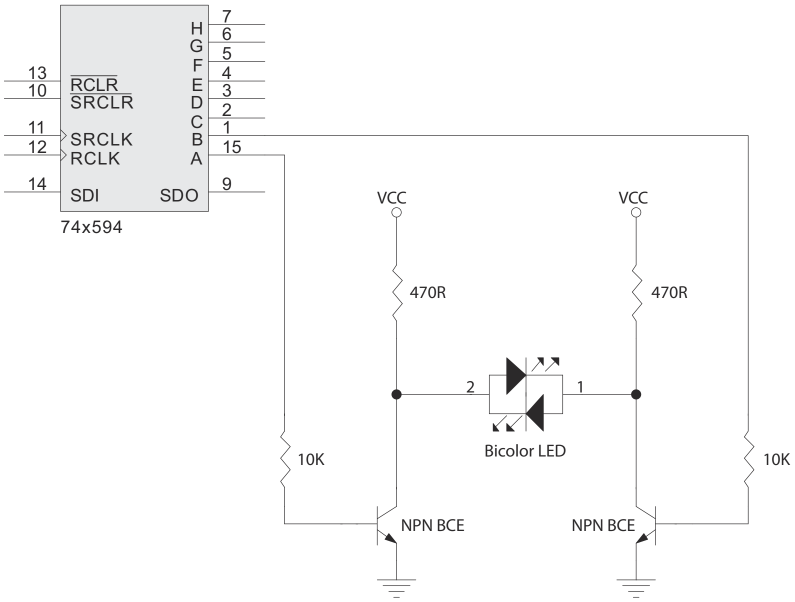
Single Color



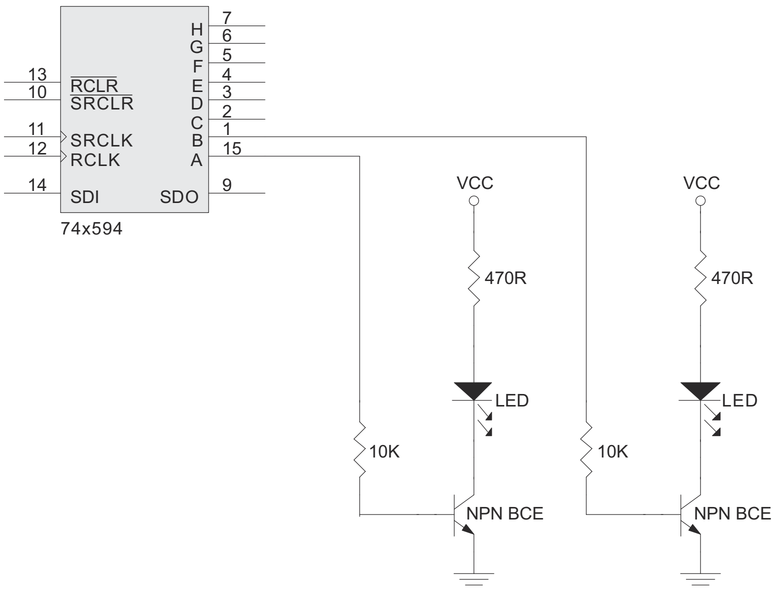
5.4.3 LEDs (External Driver Circuit)

This type of connection can be used with 74x594 or equivalent type shift registers.

Bicolor



Single Color



5.5 Fieldbus Specific Input Register (Input Register 0)

5.5.1 General

The fieldbus specific input register (Input Register 0) is used for fieldbus specific configuration settings (switches), such as node address and baud rate.

The module supports both binary and BCD-coded switches. The switch type is specified in parameter #9 ('Switch Coding'). Note that the module does not invert the individual bit values of this register; a low input voltage is interpreted as a logical zero (0), and a high input voltage is interpreted as a logical one (1).

This functionality can be disabled by setting the FBNP bit in parameter #8 ('Configuration Bits). In such a case, this register will be used for normal data exchange instead. Note however that this does not extend the number of possible inputs available for data exchange.

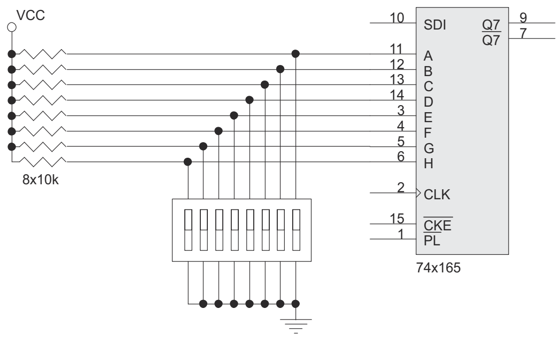
See also...

- "Configuration Bits (#8)" on page 57
- "Switch Coding (#9)" on page 59

Note: The Fieldbus Specific Input register can be used even if no SSC I/O data is present, e.g. if all data exchange is made through the SCI channel and only the node address is taken from the SSC channel.

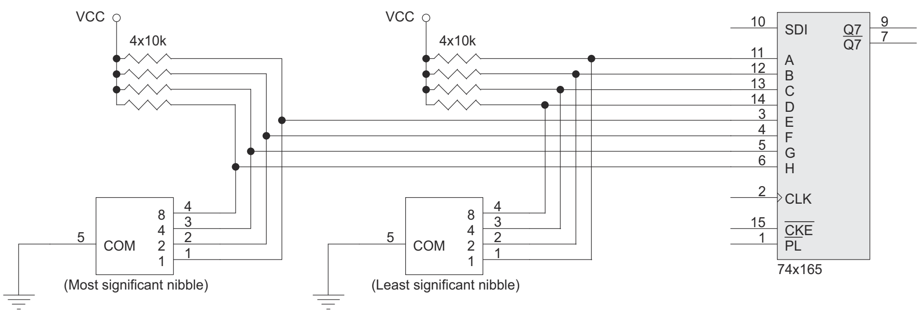
5.5.2 Binary Switches

A closed switch in the circuit below produces a logical zero (0).



5.5.3 BCD-coded Switches

The switches in the circuit below are of sinking kind (all bits are connected to common when the switch is in position zero).



5.6 Sequence Diagrams

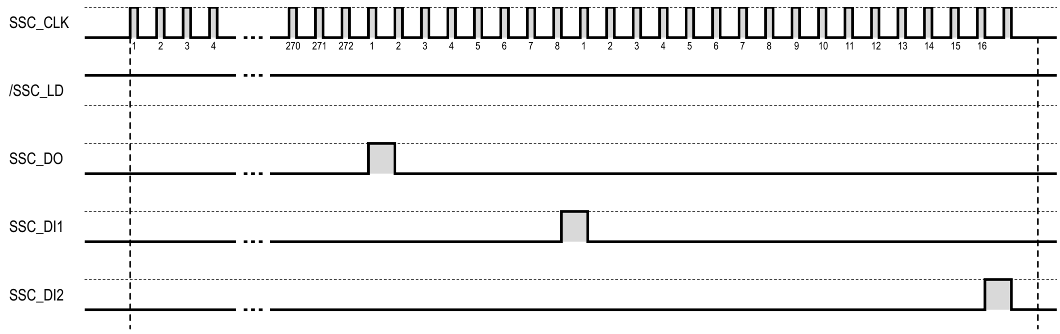
In order to ensure compatibility with all members of the Anybus-IC family the application developer must make sure that any circuitry connected to the SSC interface is fully sequence and timing compatible to a design using a full-size shift register chain, mounted on one single circuit board and built with the 74x165/74x594 shift registers as shown in the sample schematic on page 33.

Other shift registers and connection techniques may also work as long as they are sequence and timing compatible to the above.

5.6.1 Initialization Sequence (Startup Only)

A special initialization sequence is performed during startup to establish the number of attached shift registers. The module starts by clearing the internal register in all shift registers by shifting out zeroes the maximum number of times possible (17 Input Registers x 8 bit + 17 Output Registers x 8 bit = 272 times).

When cleared, a logical 1 (one) is shifted through the shift register loop. The module determines the number of Output and Input Registers by counting the number of clock cycles needed before that logical 1 (one) reaches DI1 and DI2. The example below uses 1 Output Register, and 2 Input Registers.

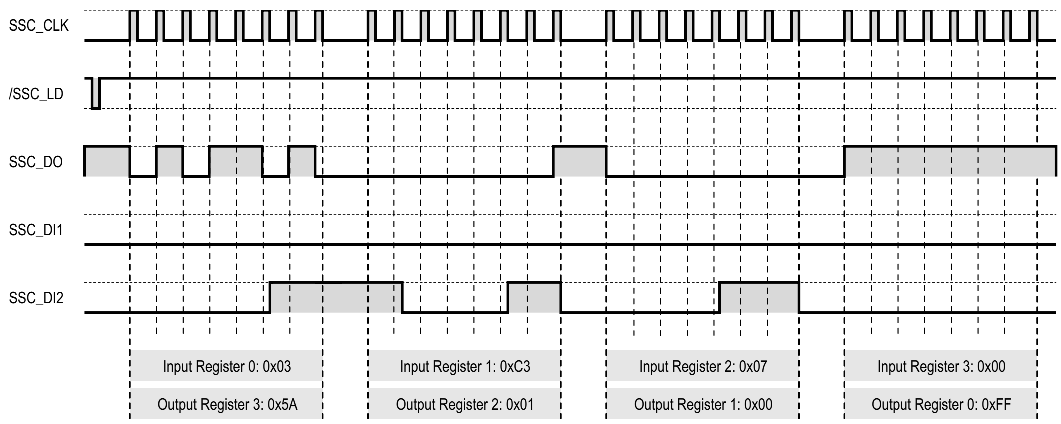


When done, the module starts executing refresh-cycles as described below.

5.6.2 Refresh Sequence (Normal Operation)

The refresh sequence is performed every 5 ms ± 2 ms. The Input Registers are read in consecutive order (0... 16), while the Output Registers are read in reverse order (16... 0). Note that the refresh sequence may be temporarily interrupted by other tasks, but will always finish after the interruption in order to keep data consistency.

The following example features 4 Input Registers and 4 Output Registers.



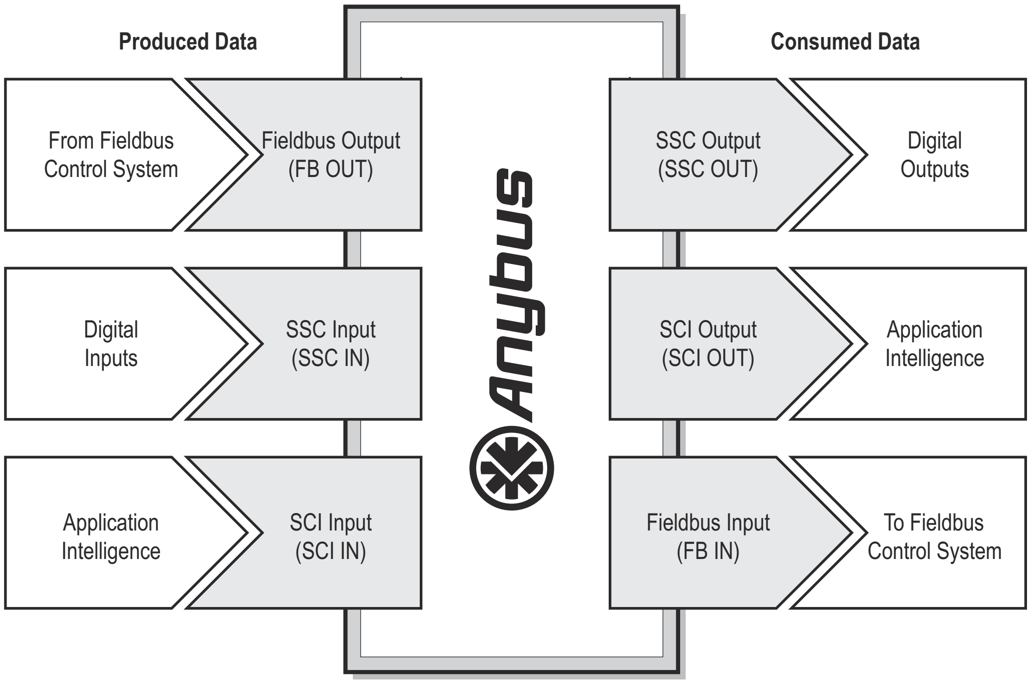
The refresh sequence is initiated by a /SSC_LD pulse ≥ 300 ns. This pulse loads the input shift registers with the input parallel data available. The load pulse is followed by a ≥ 900 ns delay before the clock, SCC_CLK, is activated. The clock cycle is ≥ 660 ns, giving a maximum frequency of approximately 1,5 MHz, with the signal staying high/low for ≥ 300 ns. SSC_DI2 is sampled on the positive flank of the clock pulse and the next bit in the shift register will be shifted to the output of the register.

The output data from the Anybus-IC is shifted out on the negative flank of the clock. The output shift registers sample the serial data from the Anybus-IC on the positive flank of the clock. Once all registers have been updated, the clock stops. After a delay of ≥ 900 ns, a new pulse on /SSC_LD, ≥ 300 ns, updates the output register circuits.

6. I/O Mapping

6.1 General Information

Each communication channel (i.e. SSC, fieldbus, SCI) uses two buffers. One which holds incoming (i.e. produced) data, and one which holds outgoing (i.e. consumed) data. Data produced on one channel can be mapped (i.e. copied automatically) to the consuming buffer of another channel. How this mapping shall be performed is specified by the I/O Parameters.



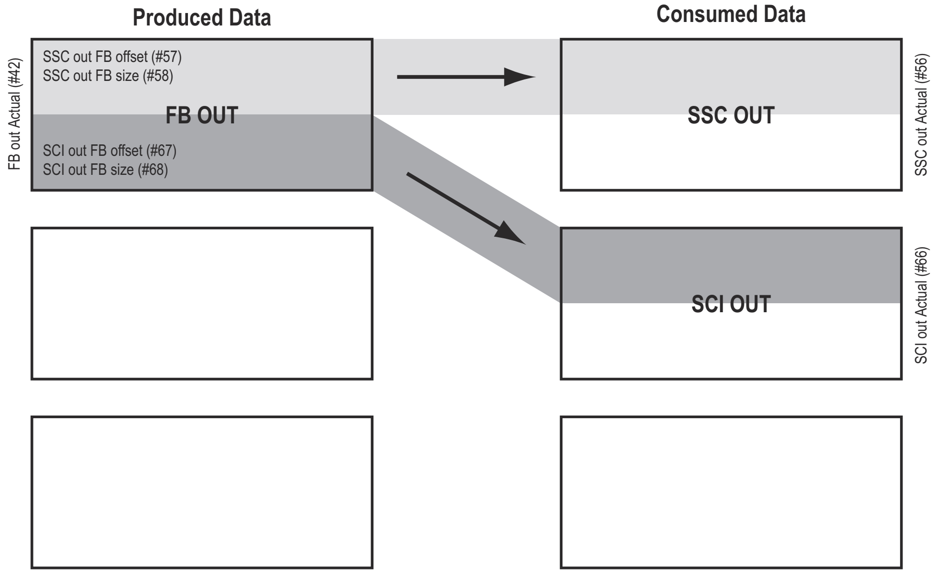
See also...

- "Fieldbus Mapping" on page 40 (mapping of data from FB OUT to SSC OUT and SCI OUT)
- "SSC Mapping" on page 41 (mapping of data from SSC IN to FB IN and SCI OUT)
- "SCI Mapping" on page 42 (mapping of data from SCI IN to FB IN and SSC OUT)
- "I/O Parameters" on page 73

Note: Data can only be mapped to another channel; it is not possible to map data produced on one channel to the very same channel's consuming buffer (i.e. causing a "loop").

6.2 Fieldbus Mapping

Data written by the fieldbus control system resides in the FB OUT buffer. This data may be mapped, i.e. copied automatically, to SCC OUT and/or SCI OUT.

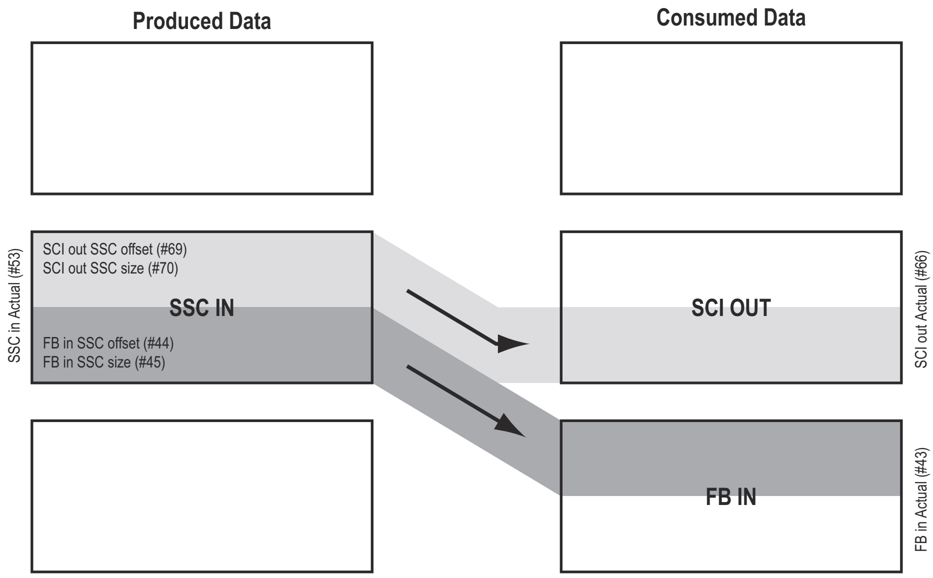


Related Parameters

Parameter	Description
FB Out Actual (#42)	Specifies the total size of the FB OUT buffer after initialization. The value specified here is the maximum amount of data that can be mapped to other channels.
SSC Out FB Offset (#57)	Specifies the source offset (in the FB OUT buffer) for FB OUT to SCC OUT mapping.
SSC Out FB Size (#58)	Specifies the number of bytes to copy from FB OUT to SSC OUT.
SCI Out FB Offset (#67)	Specifies the source offset (in the FB OUT buffer) for FB OUT to SCI OUT mapping.
SCI Out FB Size (#68)	Specifies the number of bytes to copy from FB OUT to SCI OUT.

6.3 SSC Mapping

Data read from the shift registers on the SSC channel resides in the SSC IN buffer. This data may be mapped, i.e. copied automatically, to FB IN and/or SCI OUT.

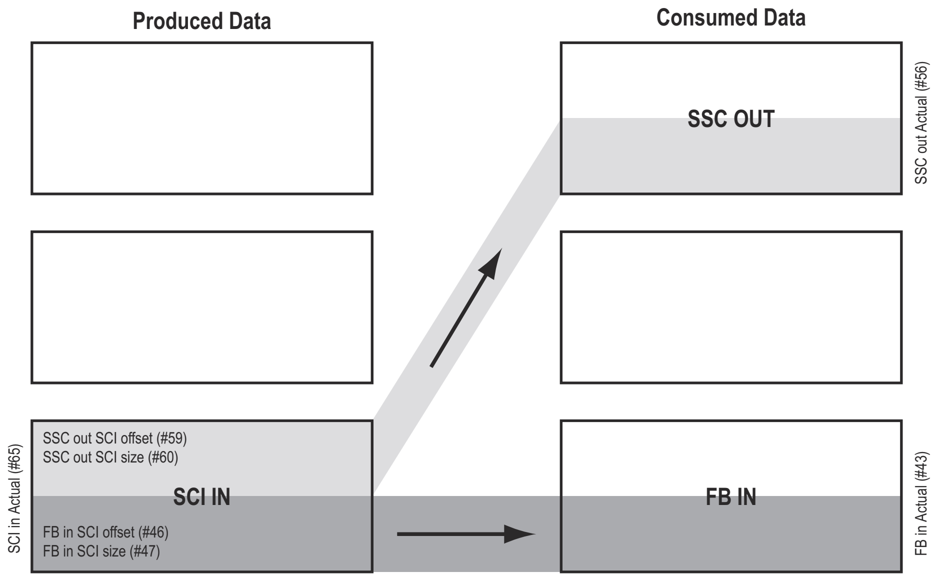


Related Parameters

Parameter	Description
SSC In Actual (#53)	Specifies the total size of the SSC IN buffer after initialization. The value specified here is the maximum amount of data that can be mapped to other channels.
FB In SSC Offset (#44)	Specifies the source offset (in the SSC IN buffer) for SSC IN to FB IN mapping.
FB In SSC Size (#45)	Specifies the number of bytes to copy from SSC IN to FB IN.
SCI Out SSC Offset (#69)	Specifies the source offset (in the SSC IN buffer) for SSC IN to SCI OUT mapping.
SCI Out SSC Size (#70)	Specifies the number of bytes to copy from SSC IN to SCI OUT.

6.4 SCI Mapping

Data written by the application on the SCI channel resides in the SCI IN buffer. This data may be mapped, i.e. copied automatically, to FB IN and/or SSC OUT.



Related Parameters

Parameter	Description
SCI In Actual (#65)	Specifies the total size of the SCI IN buffer after initialization. The value specified here is the maximum amount of data that can be mapped to other channels.
FB In SCI Offset (#46)	Specifies the source offset (in the SCI IN buffer) for SCI IN to FB IN mapping.
FB In SCI Size (#47)	Specifies the number of bytes to copy from SCI IN to FB IN.
SSC Out SCI Offset (#59)	Specifies the source offset (in the SCI IN buffer) for SCI IN to SSC OUT mapping.
SSC Out SCI Size (#60)	Specifies the number of bytes to copy from SCI IN to SSC OUT.

7. Initialization

7.1 General Information

The Anybus module features three modes of operation:

- **Normal Initialization**
  This mode is suitable for intelligent applications where the module shall be controlled by e.g. a microcontroller via the SCI channel.

- **Automatic Initialization (Standalone)**
  This mode is suitable for nonintelligent applications. The SCI channel will be disabled, but parameter settings etc. can still be accessed via the MIF interface.

- **Fieldbus Specific Initialization**
  This mode enables advanced fieldbus specific features when available. Consult each fieldbus appendix for further information.

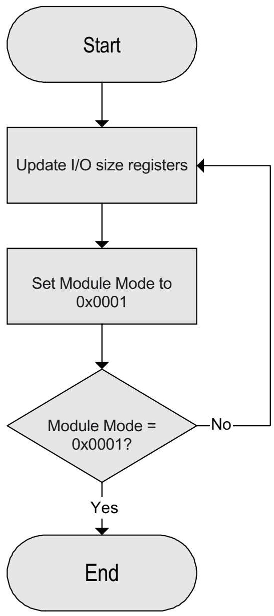
Note: The examples in this chapter assume that all parameters are set to their default values prior to initialization. To reset the module to its factory default settings, set parameter #1 (“Module Mode”) to 0004h.

7.2 Normal Initialization

This mode is suitable for intelligent applications where a microcontroller or UART is connected to the SCI channel.

Initialization Sequence

The following steps initialize the module via the SCI channel.



1. Start-up
2. If necessary, perform the automatic baud rate detection sequence for the SCI channel, see “Baud Rate” on page 27
3. Configure the I/O data sizes using the I/O parameters
4. Set parameter #1 (“Module Mode”) to 0x0001 (Normal Mode)
5. Check if initialization was successful
6. End of initialization

Note: If required, the procedure above can also be performed using the MIF interface. However, since this interface is designed for debugging and configuration purposes, this initialization method should only be used when evaluating the various functions of the module.
See also...

- “Initialization Examples, Normal Initialization” on page 45

7.3 Automatic Initialization (Standalone)

Connecting SCI_DE [AUTO] (pin 29) to ground (GND) will cause the module to initialize itself automatically to run "standalone". This mode is intended for nonintelligent applications such as valve terminals and modular I/O devices.

Automatic initialization affects the implementation as follows:

- The SCI channel will be completely disabled, and SCI related parameters will either be set to zero or ignored, depending on context. Parameters can however still be set via the MIF interface.
- SSC- and fieldbus related I/O parameters will be set automatically based on the shift register configuration. All SSC data will be mapped to the fieldbus and vice versa.
- The settings in parameter #8 ('Configuration Bits') will be set to reflect standalone operation.

  Note: If parameter #8 "Configuration Bits" is set to a value different than zero (0000h), the automatic initialization may not work as expected (e.g. if the SSCI bit is 1, the SSC Input data size will be taken from parameter #51 "SSC In Config" instead of the automatically detected size). To reset the module to its factory default settings, set parameter #1 ("Module Mode") to 0004h.

See also...

- "Application Connector" on page 14 (pin 29)
- "MIF Interface" on page 21
- "SSC Channel" on page 31
- "Initialization Examples, Automatic Initialization" on page 49
- "General Parameters" on page 52 ("Configuration Bits (#8)" on page 57)
- "I/O Parameters" on page 73

7.4 Fieldbus Specific Initialization

For advanced implementations, certain Anybus-IC versions feature special initialization modes which provide support for advanced fieldbus specific functions.

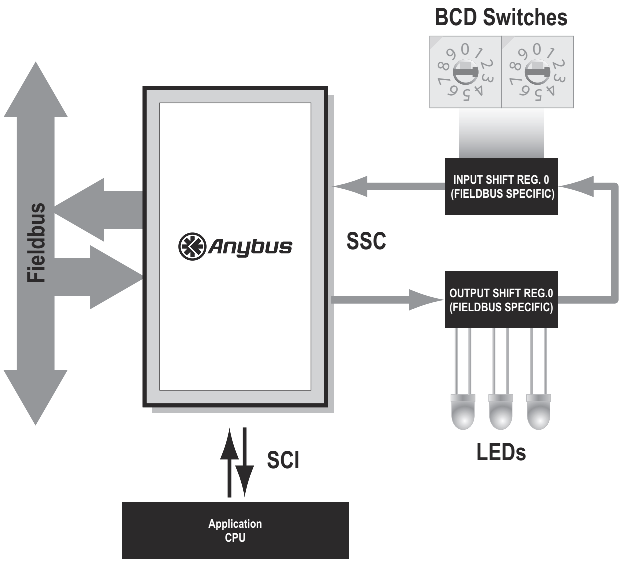
For more information, consult each separate fieldbus appendix.

7.5 Initialization Examples, Normal Initialization

7.5.1 Switches and LEDs on SSC, Data Exchange via SCI

Properties:

- SCI channel is interfaced to a microcontroller
- Automatic baud rate detection is used (SCI)
- All I/O is mapped between the SCI and Fieldbus channels
  (In this case 8 bytes in each direction)
- LEDs on the Fieldbus Specific Output Register (0)
- BCD-coded switches on the Fieldbus Specific Input Register



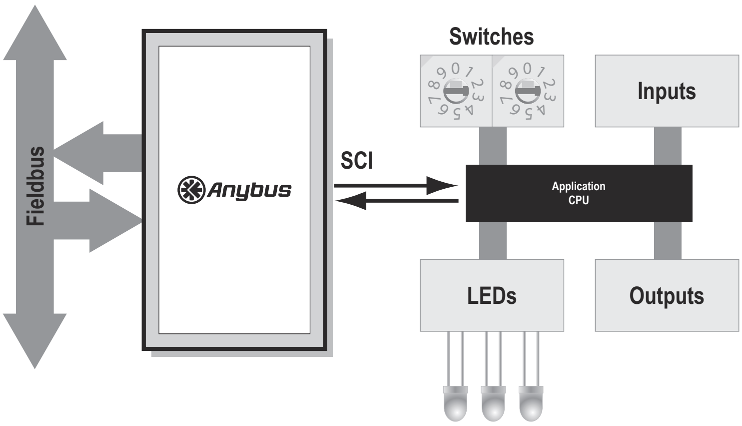
Parameter Values

Parameter	Setting
Configuration Bits (#8)	SSCI=1, SSCO=1
Switch Coding (#9)	0x00
SCI Rate Config (#14)	0x00 (default)
FB Out Config (#41)	0x0008
FB In SSC Size (#45)	0x0000 (default)
FB In SCI Offset (#46)	0x0000 (default)
FB In SCI Size (#47)	0x0008
SSC In Config (#51)	0x0000 (default)
SSC Out Config (#54)	0x0000 (default)
SCI In Config (#64)	0x0008
SCI Out FB Offset (#67)	0x0000 (default)
SCI Out FB Size (#68)	0x0008
SCI Out SSC Size (#70)	0x0000 (default)

7.5.2 Switches, LEDs and Data Exchange via SCI

Properties:

- SCI channel is interfaced to a microcontroller
- All I/O is mapped between the SCI and Fieldbus channels
  (In this case 8 bytes in each direction)
- LEDs and outputs handled by application
- Switches and inputs handled by application



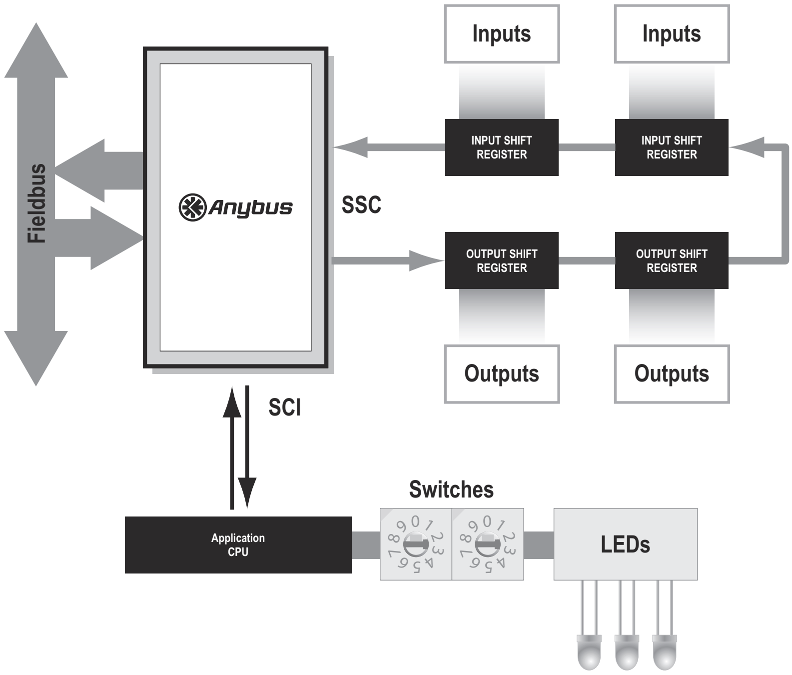
Parameter Values

Parameter	Setting
Configuration Bits (#8)	FBNP=1, FBLP =1, SSCI=1, SSCO=1
Switch Coding (#9)	0x00
SCI Rate Config (#14)	0x00 (default)
FB Out Config (#41)	0x0008
FB In SSC Size (#45)	0x0000 (default)
FB In SCI Offset (#46)	0x0000 (default)
FB In SCI Size (#47)	0x0008
SSC In Config (#51)	0x0000 (default)
SSC Out Config (#54)	0x0000 (default)
SCI In Config (#64)	0x0008
SCI Out FB Offset (#67)	0x0000 (default)
SCI Out FB Size (#68)	0x0008
SCI Out SSC Size (#70)	0x0000 (default)

7.5.3 Switches and LEDs on SCI, Data Exchange via SSC and SCI

Properties:

- SCI channel is interfaced to a microcontroller
- LEDs handled by application
- Switches handled by application
- 2 bytes of SSC data in each direction
- 6 bytes of SCI data in each direction
- Fieldbus data mapped to both SCI and SSC



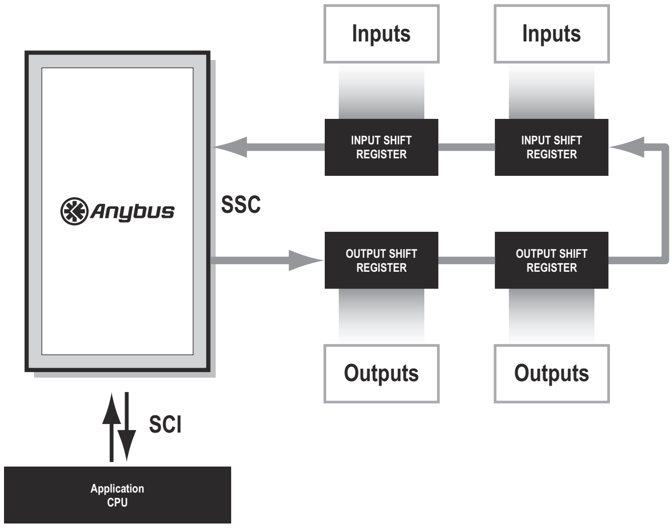
Parameter Values

Parameter	Setting
Configuration Bits (#8)	FBNP=1, FBLP =1, SSCI=1, SSCO=1
SCI Rate Config (#14)	0x00
SCI In Config (#64)	0x0006
SCI Out FB Offset (#67)	0x0002
SCI Out FB Size (#68)	0x0006
FB Out Config (#41)	0x0008
FB In SSC Size (#45)	0x0002
FB In SCI Offset (#46)	0x0000
FB In SCI Size (#47)	0x0006
FB In SSC Offset (#44)	0x0000
SSC In Config (#51)	0x0002
SSC Out Config (#54)	0x0002
SSC Out FB Offset (#57)	0x0000
SSC Out FB Size (#58)	0x0002

7.5.4 SCI and SSC Used for Data Exchange (No Fieldbus I/O)

Properties:

- SCI channel is interfaced to a microcontroller
- 2 bytes of SSC data in each direction
- 2 bytes of SCI data in each direction
- All data mapped between SSC and SCI



Parameter Values

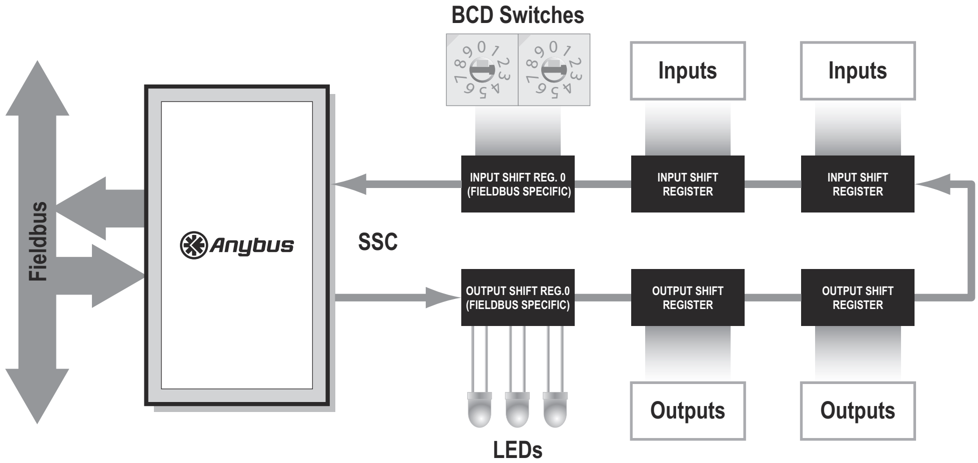
Parameter	Setting
Configuration Bits (#8)	FBNP=1, FBLP =1, SSCI=1, SSCO=1
SCI Rate Config (#14)	0x00
SCI In Config (#64)	0x0002
FB Out Config (#41)	0x0000
FB In SSC Size (#45)	0x0000
FB In SCI Offset (#46)	0x0000
FB In SCI Size (#47)	0x0000
FB In SSC Offset (#44)	0x0000
SSC In Config (#51)	0x0002
SSC Out Config (#54)	0x0002
SSC Out SCI Size (#60)	0x0002
SCI Out SSC Size (#70)	0x0002

7.6 Initialization Examples, Automatic Initialization

7.6.1 Switches and LEDs on SSC

Properties:

- Standalone operation (Automatic initialization)
- All data is mapped between Fieldbus and SSC
- LEDs on the Fieldbus Specific Output Register (0)
- BCD-coded switches on the Fieldbus Specific Input Register



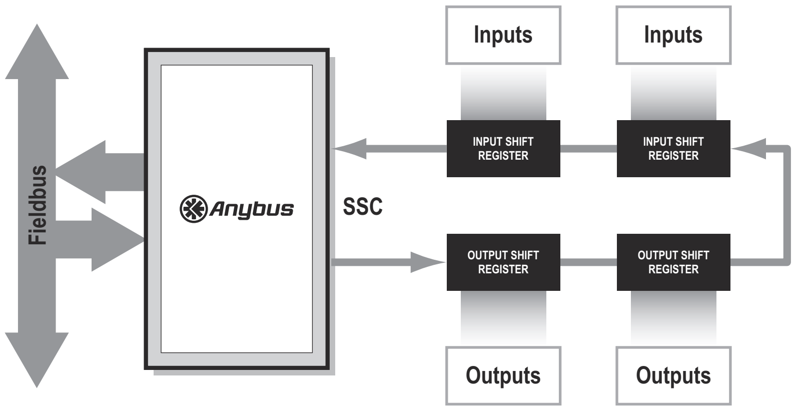
Parameter Values

Parameter	Setting
Configuration Bits (#8)	00h (default)
Switch Coding (#9)	00h

7.6.2 Preconfigured Node Address, no LEDs

Properties:

- Standalone operation (Automatic initialization)
- All data is mapped between Fieldbus and SSC
- No LEDs or switches



Parameter Values

Parameter	Setting
Configuration Bits (#8)	FBNP=1, FBLP =1
(fieldbus specific)	Node address specified via MIF-interface (fieldbus specific parameter)

8. Parameters

8.1 General Information

From the host application side, all settings and data in the module are represented through entities called 'Parameters'. Parameters can be accessed by the user through the MIF interface, or by the application via the SCI channel.

The parameters are grouped into three categories based on their usage as follows:

- **General Anybus-IC Parameters**
  Used for configuration and status information, present on all versions of the Anybus-IC.
- **I/O Parameters**
  Specifies data sizes and I/O mapping, present on all versions of the Anybus-IC.
- **Fieldbus Specific Parameters**
  Entirely fieldbus specific; consult each separate fieldbus appendix for further information.

Note 1: When accessing parameters via the SCI channel (e.g. using Modbus), byte-sized parameter values are placed in the least significant byte of the word.

Note 2: In this document, register numbers are specified using the protocol convention (base 0), i.e. there is a 1:1 correlation between the register number specified in this document and the actual register value in the message frame.

8.2 General Parameters

These parameters are used to configure the basic settings of the module.

#	Modbus Address	Name	Size	Default	Access
1	0x5001	Module Mode	2 bytes	-	R/W
2	0x5002	Module Status	2 bytes	-	R
3	0x5003	Module Type	2 bytes	-	R
4	0x5004	Fieldbus Type	2 bytes	-	R
7	0x5007	LED State	2 bytes	-	R
8	0x5008	Config Bits	2 bytes	0x0000	R/W
9	0x5009	Switch Coding	1 byte	Fieldbus dependent[a]	R/W
10	0x500A	Offline Action	1 byte	0x00	R/W
11	0x500B	Idle Action	1 byte	0x00	R/W
12	0x500C	Interrupt Config	2 bytes	0x0001	R/W
13	0x500D	Interrupt Cause	2 bytes	-	R
14	0x500E	SCI Rate Config	1 byte	0x00	R/W
15	0x500F	SCI Rate Actual	1 byte	-	R
16	0x5010	SCI Settings Config	1 byte	0x00	R/W
17	0x5011	SCI Settings Actual	1 byte	-	R
18	0x5012	MIF Rate Config	1 byte	0x04	R/W
19	0x5013	MIF Rate Actual	1 byte	-	R
20	0x5014	MIF Settings Config	1 byte	0x00	R/W
21	0x5015	MIF Settings Actual	1 byte	-	R
22	0x5016	Modbus RTU Address	1 byte	0x01	R/W
23	0x5017	Modbus CRC Disable	1 byte	0x00	R/W
27	0x501B... 0x5032	FB Fault Values	48 bytes	0x00	R/W

a. See separate fieldbus appendix

Note: In this document, register numbers are specified using the protocol convention (base 0), i.e. register 0042h equals 0042h in the message frame.

8.2.1 Module Mode (#1)

This parameter is used to determine the current operating mode of the module.

Parameter number	1
Modbus Address	0x5001
Default value	-
Range	0x0000 - 0x0005
Size	2 bytes
Stored in NV RAM	No
Access	R/W

Valid Settings

- **0x0000 - Start up Mode**

  This is the initial value of the parameter in all cases after power up except when the module is automatically initialized.

- **0x0001 - Normal Operation Mode**

  When all parameters are updated with correct settings, the normal initialization is triggered by writing this value. If the module is automatically initialized, the parameter automatically gets this value.

  Note: If automatic baud rate detection on the SCI channel is enabled, it is not possible to initialize the module in normal operation mode via the MIF interface until the baud rate has been detected.

- **0x0002 - Fieldbus Specific Init**

  If the Anybus module supports fieldbus specific initialization (fieldbus dependent) this value starts the initialization. See fieldbus appendix for more information.

- **0x0003 - Reset Module**

  This value makes a reset of the module. The module needs to be reinitialized to start communicating. Note that this is not the same as mode 0x0004, see below.

- **0x0004 - Set Default**

  All configurable parameters will be set to their factory default values. Note that password protected parameters will not be affected unless the password is entered before sending “Set default”. Note that this is not the same as mode 0x0003, see above.

- **0x0005 - Self Test**

  By writing this value to the parameter, an internal self test is initiated on the Anybus module.

  For more information, see “Self Test Sequence” on page 86 .

8.2.2 Module Status (#2)

This parameter holds information about the current status of the module. This parameter is also used to deliver the result of the self test sequence (See "Self Test Sequence" on page 86)

Parameter number	2
Modbus Address	0x5002
Default value	-
Range	Bit field
Size	2 bytes
Stored in NV RAM	No
Access	R

Bit Layout

b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
RCF	FCF	ECF	-	-	SCIC	SSCC	FBC	-	-	-	-	-	-	SCI	SSC

- **SSC**
  1: SSC channel running - Shift registers are detected on the SSC channel and the autoinitialized sizes are present in parameter #52 "SSC In Auto" and parameter #55 "SSC Out Auto".
  0: SSC channel stopped/not used - No shift registers are detected on the SSC channel.

- **SCI**
  1: SCI channel running
  0: SCI channel stopped/not used - Baud rate configuration error / baud rate not detected

- **FBC**
  1: FB I/O Configuration failure - I/O data mapping configuration error
  0: FB I/O Configuration OK

- **SSCC**
  1: SSC I/O Configuration failure - I/O data mapping configuration error
  0: SSC I/O Configuration OK

- **SCIC**
  1: SCI I/O Configuration failure - I/O data mapping configuration error
  0: SCI I/O Configuration OK

- **ECF**[1]
  1: EEPROM memory check failed
  0: EEPROM memory check OK

- **FCF**[1]
  1: FLASH memory check failed
  0: FLASH memory check OK

- **RCF**[1]
  1: RAM check failed
  0: RAM check OK

1. This bit is only set after the self test is performed.

8.2.3 Module Type (#3)

This parameter identifies which type of module that is used.

Parameter number	3
Modbus Address	0x5003
Default value	-
Range	0x0000h - 0xFFFF
Size	2 bytes
Stored in NV RAM	Yes
Access	R

Values

- **0x0301 - Standard Anybus-IC**

8.2.4 Fieldbus Type (#4)

This parameter identifies the fieldbus interface.

Parameter number	4
Modbus Address	0x5004
Default value	-
Range	0x0000 - 0xFFFF
Size	2 bytes
Stored in NV RAM	Yes
Access	R

Values

- **0x0001 - PROFIBUS DP**
- **0x0020 - CANopen**
- **0x0025 - DeviceNet**
- **0x0083 - EtherNet/IP**
- **0x0084 - PROFINET**

8.2.5 LED State (#7)

The state of the LED register can be read using this parameter.

Note: This parameter is updated with the LED state, even if the LED register is not used.

Parameter number	7
Modbus Address	0x5007
Default value	-
Range	Bit field
Size	2 bytes
Stored in NV RAM	No
Access	R

Bit Layout

b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
LED 8		LED 7		LED 6		LED 5		LED 4		LED 3		LED 2		LED 1	

Description of LED 1 behavior. All the other LEDs behave according to the same bit pattern.

LED 1 (bit 1)	LED 1 (bit 0)	Description
0	0	LED 1 is turned off
0	1	LED 1 is turned on
1	0	LED 1 is flashing 1Hz
1	1	Reserved (LED test - Fieldbus specific - See fieldbus appendix)

8.2.6 Configuration Bits (#8)

This parameter determines which values that will be valid for different initialization parameters.

Parameter number	8
Modbus Address	0x5008
Default value	0x0000
Range	Bit field
Size	2 bytes
Stored in NV RAM	Yes
Access	R/W

Bit Layout

b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
-	-	-	-	-	-	-	-	FBBR	FBNA	BR	NA	FBLP	FBNP	SSCO	SSCI

- **SSCI**
  1: Configured SSC input size is used (see "SSC In Config (#51)" on page 77).
  0: Automatically initialized SSC input size is used. See parameter #52 "SSC In Auto"
- **SSCO**
  1: Configured SSC output size is used (see "SSC Out Config (#54)" on page 78).
  0: Automatically initialized SSC output size is used. See parameter #55 "SSC Out Auto"
- **FBNP**
  (If no input shift registers are connected, this bit is automatically set to 1).
  1: Fieldbus specific input register is not present on the SSC channel
  0: Fieldbus specific input register is present on the SSC channel
- **FBLP**
  (If no output shift registers are connected, this bit is automatically set to 1).
  1: Fieldbus specific output register is not present on the SSC channel
  0: Fieldbus specific output register is present on the SSC channel
- **NA**[1]
  (If no input shift registers are connected, this bit is automatically set to 1).
  1: Node address determined by fieldbus specific node address parameters[2]
  0: Node address determined by the fieldbus specific input register.

1. If the FBNA bit is set, the value of the NA bit will be ignored.
2. Consult each separate fieldbus appendix for further information.

- **BR**

  (If no input shift registers are connected, this bit is automatically set to 1).

  1: Fieldbus baud rate is set using fieldbus specific baud rate parameter[1]

  0: Fieldbus baud rate is set via fieldbus, or via switches on the fieldbus specific input register.

- **FBNA**

  This bit determines the behavior on systems where the node address can be received from the fieldbus. On fieldbus systems that does not feature this functionality, this bit has no function.

  1: Node address is received from the fieldbus. The value of the NA bit will be ignored.

  0: Node address source is determined by the NA bit, see above.

- **FBBR**

  This bit is fieldbus specific. Consult each separate fieldbus appendix for further information.

  0: Fieldbus specific features disabled.

  1: Fieldbus specific features enabled.

1. Consult each separate fieldbus appendix for further information.

8.2.7 Switch Coding (#9)

If the fieldbus specific input register is enabled, this parameter determines how the value of the switches should be interpreted by the module.

Parameter number	9
Modbus Address	0x5009
Default value	Fieldbus dependent, see separate fieldbus appendix.
Range	0x00 - 0x01
Size	1 byte
Stored in NV RAM	Yes
Access	R/W

Values

- **0x00 - BCD-coded switches**

  BCD-coded switches encodes each decimal digit using four bits. Two switches are used to specify the decimal value in the range of 0... 99. The table below lists valid switch values and their corresponding decimal value. Values not listed are considered invalid.

#	Switch Pattern
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001

Example

63 in decimal format becomes 0110 0011 in BCD-coded form.

- **0x01 - Binary switches**

  When using binary switches, the correlation is 1:1 as shown in the table below.

#	Switch Pattern
0	0000 0000
1	0000 0001
2	0000 0010
...	...
254	1111 1110
255	1111 1111

Example

63 in decimal format becomes 0011 1111 in binary form.

8.2.8 Offline Action Config (#10)

When the fieldbus goes from online to offline or from idle to offline, the fieldbus outputs can be configured to behave in different ways.

Note: The module must have been online once for the offline action to take effect.

Parameter number	10
Modbus Address	0x500A
Default value	0x00
Range	0x00 - 0x02
Size	1 byte
Stored in NV RAM	Yes
Access	R/W

Values

- **0x00 - Clear**
  Fieldbus outputs are cleared when the fieldbus goes offline.
- **0x01 - Freeze**
  Fieldbus outputs freeze in the states they are in when the fieldbus goes offline.
- **0x02 - Fault values**
  Fault values configured in parameter #27 “FB Fault Values” are copied to the fieldbus outputs when the fieldbus goes offline.

8.2.9 Idle Action Config (#11)

When the fieldbus goes from online to idle or from offline to idle, the fieldbus outputs can be configured to behave in different ways.

Note: The Anybus module must have been online once for the idle action to take effect.

Parameter number	11
Modbus Address	0x500B
Default value	0x00
Range	0x00 - 0x02
Size	1 byte
Stored in NV RAM	Yes
Access	R/W

Values

- **0x00 - Clear**
  Fieldbus outputs are cleared when the fieldbus goes to idle.

- **0x01 - Freeze**
  Fieldbus outputs freeze in the states they are in when the fieldbus goes to idle.

- **0x02 - Fault values**
  Fault values configured in parameter #27 “FB Fault Values” are copied to the fieldbus outputs when the fieldbus goes to idle.

8.2.10 Interrupt Config (#12)

This parameter defines events that are allowed to trigger an interrupt. See also parameter #13 "Interrupt Cause".

Parameter number	12
Modbus Address	0x500C
Default value	0x0001
Range	Bit field
Size	2 bytes
Stored in NV RAM	Yes
Access	R/W

Bit Layout

b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
-	-	-	-	-	-	-	-	-	IDLE	RES	DEF	ACYC	FBOFF	FBON	START

- **START**[1]
  1: An interrupt will be generated when the module has started from power on and is ready to communicate.
  0: This event will not cause an interrupt.
- **FBON**
  1: An interrupt will be generated when the fieldbus goes from offline to online.
  0: This event will not cause an interrupt.
- **FBOFF**
  1: An interrupt will be generated when the fieldbus goes from online to offline.
  0: This event will not cause an interrupt.
- **ACYC**[2]
  1: An interrupt will be generated when new acyclic data is received from the fieldbus master.
  0: This event will not cause an interrupt.
- **DEF**[2]
  1: An interrupt will be generated when "set default" is received from the fieldbus master.
  0: This event will not cause an interrupt.
- **RES**[2]
  1: An interrupt will be generated when "reset" is received from the fieldbus master.
  0: This event will not cause an interrupt.
- **IDLE**[2]
  1: An interrupt will be generated when the fieldbus goes from online to idle or from offline to idle.
  0: This event will not cause an interrupt.

1. If automatic baud rate detection is used, the interrupt is not generated until the correct baud rate is detected.
2. This bit is fieldbus dependent, i.e. it may not be available on all versions of the Anybus-IC.

8.2.11 Interrupt Cause (#13)

This parameter indicates the event that has caused an interrupt. The events that shall generate an interrupt are configured in parameter #12 "Interrupt Config". The parameter is automatically cleared by the Anybus module when read by the application. See "Interrupt (/INT) & Bootloader Enable (BLE)" on page 85 for more information about the interrupt function.

Parameter number	13
Modbus Address	0x500D
Default value	-
Range	Bit field
Size	2 bytes
Stored in NV RAM	No
Access	R

Bit Layout

b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
-	-	-	-	-	-	-	-	-	IDLE	RES	DEF	ACYC	FBOFF	FBON	START

- **START**
  1: The Anybus module has started and is ready to communicate.
  0: This event has not caused an interrupt.

- **FBON**
  1: A transition from offline to online on the fieldbus has occurred.
  0: This event has not caused an interrupt.

- **FBOFF**
  1: A transition from online to offline on the fieldbus has occurred.
  0: This event has not caused an interrupt.

- **ACYC**
  1: New acyclic data is received from the fieldbus master.
  0: This event has not caused an interrupt.

- **DEF (Fieldbus Dependent)**
  1: "Set default" has been received from the fieldbus master
  0: This event has not caused an interrupt.

- **RES (Fieldbus Dependent)**
  1: "Reset" has been received from the fieldbus master
  0: This event has not caused an interrupt.

- **IDLE (Fieldbus Dependent)**
  1: The fieldbus has gone from online to idle or from offline to idle.
  0: This event has not caused an interrupt.

8.2.12 SCI Rate Config (#14)

This parameter is used to configure the baud rate of the SCI channel. A reset/power cycle of the module is necessary in order for any changes to have effect.

Parameter number	14
Modbus Address	0x500E
Default value	0x00
Range	0x00h - 0x0A (see note)
Size	1 byte
Stored in NV RAM	Yes
Access	R/W

- **Values**

Value	Baud Rate
0x00	Automatic baud rate detection (default)
0x01	4.8 kbit/s
0x02	9.6 kbit/s
0x03	19.2 kbit/s
0x04	38.4 kbit/s
0x05	57.6 kbit/s
0x06	reserved
0x07	156.25 kbit/s[a]
0x08	208.33 kbit/s[a]
0x09	312.5 kbit/s[a]
0x0A	625 kbit/s[a]

a. These baud rates are only supported by Anybus-IC DeviceNet, PROFIBUS and CANopen modules. These baud rates are not supported by automatic baud rate detection.

8.2.13 SCI Rate Actual (#15)

This parameter returns is the actual baud rate of the SCI channel.

Parameter number	15
Modbus Address	0x500F
Default value	-
Range	0x00 - 0x05 (see note)
Size	1 byte
Stored in NV RAM	No
Access	R

- **Values**

Value	Baud Rate
0x00	Baud rate not set
0x01	4.8 kbit/s
0x02	9.6 kbit/s
0x03	19.2 kbit/s
0x04	38.4 kbit/s
0x05	57.6 kbit/s
0x06	reserved
0x07	156.25 kbit/s[a]
0x08	208.33 kbit/s[a]
0x09	312.5 kbit/s[a]
0x0A	625 kbit/s[a]

a. These baud rates are only supported by Anybus-IC DeviceNet, PROFIBUS and CANopen modules. These baud rates are not supported by automatic baud rate detection.

8.2.14 SCI Settings Config (#16)

This parameter is used to configure the port settings of the SCI channel. A reset/power cycle of the module is necessary in order for any changes to have effect.

This parameter has no effect when automatic baud rate detection is enabled.

Parameter number	16
Modbus Address	0x5010
Default value	0x00
Range	Bit field
Size	1 byte
Stored in NV RAM	Yes
Access	R/W

Bit Layout

b7	b6	b5	b4	b3	b2	b1	b0
-	-	-	-	-	-	PAR1	PAR2

- **PAR2**

  1: Enable Parity

  0: Disable Parity

- **PAR1**

  (This bit has no effect if parity is disabled, see above)

  1: Odd Parity

  0: Even Parity

8.2.15 SCI Settings Actual (#17)

This parameter returns the actual port settings for the SCI channel. If automatic baud rate detection is enabled, the detected port settings are present in this parameter.

Parameter number	17
Modbus Address	0x5011
Default value	-
Range	Bit field
Size	1 byte
Stored in NV RAM	No
Access	R

Bit Layout

b7	b6	b5	b4	b3	b2	b1	b0
-	-	-	-	-	-	PAR1	PAR2

- **PAR2**

  1: Enable Parity

  0: Disable Parity

- **PAR1**

  (This bit has no effect if parity is disabled, see above)

  1: Odd Parity

  0: Even Parity

8.2.16 MIF Rate Config (#18)

This parameter is used to configure the baud rate of the MIF interface. A reset/power cycle of the module is necessary in order for any changes to have effect.

Note: Automatic baud rate detection is not supported on this interface.

Parameter number	18
Modbus Address	0x5012
Default value	0x04
Range	0x01 - 0x05 (see note)
Size	1 byte
Stored in NV RAM	Yes
Access	R/W

- **Values**

Value	Baud Rate
0x01	4.8 kbit/s
0x02	9.6 kbit/s
0x03	19.2 kbit/s
0x04	38.4 kbit/s (default)
0x05	57.6 kbit/s

Note: Additional baud rates may be available on certain Anybus implementations. For more information, consult each separate fieldbus appendix.

8.2.17 MIF Rate Actual (#19)

This parameter returns the actual baud rate settings for the MIF interface.

Parameter number	19
Modbus Address	0x5013
Default value	-
Range	0x01 - 0x05 (see note)
Size	1 byte
Stored in NV RAM	No
Access	R

- **Values**

Value	Baud Rate
0x01	4.8 kbit/s
0x02	9.6 kbit/s
0x03	19.2 kbit/s
0x04	38.4 kbit/s (default)
0x05	57.6 kbit/s

Note: Additional baud rates may be available on certain Anybus implementations. For more information, consult each separate fieldbus appendix.

8.2.18 MIF Settings Config (#20)

This parameter is used to configure the port settings of the MIF interface. A reset/power cycle of the module is necessary in order for any changes to have effect.

Parameter number	20
Modbus Address	0x5014
Default value	0x00
Range	Bit field
Size	1 byte
Stored in NV RAM	Yes
Access	R/W

Bit Layout

b7	b6	b5	b4	b3	b2	b1	b0
-	-	-	-	-	STOP	PAR1	PAR2

- **PAR2**

  1: Enable parity

  0: Disable parity

- **PAR1**

  (If parity is disabled (PAR2 = 0) this bit has no effect)

  1: Odd Parity

  0: Even Parity

- **STOP**

  1: 2 stop bits are used

  0: 1 stop bit is used

8.2.19 MIF Settings Actual (#21)

This parameter returns the actual port settings for the MIF interface.

Parameter number	21
Modbus Address	0x5015
Default value	-
Range	Bit field
Size	1 byte
Stored in NV RAM	No
Access	R

Bit Layout

b7	b6	b5	b4	b3	b2	b1	b0
-	-	-	-	-	STOP	PAR1	PAR2

- **PAR2**
  1: Parity is enabled
  0: Parity is disabled
- **PAR1**
  (If parity is disabled (PAR2 = 0) this bit has no effect)
  1: Odd Parity
  0: Even Parity
- **STOP**
  1: 2 stop bits are used
  0: 1 stop bit is used

8.2.20 Modbus RTU Address (#22)

This parameter is used to configure the Modbus RTU Address used on the SCI channel.

Note: If automatic baud rate detection is used, the Modbus RTU address must be 01h.

Parameter number	22
Modbus Address	0x5016
Default value	0x01
Range	0x01 - 0xF7
Size	1 byte
Stored in NV RAM	Yes
Access	R/W

8.2.21 Modbus CRC Disable (#23)

This parameter is used to disable / enable the Modbus CRC. Disabling this will force the module to skip the CRC field in all Modbus messages (both in query and response messages), i.e. the CRC field will be completely removed from the message frame. Generally, it is not recommended to disable Modbus CRC checking. Use this function only in very special cases.

Parameter number	23
Modbus Address	0x5017
Default value	0x00
Range	0x00 - 0x01
Size	1 byte
Stored in NV RAM	Yes
Access	R/W

Values

- **0x00 - Enable Modbus CRC checking.**

  Resulting Modbus message frame format:

Start				Address	Function	Data	CRC	End			
char	char	char		8bits	8bits	n*8bits	16bits	char	char	char	

- **0x01 - Disable Modbus CRC checking.**

  Resulting Modbus message frame format:

Start				Address	Function	Data	End			
char	char	char		8bits	8bits	n*8bits	char	char	char	

8.2.22 FB Fault Values (#27)

This parameter holds fault values that can be copied to the fieldbus output area. See parameter #10 “Offline Action” and parameter #11 “Idle Action” for more information.

Parameter number	27
Modbus Address	0x501B - 0x5032
Default value	0x00
Range	0x00 - 0xFF
Size	48 bytes
Stored in NV RAM	Yes
Access	R/W

8.3 I/O Parameters

Each communication channel features its own set of I/O parameters, which determine how produced data shall be mapped to other channels. These parameters must be properly set up during initialization (i.e. prior to setting Module Mode to 0x0001).

#	Modbus Address	Name	Size	Default	Access
40	0x6000	FB Byte Order	1 byte	0x00	R/W
41	0x6001	FB Out Config	2 bytes	0x0000	R/W
42	0x6002	FB Out Actual	2 bytes	-	R
43	0x6003	FB In Actual	2 bytes	-	R
44	0x6004	FB In SSC Offset	2 bytes	0x0000	R/W
45	0x6005	FB In SSC Size	2 bytes	0x0000	R/W
46	0x6006	FB In SCI Offset	2 bytes	0x0000	R/W
47	0x6007	FB In SCI Size	2 bytes	0x0000	R/W
50	0x600A	SSC Byte Order	1 byte	0x00	R/W
51	0x600B	SSC In Config	2 bytes	0x0000	R/W
52	0x600C	SSC In Auto	2 bytes	-	R
53	0x600D	SSC In Actual	2 bytes	-	R
54	0x600E	SSC Out Config	2 bytes	0x0000	R/W
55	0x600F	SSC Out Auto	2 bytes	-	R
56	0x6010	SSC Out Actual	2 bytes	-	R
57	0x6011	SSC Out FB Offset	2 bytes	0x0000	R/W
58	0x6012	SSC Out FB Size	2 bytes	0x0000	R/W
59	0x6013	SSC Out SCI Offset	2 bytes	0x0000	R/W
60	0x6014	SSC Out SCI Size	2 bytes	0x0000	R/W
63	0x6017	SCI Byte Order	1 byte	0x00	R/W
64	0x6018	SCI In Config	2 bytes	0x0000	R/W
65	0x6019	SCI In Actual	2 bytes	-	R
66	0x601A	SCI Out Actual	2 bytes	-	R
67	0x601B	SCI Out FB Offset	2 bytes	0x0000	R/W
68	0x601C	SCI Out FB Size	2 bytes	0x0000	R/W
69	0x601D	SCI Out SSC Offset	2 bytes	0x0000	R/W
70	0x601E	SCI Out SSC Size	2 bytes	0x0000	R/W

Note: In this document, register numbers are specified using the protocol convention (base 0), i.e. there is a 1:1 correlation between the register number specified in this document and the actual register value in the message frame.

8.3.1 FB Byte Order (#40)

This parameter determines if the bytes in the fieldbus I/O area shall be byte swapped or not relative to the other I/O areas.

Note that in order for this function to work properly, the I/O length must be a multiple of 16 bits / 2 bytes.

Example:

If data is mapped from the “FB Output area” to the “SSC Output area”, parameter #40 “FB Byte Order” is 0x00, and parameter #50 “SSC Byte Order” is 0x01, the data written to the “FB Output area” will be swapped when it reaches the “SSC Output area”. If the byte order parameters has the same value for both areas, no swap will be made.

Note: Both the FB Input area and the FB Output area are affected by this parameter.

Parameter number	40
Modbus Address	0x6000
Default value	0x00
Range	0x00 - 0x01
Size	1 byte
Stored in NV RAM	Yes
Access	R/W

Values

- **0x00**
  Do not swap bytes in the fieldbus I/O area.
- **0x01**
  Swap bytes in the fieldbus I/O area.

8.3.2 FB Out Config (#41)

This parameter configures the size of the FB Out area. The size is specified in bytes.

Parameter number	41
Modbus Address	0x6001
Default value	0x0000
Range	0x0000 - 0x0090h
Size	2 bytes
Stored in NV RAM	Yes
Access	R/W

8.3.3 FB Out Actual (#42)

This parameter holds the actual size of the FB Out area after initialization. The size is specified in bytes.

Parameter number	42
Modbus Address	0x6002
Modbus Address	
Default value	-
Range	0x0000 - 0x0090
Size	2 bytes
Stored in NV RAM	No
Access	R

8.3.4 FB In Actual (#43)

This parameter holds the actual size of the FB In area after initialization. The value of this parameter is calculated using parameter #45 "FB In SSC Size" and parameter #47 "FB In SCI Size". The size is specified in bytes.

Parameter number	43
Modbus Address	0x6003
Default value	-
Range	0x0000 - 0x0090
Size	2 bytes
Stored in NV RAM	No
Access	R

8.3.5 FB In SSC Offset (#44)

This parameter is used to set the source location for the SSC Input -> Fieldbus Input mapping.

Parameter number	44
Modbus Address	0x6004
Default value	0x0000
Range	0x0000h - 0x000F
Size	2 bytes
Stored in NV RAM	Yes
Access	R/W

8.3.6 FB In SSC Size (#45)

This parameter is used to specify how many bytes that will be mapped from the SSC Input area to the Fieldbus Input area.

Parameter number	45
Modbus Address	0x6005
Default value	0x0000
Range	0x0000 - 0x0010
Size	2 bytes
Stored in NV RAM	Yes
Access	R/W

8.3.7 FB In SCI Offset (#46)

This parameter is used to set the source location for the SCI Input -> Fieldbus Input mapping.

Parameter number	46
Modbus Address	0x6006
Default value	0x0000
Range	0x0000 - 0x007F
Size	2 bytes
Stored in NV RAM	Yes
Access	R/W

8.3.8 FB In SCI Size (#47)

This parameter is used to specify how many bytes that will be mapped from the SCI Input area to the Fieldbus Input area.

Parameter number	47
Modbus Address	0x6007
Default value	0x0000
Range	0x0000 - 0x0080
Size	2 bytes
Stored in NV RAM	Yes
Access	R/W

8.3.9 SSC Byte Order (#50)

This parameter determines if the bytes in the SSC I/O area shall be swapped or not relative to the other I/O areas.

Example

If data is mapped from the "SSC Input area" to the "FB Input area", parameter #50 "SSC Byte Order" is 0x00, and parameter #40 "FB Byte Order" is 0x01, the data written to the "SSC Input area" will be swapped when it reaches the "FB Input area". If the byte order parameters has the same value for both areas, no swap will be made.

Note that in order for this function to work properly, the I/O length must be a multiple of 16 bits / 2 bytes.

Note: The entire SSC I/O area is affected by the state of this parameter no matter of the contents.

Parameter number	50
Modbus Address	0x600A
Default value	0x00
Range	0x00 - 0x01
Size	1 byte
Stored in NV RAM	Yes
Access	R/W

Values

- **0x00**
  Do not swap bytes in the SSC I/O area.
- **0x01**
  Swap bytes in the SSC I/O area.

8.3.10 SSC In Config (#51)

This parameter is used to configure the total size of the SSC In area (the FB specific input byte is not included in this size). The size is specified in bytes.

In order for the value of this parameter to be valid after initialization, the SSCI bit in parameter #8 "Configuration Bits" must be set.

Parameter number	51
Modbus Address	0x600B
Default value	0x0000
Range	0x0000 - 0x0010
Size	2 bytes
Stored in NV RAM	Yes
Access	R/W

8.3.11 SSC In Auto (#52)

This parameter returns the automatically configured size of the SSC In area (the FB specific input byte is not included in this size). The size is specified in bytes.

In order for the value of this parameter to be valid after initialization, the SSCI bit in parameter #8 "Configuration Bits" must be cleared.

Parameter number	52
Modbus Address	0x600C
Default value	-
Range	0x0000 - 0x0010
Size	2 bytes
Stored in NV RAM	No
Access	R

8.3.12 SSC In Actual (#53)

This parameter returns the actual size of the SSC In area after initialization (the fieldbus specific input byte is not included in this size). The size is specified in bytes.

Parameter number	53
Modbus Address	0x600D
Default value	-
Range	0x0000 - 0x0010
Size	2 bytes
Stored in NV RAM	No
Access	R

8.3.13 SSC Out Config (#54)

This parameter is used to configure the total size of the SSC Out area (the FB specific output byte is not included in this size). The size is specified in bytes.

In order for the value of this parameter to be valid after initialization, the SSCO bit in parameter #8 "Configuration Bits" must be set.

Parameter number	54
Modbus Address	0x600E
Default value	0x0000
Range	0x0000 - 0x0010
Size	2 bytes
Stored in NV RAM	Yes
Access	R/W

8.3.14 SSC Out Auto (#55)

This parameter returns the automatically configured size of the SSC Out area (the FB specific output byte is not included in this size). The size is specified in bytes.

In order for the value of this parameter to be valid after initialization, the SSCO bit in parameter #8 "Configuration Bits" must be cleared.

Parameter number	55
Modbus Address	0x600F
Default value	-
Range	0x0000 - 0x0010
Size	2 bytes
Stored in NV RAM	No
Access	R

8.3.15 SSC Out Actual (#56)

This parameter returns the actual size of the SSC Out area after initialization (the FB specific output byte is not included in this size). The size is specified in bytes.

Parameter number	56
Modbus Address	0x6010
Default value	-
Range	0x0000 - 0x0010
Size	2 bytes
Stored in NV RAM	No
Access	R

8.3.16 SSC Out FB Offset (#57)

This parameter is used to set the source location for the Fieldbus Output -> SSC output mapping.

Parameter number	57
Modbus Address	0x6011
Default value	0x0000
Range	0x0000 - 0x008F
Size	2 bytes
Stored in NV RAM	Yes
Access	R/W

8.3.17 SSC Out FB Size (#58)

This parameter is used to specify how many bytes that will be mapped from the Fieldbus Output area to the SSC Output area.

Parameter number	58
Modbus Address	0x6012
Default value	0x0000
Range	0x0000 - 0x0010
Size	2 bytes
Stored in NV RAM	Yes
Access	R/W

8.3.18 SSC Out SCI Offset (#59)

This parameter is used to set the source location for the SCI Input -> SSC Output mapping.

Parameter number	59
Modbus Address	0x6013
Default value	0x0000
Range	0x0000 - 0x007F
Size	2 bytes
Stored in NV RAM	Yes
Access	R/W

8.3.19 SSC Out SCI Size (#60)

This parameter is used to specify how many bytes that will be mapped from the SCI Input area to the SSC Output area.

Parameter number	60
Modbus Address	0x6014
Default value	0x0000
Range	0x0000 - 0x0010
Size	2 bytes
Stored in NV RAM	Yes
Access	R/W

8.3.20 SCI Byte Order (#63)

This parameter determines if the bytes in the SCI I/O area shall be swapped or not relative to the other I/O areas.

Example:

If data is mapped from the “SCI Input area” to the “FB Input area”, parameter #63 “SCI Byte Order” is 0x00, and parameter #40 “FB Byte Order” is 0x01, the data written to the “SCI Input area” will be swapped when it reaches the “FB Input area”. If the byte order parameters has the same value for both areas, no swap will be made.

Note that in order for this function to work properly, the I/O length must be a multiple of 16 bits / 2 bytes.

Note: The entire SCI I/O area is affected by the state of this parameter no matter of the contents.

Parameter number	63
Modbus Address	0x6017
Default value	0x00
Range	0x00 - 0x01
Size	1 byte
Stored in NV RAM	Yes
Access	R/W

Values

- **0x00**
  Do not swap bytes in the SCI I/O area.
- **0x01**
  Swap bytes in the SCI I/O area.

8.3.21 SCI In Config (#64)

This parameter configures the size of the SCI In area. The size is specified in bytes.

Parameter number	64
Modbus Address	0x6018
Default value	0x0000
Range	0x0000 - 0x0080
Size	2 bytes
Stored in NV RAM	Yes
Access	R/W

8.3.22 SCI In Actual (#65)

This parameter holds the actual size of the SCI In area after initialization. The size is specified in bytes.

Parameter number	65
Modbus Address	0x6019
Default value	-
Range	0x0000 - 0x0080
Size	2 bytes
Stored in NV RAM	No
Access	R

8.3.23 SCI Out Actual (#66)

This parameter holds the actual size of the SCI Out area after initialization. The value of this parameter is calculated using parameter #68 “SCI Out FB Size” and parameter #70 “SCI Out SSC Size”. The size is specified in bytes.

Parameter number	66
Modbus Address	0x601A
Default value	-
Range	0x0000 - 0x0080
Size	2 bytes
Stored in NV RAM	No
Access	R

8.3.24 SCI Out FB Offset (#67)

This parameter is used to set the source location for the Fieldbus Output -> SCI Output mapping.

Parameter number	67
Modbus Address	0x601B
Default value	0x0000
Range	0x0000 - 0x007F
Size	2 bytes
Stored in NV RAM	Yes
Access	R/W

8.3.25 SCI Out FB Size (#68)

This parameter is used to specify how many bytes that will be mapped from the Fieldbus Output area to the SCI Output area.

Parameter number	68
Modbus Address	0x601C
Default value	0x0000
Range	0x0000 - 0x0080
Size	2 bytes
Stored in NV RAM	Yes
Access	R/W

8.3.26 SCI Out SSC Offset (#69)

This parameter is used to set the source location for the SSC Input -> SCI Output mapping.

Parameter number	69
Modbus Address	0x601D
Default value	0x0000
Range	0x0000 - 0x000F
Size	2 bytes
Stored in NV RAM	Yes
Access	R/W

8.3.27 SCI Out SSC Size (#70)

This parameter is used to specify how many bytes that will be mapped from the SSC Input area to the SCI Output area.

Parameter number	70
Modbus Address	0x601E
Default value	0x0000
Range	0x0000 - 0x0010
Size	2 bytes
Stored in NV RAM	Yes
Access	R/W

8.4 Fieldbus Specific Parameters

Consult each separate fieldbus appendix for further information.

9. Miscellaneous

9.1 Interrupt (/INT) & Bootloader Enable (BLE)

During runtime, this pin acts as an active low interrupt output. Events that shall generate an interrupt are specified in parameter #12 (“Interrupt Config”).

When an interrupt has occurred (i.e. when the interrupt pin has gone low), the cause of the interrupt can be read from parameter #13 (“Interrupt Cause”). The value of this register holds its value until it has been read by the application. When read, the interrupt is cleared and the interrupt signal goes high again.

If this pin is connected to ground (GND) during power on, the module will start in a special boot loader mode, allowing new firmware to be downloaded via the MIF interface. Generally, this function should only be used if erroneous data has accidentally been downloaded into the on-board flash. Normally, firmware upgrades should be performed via the ‘Firmware Upgrade’ menu.

Note: Do not connect this pin to ground during normal operation.

See also...

- “Application Connector” on page 14
- “MIF Interface” on page 21
- “Interrupt Config (#12)” on page 62
- “Interrupt Cause (#13)” on page 63

9.2 Reset (/RESET)

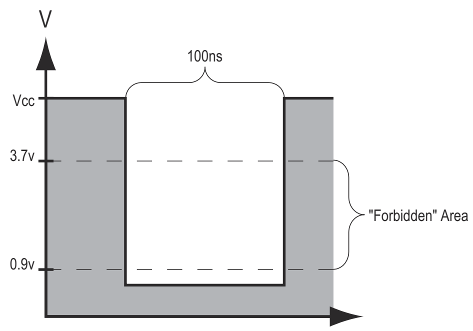
To trigger a hardware reset, a high-to-low transition with a minimum duration of 100 ns is necessary (see figure).

It is generally recommended to connect a 100 nF capacitor between the reset signal and ground (GND).

If not used, this signal can safely be connected directly to Vcc.

See also...

- “Application Connector” on page 14



Note: This signal may possess an internal load capacitance of up to 100 nF. This means that a capacitive load in excess of 100 nF must be taken into account when designing the application.

9.3 Self Test Sequence

9.3.1 General Information

The application can instruct the module to perform a self test sequence using parameter #1 “Module Mode”. The result of the test is presented in parameter #2 “Module Status”.

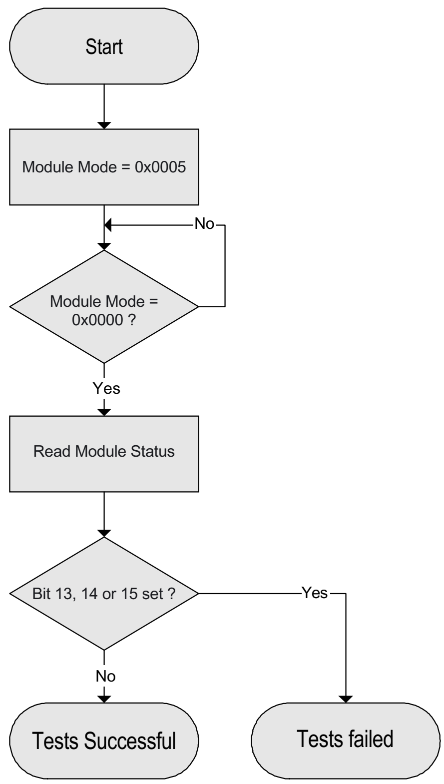
Note: This test can only be performed before the module is initialized.

9.3.2 Basic Procedure

1. Start the hardware tests by writing 0x0005 to parameter #1 (“Module Mode”).

2. During the test, parameter #1 (“Module Mode”) has the value 0x0005. When tests are finished, the value will be 0x0000.

3. Read parameter #2 (“Module Status”) to get information about the tests.

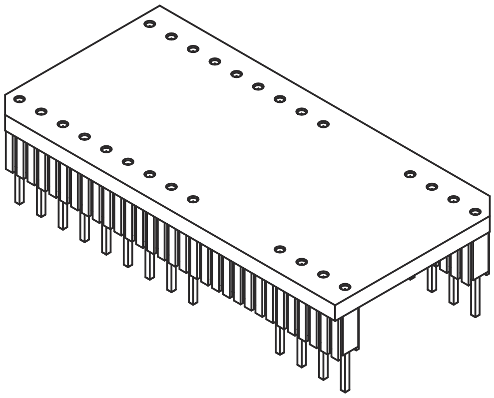


9.3.3 Test Evaluation

If bit 13, 14 or 15 is set, the corresponding test has failed. If the bit is cleared, the corresponding test passed successfully.

A. Mechanical Specification

A.1 General Information

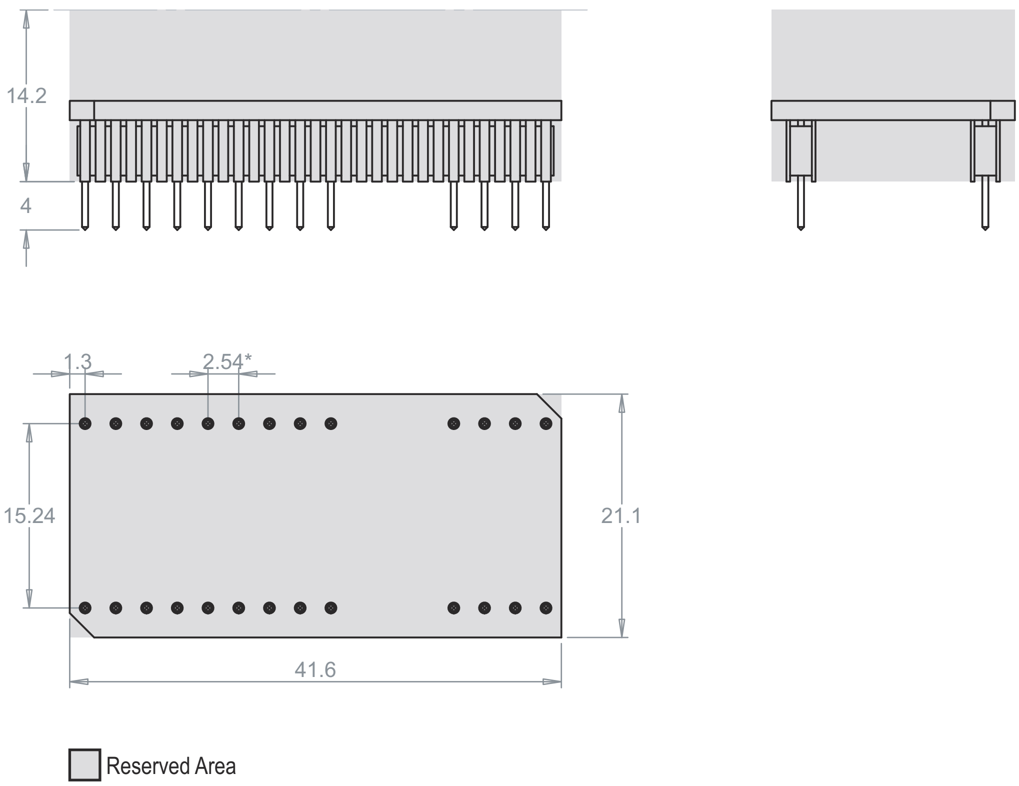


The application interface uses a standard DIL-32 footprint.

It is generally recommended to use a DIL socket instead of soldering the module directly to the application circuit board.

A.2 Measurements

All measurements are in millimeters, tolerance is ± 0.20 mm unless otherwise stated.



*The 2.54 mm measurement from pin to pin conforms to DIL tolerance levels.

B. Firmware Upgrade

The firmware of the module can be updated using the HMS firmware download utility.

For more information, contact HMS technical support.

C. Object Messaging (0x5B)

C.1 General Information

Modbus Object Messaging, originally developed for Modbus-TCP, is an extension to the standard Modbus protocol which is used to address functions and data in an object oriented manner. To suit the Anybus-IC, certain changes/additions have been made to the original specification.

Object Messaging is needed for certain fieldbus specific functionality, consult each separate fieldbus appendix for further information.

Function Name	'Object Messaging'
Function Code	0x5B
Broadcast Supported	No

C.2 Message Format

The Modbus object messaging is based on dividing the standard data field in Modbus into 7 subfields according to the figure below.

Message Frame

Address	Function	Subfield	CRC
(address)	91	(see below)	(CRC)

Query - Subfield Format

Fragment byte count	Fragment protocol	Class ID	Instance ID	Service Code	Attribute	Data	Stuff byte
8 bits	8 bits	16 bits	16 bits	16 bits	16 bits	n*16 bits	8 bits

Response - Subfield Format

Fragment byte count	Fragment protocol	Class ID	Instance ID	Service Code	Error Code	Data	Stuff byte
8 bits	8 bits	16 bits	16 bits	16 bits	16 bits	n*16 bits	8 bits

Note: When using fragmented Object Messaging the receiving part (either master or slave) should acknowledge each fragment by increasing the Fragment Sequence Number and send a response where the Class ID, Instance ID, Service Code, Attribute, eventual Error Code and Data is to be left out, only leaving the Fragment byte count and Fragment protocol of the Object messaging subfield.

C.3 Subfield Contents

C.3.1 Fragment Byte Count

This field contains the number of bytes of the current object message (itself excluded).

The maximum number of bytes is 197.

Note: If a stuff byte is added at the end of the message, it is not included in the Fragment byte count.

C.3.2 Fragment Protocol

This field is used when sending fragmented messages. The bits are described below.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
FSN			-	-	-	LFI	FIPI

- **FIPI - Fragment In Process Indicator**

  1: This message is a fragment of a fragmented message.

  0: This message is not fragmented.

- **LFI - Last Fragment Indicator**

  1: This is the last fragment in a fragmented message.

  0: This not the last fragment in a fragmented message.

- **FSN - Fragment Sequence Number**

  This is a counter counting from 000_2 to 111_2. Each fragment in a fragmented message has a sequential number in this field.

C.3.3 Class ID

ID of the object class associated with the service.

C.3.4 Instance ID

ID of the instance associated with the service.

C.3.5 Error Codes

In the response from the Anybus-IC, the following error codes may be used.

- **General Errors**

Value	Description	Comments
0x0000	Success	-
0x0001	Invalid Service Code	The requested service is not implemented or defined for this object.
0x0002	Invalid Service Code Parameter	The parameters required to perform the service are invalid.
0x0003	Invalid Attribute	The specified attribute is not supported in this object.
0x0004	Attribute out of range	Set value is out of range for the attribute.
0x0005	Not valid in this state	The object cannot perform the requested service in its current state.
0x0006	Fragmentation error	Error in message fragmentation.
0x00FF	Unspecified error	-

- **Manufacturer Specific Errors**

Value	Description	Comments
0x0101	Class Not Supported	The class specified is not implemented in this device.
0x0104	Instance Not Supported	The specified instance does not exist.
0x0105	Instance Already Exist	The requested instance to be created already exists.
0x0107	Attribute Not Settable	A request to modify a nonmodifiable attribute.
0x0109	Not Enough Data	The message provides less data than was needed for the attribute.
0x010A	Too Much Data	The message provides more data than was needed for the attribute.
0x010C	Resource Unavailable	Resources needed for the object to perform the requested service were unavailable.
0x010D	Device State Conflict	The device’s current mode/state prohibits the execution of the requested service.
0x010F	Attribute Not Gettable	A request to a write-only attribute.

C.3.6 Service Code

Value	Description	Comments
0x0001	Get Attribute	This command retrieves the value of an attribute. The 16 bit attribute number is specified in field Attribute[a]. The Data field is not used.
0x0002	Get Attribute Response	A response to a Get Attribute command returns the value of an attribute in the Data field[a].
0x0003	Set Attribute	This command assigns a value to an attribute. The 16 bit attribute number is specified in field Attribute[a]. The Data field contains the data to be written.
0x0004	Set Attribute Response	A response to a Set Attribute command contains no data, i.e. the Data field[a] is not used.
0x0005	Create	This command creates a new instance within the object.
0x0006	Create Response	-
0x0007	Remove	-
0x0008	Remove Response	-
0x0009	Reset	This command performs a reset command on an object.
0x000A	Reset Response	-
0x000B	Start	-
0x000C	Start Response	-
0x000D	Stop	-
0x000E	Stop Response	-
0x000F	Save	-
0x0010	Save Response	-
0x0011	Restore	-
0x0012	Restore Response	-
0x0013	Nop	-
0x0014	Nop Response	-
0x0015... 0x007F	-	Not used
0x0080... 0x00FF	-	Class specific services

a. See page C-89 “Message Format”

C.3.7 Attribute

If a message is fragmented (i.e. several messages to transmit one big data area) the Anybus-IC expects the Attribute to be a part of every fragment. If an attribute is not used in the service, this word must be 0x0000. This is an HMS specific addition to the official Modbus Object Messaging specification.

C.3.8 Data

Data associated with the service.

C.3.9 Stuff Byte

The length of the standard data field in modbus must always be a multiple of 16 bits. If it is not, the stuff byte is added by the end of the fragment to ensure this. The stuff byte does not contain any meaningful data and is not included in the Fragment byte count.

D. Technical Specification

Note: The properties specified in this chapter applies to all Anybus-IC modules unless otherwise stated. Any deviations from what is stated herein is specified separately in each network appendix.

D.1 Environmental

Temperature

Operating: -40 to +85 °C (-40 to 185°F)
Storage: -40 to +85 °C (-40 to 185°F)

(Tests performed according to IEC 68-2-1 and IEC 68-2-2)

Wave Soldering

Temperature: 320°C
Velocity: 10 mm/s

Humidity

5 to 95% noncondensing (tests performed according to IEC 68-2-30)

D.2 Power Supply

Supply Voltage

The module requires a regulated +5 V ± 5% DC power supply.

The power supply rise time (0.1 V_{CC} to 0.9 V_{CC}) must be less than 50 ms.

Power Consumption

The maximum power consumption may vary. Please consult each separate fieldbus appendix.

Isolation

Isolation distances between application and network (according to EN 60950-1; Pollution degree 2; Material Group IIIb):

Isolation Barrier	Working Voltage/Transient Voltage		Distance	
	Creepage	Clearance	External	Internal
Application to Network[a]	250 V/2500 V	250 V/2500 V	2.5 mm	0.4 mm

a. Valid for all modules except Ethernet modules which utilize a customer supplied transformer.

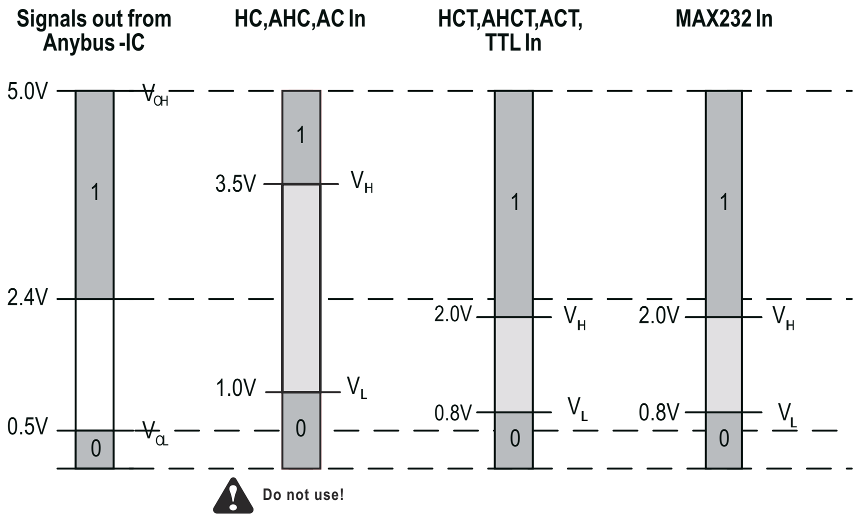
Protective Earth & Shielding

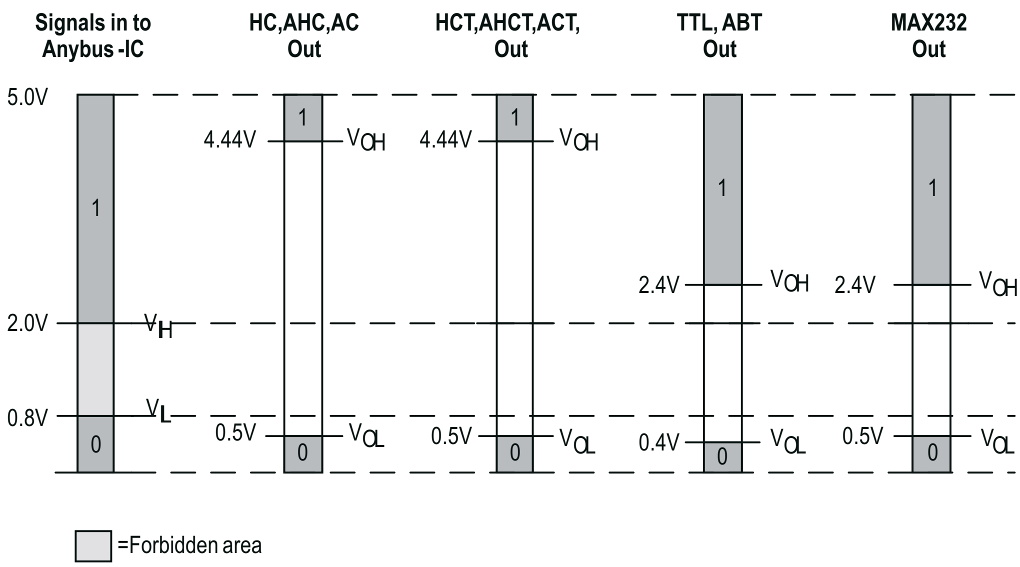
PE-requirements are fieldbus dependent. Please consult the separate fieldbus appendix for details.

D.3 Signal Levels

It is recommended to use 74HCTxxx / 74ACTxxx type TTL circuits. 74HCxxx, 74ACxxx, and 74AHCxxx type circuits are not recommended, and may not work properly as the "forbidden area" of these types of circuits is not within the boundaries allowed by the Anybus-IC. (See figure below)

When connecting current demanding components (e.g LEDs) directly to the outputs of the SSC shift registers, it is required to use shift registers of sufficient current capacity, e.g. 74ACTxxx.





Note: For exact signal levels, consult the data sheet for the used logic circuit. Signal levels may depend on temperature and supply voltage.

D.4 Regulatory Compliance

D.4.1 Fieldbus Certification

All Anybus-IC modules are precertified and found to comply with each fieldbus standard. Please note that although the module itself has been precertified, the final product may still require recertification depending on the fieldbus standard.

This precertification is valid under the following conditions:

- Standard fieldbus connectors
- No fieldbus specific initialization parameters
- Nonmodified device description file (i.e. '.GSD' or '.EDS')

Any changes to the conditions above invalidates the precertification. For more information, consult each fieldbus standard specification and/or contact HMS.

D.4.2 EMC Compliance (CE)

Generally, Anybus-IC products are certified according to the European CE standard unless otherwise stated. It is however important to note that although the Anybus module itself is certified, the final product may still require recertification depending on the application.

D.4.3 UL/cUL-Certificate

The Anybus-IC modules are UL/cUL recognized for the US (NRAQ2) and Canada (NRAQ8) according to UL508, "Programmable Controller".