Hardware Design Guide

Anybus® CompactCom 30

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Important User Information

This document is intended to provide a good understanding of the mechanical and electric properties of the Anybus CompactCom 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 (Network Interface Appendix).

The reader of this document is expected to be familiar with hardware design and communication systems in general. For more information, documentation etc., please visit the HMS web site, 'www.anybus.com'.

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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.

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Table of Contents

P. About This Document

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

P.1 Related Documents

Document	Author
Anybus CompactCom Software Design Guide	HMS
Anybus CompactCom Driver User Manual	HMS
Anybus CompactCom 30 Network Appendix (separate document for each supported fieldbus system)	HMS
Anybus CompactCom Brick and without Housing Design Guide	HMS
Low-Cost, Low-Power Level Shifting in Mixed-Voltage (5V, 3.3V) Systems (SCBA002A)	Texas Instruments
LT1767 Data sheet	Linear Technology
EN 60950	European Union
EN 61000	European Union
EN 55011	European Union

P.2 Document History

Summary of Recent Changes (2.23... 2.24)

Change	Page(s)
Added service mode in chapter 2.2.1	12
Updated support information	6

Revision List

Revision	Date	Author	Chapter(s)	Description
1.00 - 1.25				See earlier revisions
2.00	2010-05-31	KeL	All	Major update
2.10	2012-02-29	KeL	2, 3, A	Updates
2.11	2012-05-25	KeL	B	Minor update
2.12	2012-05-31	KeL	B	Minor correction
2.20	2012-09-13	KeL	1, 2, B	New connector type, minor corrections
2.21	2013-04-02	KeL	2, 5	Minor update
2.22	2013-05-13	KaD	P, B	Minor update
2.23	2014-01-28	KeL	1, 2	Added info on functional safety, minor corrections
2.24	2014-04-01	KaD	2	Minor updates

P.3 Conventions & Terminology

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' refers to the Anybus CompactCom.
- The terms 'host' or 'host application' refers to the device that hosts the Anybus module.
- Hexadecimal values are written in the format NNNNh or 0xNNNN, where NNNN is the hexadecimal value.
- A byte always consists of 8 bits.
- All measurements in this document have a tolerance of ±0.20mm unless otherwise stated.
- Outputs are TTL compliant 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.

P.4 Support

For general contact information and support, please refer to the contact and support pages at www.anybus.com.

1. Introduction

1.1 General Description

The Anybus CompactCom network communication module is a high performance, low cost communication solution for industrial field devices. All Anybus CompactCom implementations share the same footprint and electrical interface, allowing the host application to support all major networking systems using the same hardware platform.

Two different host interface options are provided, serial and parallel, allowing easy integration into almost any platform. The parallel interface is based on a dual port memory architecture, where the host application and the Anybus module exchange data by means of shared memory. This allows for very efficient data exchange, and generally produces very little overhead for the host application. The serial interface is a common asynchronous serial interface which can operate at baud rates from 19.2 kbps - 625 kbps.

A unique mechanical concept allows the module to be implemented as an end-user option (plug-in), or embedded into the host product at the manufacturing stage. The plug-in concept allows the vendor to assemble and ship their product without the Anybus CompactCom module fitted. The end user can then at a later stage decide whether to install an Anybus module or not.

Typical applications are Frequency Inverters, PLC's, HMI's, Visualization Devices, Instruments, Scales, Robotics and Intelligent measuring devices.

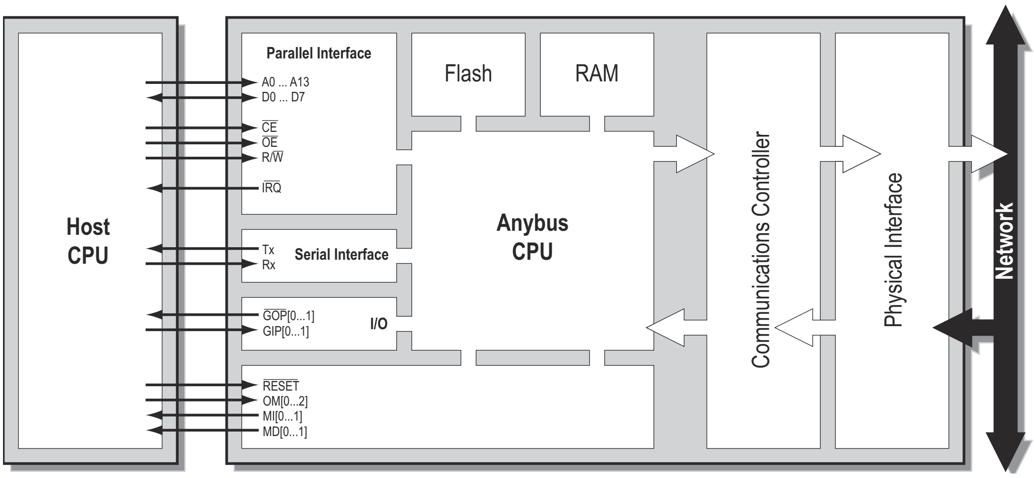
1.2 Features

- Integrated protocol stack handling (Where applicable)
- Galvanically isolated network interface (Where applicable)
- On-board network status indications according to each network standard (Where applicable)
- On-board network connectors according to each network standard
- Compact size (52 x 50mm, 2” x 1.97”)
- Firmware upgradable (FLASH technology)
- 3.3 V design
- Low power consumption
- Parallel & serial interface modes
- Pre-compliance tested for network conformance (Where applicable)[1]
- Pre-compliance tested for CE & UL
- Version with M12 connector available for PROFINET (2-port), EtherNet/IP (2-port), Modbus-TCP (2-port), PROFIBUS DP-V1, EtherCAT, and DeviceNet.
- Support for functional safety communication (PROFINET 2-port)

1. All Anybus CompactCom versions will be pre-certified for network conformance. While this is done to ensure that the final product *can* be certified, it does not necessarily mean that the final product does not require re-certification. Contact HMS for further information.

1.3 Host Interface Overview

The Anybus CompactCom features two different host communication interfaces. The figure below illustrates the basic properties of these interfaces as well as various I/O and control signals, and how they relate to the host application.



Parallel Interface

From an external point of view, the parallel interface is a common 8 bit parallel slave port interface, which can easily be incorporated into any microprocessor based system that has an address/data type bus. Generally, implementing this type of interface is comparable to implementing an 8 bit wide SRAM.

Additionally, the parallel interface features an interrupt request line, allowing the host application to service the module only when actually needed.

Serial Interface

Compared to the serial interface, the parallel interface generally offers much higher performance. However, in some applications this solution may be impractical, e.g. when the host CPU doesn't have an external address/data bus etc. In such cases, the serial interface provides a simple way of interfacing the module via a common asynchronous serial interface.

1.4 Passive vs. Active

The Anybus CompactCom product family features two types of communication modules:

- **Active CompactCom Modules**
  Active modules integrates the complete network functionality (i.e. the protocol stack and the physical interface) in the same package in order to provide network data exchange in a uniform manner.

- **Passive CompactCom Modules**
  Passive modules uses a subset of the host interface signals, and generally operates on the physical level of a serial signal (i.e. RS-232, RS-485 etc.), or enables serial data exchange on another medium/protocol such as USB or Ethernet (serial server).

Both types of modules can be supported in the host application by implementing the proper host interface signals. For more information, see "Module Compatibility" on page 23.

1.5 M12 Connector

A number of the Anybus CompactCom 30 modules are available with an M12 connector instead of the usual network connector. This applies for the EtherNet/IP (2-port), PROFINET (2-port), PROFIBUS DP-V1, Modbus-TCP (2-port), and DeviceNet modules.

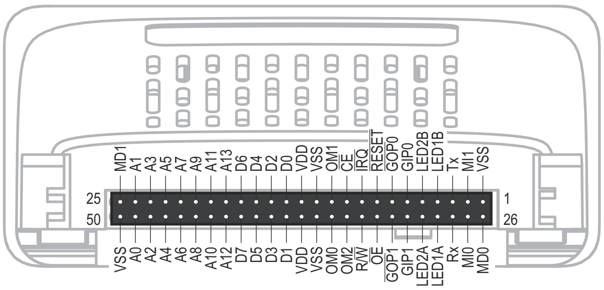
The M12 connector gives the opportunity to raise the IP rating of a product up to IP67. However, the standard Anybus CompactCom housing does not qualify for IP ratings above IP20. If a higher rating is needed, careful design of housings and/or module fronts is necessary. It is then recommended to use the Anybus CompactCom 30 module without housing, and design a new housing/front that fulfills the requirements for IP67.

2. Host Connector

2.1 Host Interface Signals

The Anybus CompactCom host interface uses a 50 pin CompactFlash™ style connector.

Important Note:
The host interface is *not* pin compatible with the CompactFlash™ standard, nor is it hot-swap capable. Failure to observe this may damage to the host product and/or the Anybus CompactCom module.



Also note that the passive CompactCom modules use a limited number of the host interface signals.

Each signal presented in the tables below is described in detail later in this document.

Active modules

Position	Signal	Type	Function	Page
36, 11, 35	OM$^{[0...2]}$	I	Operating Mode	12
27, 2	MI$^{[0...1]}$	O	Module Identification	12
8	$\overline{\text{RESET}}$	I	Reset Input, active low	13
26, 25	MD$^{[0...1]}$	O	Module Detection	14
14, 39, 15, 40, 16, 41, 17, 42	D$^{[0...7]}$	BI	Parallel Interface **Note**: When the serial interface is used by the Anybus CompactCom 30 module, signals A^{12} and A^{13} can be used for functional safety communication (Anybus CompactCom 30 PROFINET 2-Port module only). For more information, see "Safety Serial Interface (PROFINET 2-port only)" on page 14.	17
49, 24, 48, 23, 47, 22, 46, 21, 45, 20, 44, 19, 43, 18	A$^{[0...13]}$	I		
10	$\overline{\text{CE}}$	I		
33	$\overline{\text{OE}}$	I		
34	R/$\overline{\text{W}}$	I		
9	$\overline{\text{IRQ}}$	O		
28	Rx	I	Serial Interface	21
3	Tx	O		
30	LED2A	O	Network Status LED Outputs	15
29	LED1A	O		
5	LED2B	O		
4	LED1B	O		
6, 31	GIP$^{[0...1]}$	I	General Purpose I/O	22
7, 32	$\overline{\text{GOP}}^{[0...1]}$	O		
13, 38	VDD	PWR	Power Supply	27
1, 12, 37, 50	VSS	PWR	Ground	

I = Input, CMOS (3.3V)
O = Output, CMOS (3.3V)
BI = Bidirectional, Tristate
P = Power supply inputs

Note: None of the host interface signals are 5V tolerant.

Note 1: For mechanical properties, measurements etc. see "Mechanical Specification" on page 29.

Note 2: For electrical characteristics, see "Electrical Characteristics" on page 39

Passive modules

Position	Signal	Type	Function	Page
27, 2	$MI^{[0...1]}$	O	Module Identification	12
8	$\overline{RESET}$	I	Reset Input, active low	13
26, 25	$MD^{[0...1]}$	O	Module Detection	14
14, 39, 15, 40, 16, 41, 17, 42	$D^{[0...7]}$	BI	Parallel Interface	17
10[a]	$\overline{CE}$	I		
34[a]	$R/\overline{W}$	I		
33[a]	$\overline{OE}$	I		
28	Rx	I	Serial Interface	21
3	Tx	O		
30	LED2A	O	Network Status LED Outputs	15
29	LED1A	O		
5	LED2B	O		
4	LED1B	O		
6	$GIP^{[0...1]}$	I	General Purpose I/O	22
7	$\overline{GOP}^{[0...1]}$	O		
13, 38	VDD	PWR	Power Supply	27
1, 12, 37, 50	VSS	PWR	Ground	
9, 11, 18, 19, 20, 21, 22, 23, 24, 31, 32, 35, 36, 43, 44, 45, 46, 47, 48, 49	-	NC	(not used)	

I = Input, CMOS (3.3V)
O = Output, CMOS (3.3V)
BI = Bidirectional, Tristate
P = Power supply inputs
NC = Not connected

Note: None of the host interface signals are 5V tolerant.

a. The type of a passive module can be identified from host interface signals D0-D7 (on the parallel interface) if $\overline{CE}$ (10) and $\overline{OE}$ (33) are set to low and $R/\overline{W}$ (34) to high, see also “Network Identification” on page 20.

Note 1: For mechanical properties, measurements etc. see “Mechanical Specification” on page 29.

Note 2: For electrical characteristics, see “Electrical Characteristics” on page 39

2.2 Signal Descriptions

2.2.1 OM[0...2] (Operating Mode)

On active modules, these inputs selects which interface that should be used to exchange data (parallel or serial) and, if the serial interface option is used, the operating baud rate. The state of these signals is sampled once during startup, i.e. any changes requires a reset in order to have effect.

Operating Mode		Setting		
Parallel interface State	**Serial interface State**	**OM2**	**OM1**	**OM0**
Enabled	(disabled, se note 2)	LOW	LOW	LOW
(disabled, see note 2)	Enabled, baud rate: 19.2kbps	LOW	LOW	HIGH
	Enabled, baud rate: 57.6kbps	LOW	HIGH	LOW
	Enabled, baud rate: 115.2kbps	LOW	HIGH	HIGH
	Enabled, baud rate: 625kbps	HIGH	LOW	LOW
(reserved)		HIGH	LOW	HIGH
		HIGH	HIGH	LOW
Service mode		HIGH	HIGH	HIGH

LOW = V_{IL}
HIGH = V_{IH}

For more information regarding the parallel and serial interfaces, see “Parallel Interface Operation” on page 16 and “Serial Interface Operation” on page 21.

Note 1: The state of these signals <u>must</u> be stable prior to releasing the $\overline{\text{RESET}}$ signal (see “RESET (Reset Input)” on page 13). Failure to observe this may result in faulty or unexpected behavior.

Note 2: These signals have no effect on passive modules; instead the communication settings are determined by other network specific factors. Furthermore, a subset of the parallel interface signals are used for network identification purposes, see “Additional Address Lines (A[11...13])” on page 23.

2.2.2 MI[0...1] (Module Identification)

These signals indicate which type of module that is connected. It is recommended to check the state of these signals before accessing the module.

State		Module Type
MI0	**MI1**	
LOW	LOW	Anybus CompactCom (Active module)
HIGH	LOW	Anybus CompactCom (Passive module)
LOW	HIGH	(reserved)
HIGH	HIGH	

LOW = V_{OL}
HIGH = V_{OH}

2.2.3 $\overline{\text{RESET}}$ (Reset Input)

Active low master reset input. This signal should be connected to a host application controllable output pin in order to be able to support network reset requests etc.

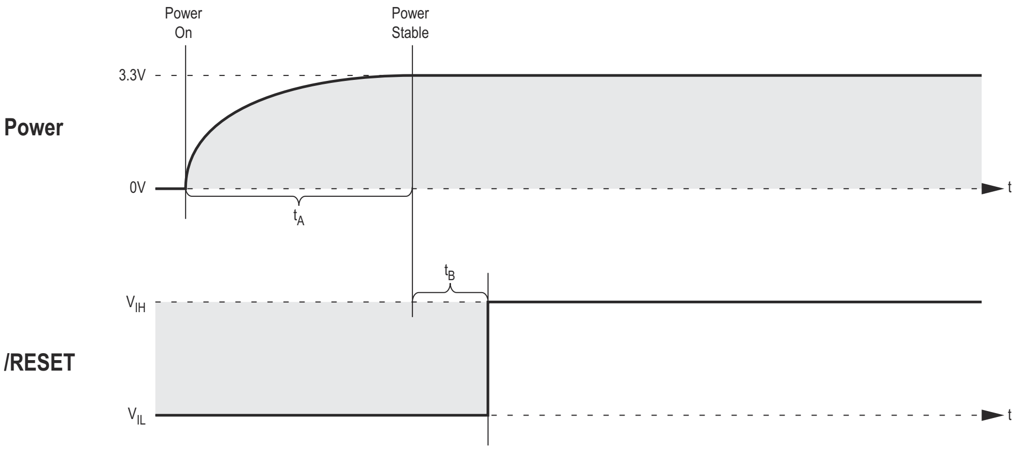
The module does not feature any internal reset regulation, which means that the host application is solely responsible for resetting the module in case the supply voltage has gone outside the specified range (see “Electrical Characteristics” on page 39). If this requirement is not fulfilled, a power brown-out (a drop in voltage) may cause unwanted side-effects such as data loss in nonvolatile memory etc.

There is no schmitt trigger circuitry on this signal, which means that the module requires a fast $\overline{\text{RESET}}$ rise time, preferably equal to the slew rate of typical logical circuits. Stable operation is not guaranteed unless $\overline{\text{RESET}}$ slews from logic 0 (zero) to 1 at a minimum rate; i.e. a simple RC-circuit is <u>not</u> sufficient.

Note: Since some devices may be powered from the network, this signal must be pulled to VSS on the host application side.

Reset (Powerup)

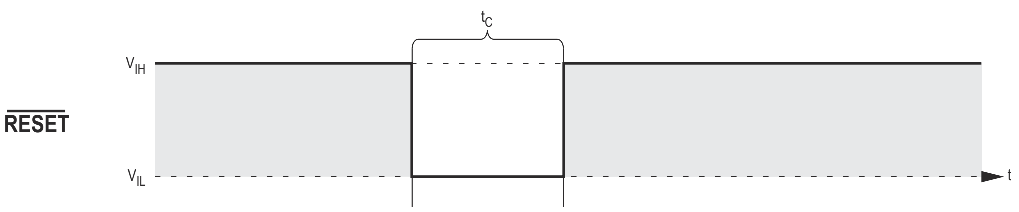
During startup, the reset signal must be held low as shown in the figure below.



Symbol	Min.	Max.	Definition
t_A	-	50 ms	Power supply rise time (0.1 VCC to 0.9 VCC).
t_B	100 ms	-	Safety margin.

Reset (Restart)

The reset pulse duration must be at least 100μs in order for the module to properly recognize a reset.



Symbol	Min.	Max.	Definition
t_C	100μs	-	Reset pulse width.

2.2.4 MD[0...1] (Module Detection)

These signals are internally connected to VSS, and can be used by the host application to detect whether a module is present or not.

State		Indication
MD0	MD1	
HIGH	HIGH	Module not present
LOW	HIGH	
HIGH	LOW	
LOW	LOW	Module present

LOW = V_{OL}
HIGH = V_{OH}

Note: If unused, leave these signals unconnected.

2.2.5 Parallel Interface

For a description of the parallel interface signals, see “Parallel Interface Operation” on page 16.

2.2.6 Serial Interface

For a description of the serial interface signals, see “Serial Interface Operation” on page 21.

2.2.7 Safety Serial Interface (PROFINET 2-port only)

If the parallel interface is used for the host application, the serial interface can be used for functional safety communication, using an add on safety module. If the host application uses the serial interface, an extra serial channel, only for functional safety communication, will be used:

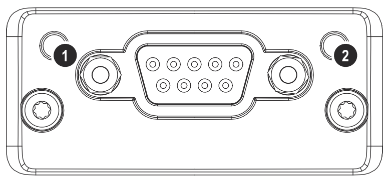
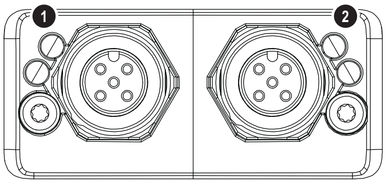
Position	Signal	Type	Function
43	ASM_Rx	I	Functional safety communication. If a Safety Module is connected, these signals must not be tied to VDD.
18	ASM_Tx	O	

Functional safety communication is only available for Anybus CompactCom 30 PROFINET 2-port. For more information, see the Anybus CompactCom 30 PROFINET 2-port Network Appendix.

2.2.8 Network Status LED Outputs

In some applications, the module may be mounted in a fashion that does not enable the user to see the on-board network indication LEDs. The LED[1A....2B] outputs are directly connected to the internal CPU and the on-board LEDs, and can be used to relay the network status indications to elsewhere on the host application.

Note that these outputs are unbuffered and thus not capable of driving LEDs directly.

<table>
<tr><th>Led #</th><th>Corresponding Signals</th><th>Front View</th></tr>
<tr><td rowspan="2">1</td><td>LED1A</td><td rowspan="4">Fieldbus connector

M12 connectors
</td></tr>
<tr><td>LED1B</td></tr>
<tr><td rowspan="2">2</td><td>LED2A</td></tr>
<tr><td>LED2B</td></tr>
</table>

Note 1: If unused, leave these signals unconnected.

Note 2: The placement and the numbering of the LEDs in this picture are only given as an example. Please refer to the network interface appendices for each specific module.

See also “Network Status LED Outputs (LED[1A...2B])” on page 24.

2.2.9 General Purpose I/O

See “General Purpose I/O” on page 22.

3. Parallel Interface Operation

3.1 General Information

Passive and active modules behave slightly differently concerning the parallel interface:

- **Active Modules**

  On active modules, the parallel interface is based on an asynchronous dual port memory architecture, allowing the Anybus module to be interfaced directly as a memory mapped peripheral.

  For increased efficiency, an optional interrupt request signal ($\overline{\text{IRQ}}$) allows the host application to service the Anybus module only when necessary. Polled operation is also possible, albeit at the cost of a slightly overhead.

  On active modules, the parallel interface must be enabled using OM$^{[0...\ 2]}$.

  See also...
  - "OM[0...2] (Operating Mode)" on page 12)

- **Passive Modules**

  Passive module uses a subset of the parallel interface signals to provide means of network identification. Unlike active modules, it is not necessary to activate this functionality using OM$^{[0...\ 2]}$. The serial interface remains enabled and is used as the main channel of communication.

  See also...
  - "Network Identification" on page 20

See also...

- "Introduction" on page 7 ("Passive vs. Active" on page 8)
- "Implementation Guidelines" on page 23("Module Compatibility" on page 23)

IMPORTANT: *The parallel interface does not support sequential or nonsequential burst access methods.*

3.2 Parallel Interface Signals

The parallel interface uses the following signals:

Signal	Description	Notes
$A^{[0...10]}$	Mandatory address input signals. Selects source/target location in shared memory.	Tie to VSS when unused
$A^{[11...13]}$	Additional address input signals (optional) (See "Additional Address Lines (A[11...13])" on page 23)	Tie to VDD when unused[a]
$D^{[0...7]}$	Bidirectional data bus. Target location is specified by $A^{[0...13]}$	Tie to VSS when unused
$\overline{CE}$	Bus chip enable; enables parallel access to the module when low. **Note:** $A^{[0...13]}$ must be stable while $\overline{CE}$ is active.	Tie to VDD when unused
$R/\overline{W}$	Bus read/write; enables input on $D^{[0...7]}$ when low.	Tie to VDD when unused
$\overline{OE}$	Bus output enable; enables output on $D^{[0...7]}$ when low.	Tie to VDD when unused
$\overline{IRQ}$	Active low Interrupt Request signal. Asserted by the Anybus module, and de-asserted (i.e. acknowledged) by the host application by reading the Status Register (3FFFh). Please note that due to technical reasons, the module may acknowledge interrupts even if $\overline{OE}$ has not been asserted, if this address (3FFFh) is present on the bus while $\overline{CE}$ is active. The use of this signal is optional albeit highly recommended. Even if the host application lacks interrupt capabilities, it is recommended to connect this signal to an input port to simplify software design. This signal must be pulled to VDD on the host application side to prevent spurious interrupts during startup.	Leave unconnected if unused

a. Please note that if a Safety Module is connected, these signals must not be tied to VDD.

Note: There are no internal pullup resistors on any of the signals above.

Note: It is important to connect the serial interface signals correctly for proper functioning of the parallel interface. See "Serial Interface Signals" on page 21 for details.

3.3 Function Table ($\overline{CE}$, R/$\overline{W}$, $\overline{OE}$, $D^{[0...7]}$)

$\overline{CE}$	$R/\overline{W}$	$\overline{OE}$	$D^{[0...7]}$ State	Comment
HIGH	X	X	High impedance	Module not selected.
LOW	LOW	X	Data Input (Write)	Data on $D^{[0...7]}$ is written to shared memory.
LOW	HIGH	LOW	Data Output (Read)	Data from shared memory is available on $D^{[0...7]}$
LOW	HIGH	HIGH	High impedance	Module is selected, but $D^{[0...7]}$ is in a high impedance state.

X =*Don't care* *LOW* = V_{IL} *HIGH* = V_{IH}

3.4 Timing Diagrams

Note: Timing depends on capacitive load. The figures in this section are valid for loads up to 25 pF.

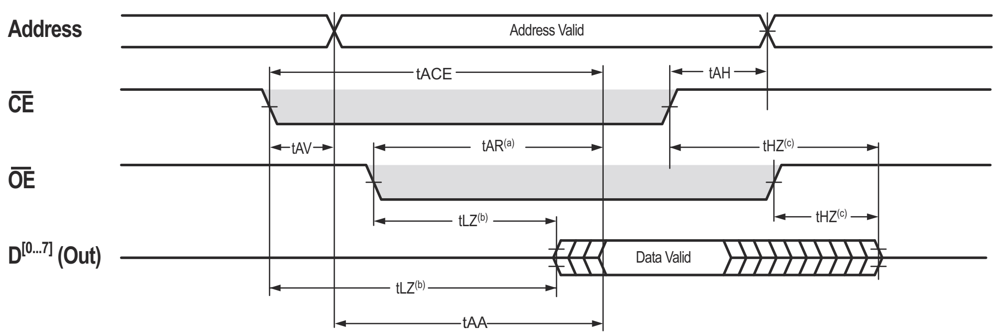
Note: $\overline{CE}$ must be high at least 3 ns between two accesses. This is applicable in both Read and Write Cycle.

3.4.1 Read Access Timing

Symbol	Parameter	Min.	Max.	Unit
tAV	Address Valid After Chip Enable	-	7	ns
tAA	Address Access Time	-	30	
tACE	Chip Enable Access Time	-	30	
tAR	Read Access Time[a]	-	15	
tAH	Address Hold Time	0	-	
tLZ	Output Low-Z Time[b]	0	-	
tHZ	Output High-Z Time[c]	-	15	

a. Start of valid data depends on which timing becomes effective last; tAR, tACE or tAA
b. Timing depends on which signal is asserted last, $\overline{OE}$ or $\overline{CE}$
c. Timing depends on which signal is de-asserted first, $\overline{OE}$ or $\overline{CE}$

Read Access Timing[1]



1. R/$\overline{W}$ = HIGH.

3.4.2 Write Access Timing

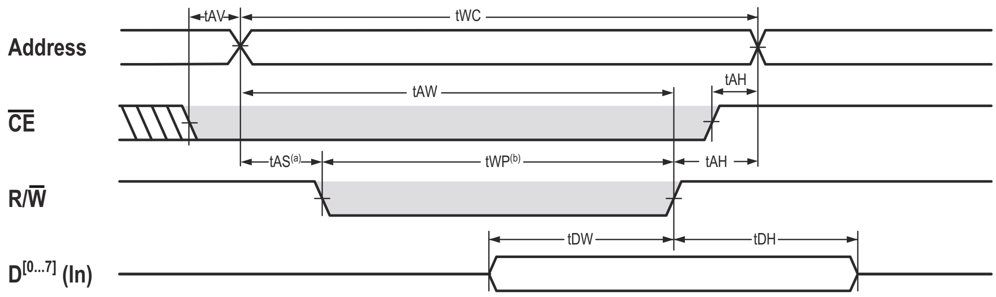
Symbol	Parameter	Min.	Max.	Unit
tWC	Write Cycle Time	30	-	ns
tSW	Chip Enable to End-of-Write	25	-	
tAW	Address Valid to End-of-Write	25	-	
tAS	Address Set-up Time[a]	0	-	
tWP	Write Pulse Width[b]	25	-	
tAH	Address Hold Time	0		
tAV	Address Valid After Chip Enable	-	7	
tDW	Data Valid to End-of-Write	15	-	
tDH	Data Hold Time	0	-	

a. Timing depends on which enable signal ($\overline{CE}$ or R/$\overline{W}$) is asserted last

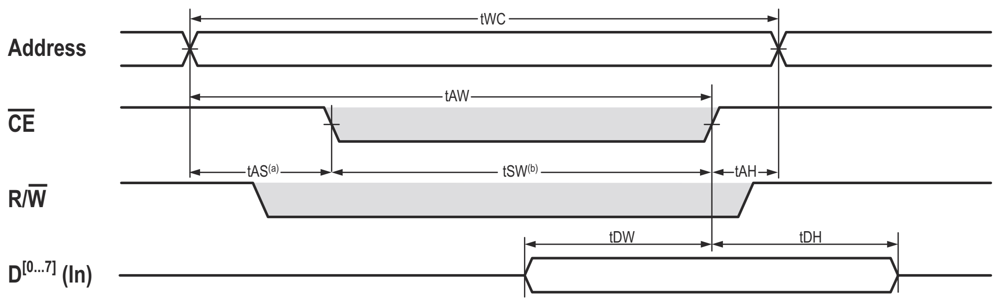
b. A write occurs during the overlap (tSW or tWP) of $\overline{CE}$ = LOW and R/$\overline{W}$ = LOW

Note: Timing depends on capacitive load. The figures in this section are valid for loads up to 25 pF.

Write Cycle (R/$\overline{W}$ controlled timing)[1]



Write Cycle ($\overline{CE}$ controlled timing)[2]



Please note that once the address is stable it must not change for the duration of the low $\overline{CE}$ signal.

1. $\overline{OE}$ = HIGH
2. $\overline{OE}$ = Don't care

3.5 Network Identification

As mentioned previously, the host application can detect the module type by examining the state of the $MI^{[0...1]}$ signals. On passive modules, the network type can then be established by reading a byte in the range 3800h... 38FFh.[1] In case of active modules, the network type is retrieved by means of the host interface protocol (consult the Anybus CompactCom Software Design Guide for further information).

In case the host application for some reason cannot use the $MI^{[0...1]}$ signals, it is still possible to retrieve the module and network type as follows:

1. Release $\overline{\text{RESET}}$ signal
2. Wait at least 1.5 s[2] (if only using passive modules, skip this step)
3. Read a byte in the range 3800h... 38FFh

The result obtained while reading from the range 3800h... 38FFh shall be interpreted as follows:

Value	Module Type & Network
00h	Active module (network type identified by means of the host communication protocol)
01h	Passive module, RS232
02h	Passive module, RS422
03h	Passive module, USB
04h	(reserved for future use)
05h	Passive module, Bluetooth
06h	(reserved for future use)
07h	(reserved for future use)
08h... 09h	(reserved for future use)
0Ah	Passive module, RS485
(0Bh... FFh)	(reserved for future use)

See also...

- “Introduction” on page 7 (“Passive vs. Active” on page 8)
- “General Information” on page 16
- “Implementation Guidelines” on page 23 (“Module Compatibility” on page 23)
- Anybus CompactCom Software Design Guide

1. The type of a passive module can also be identified from host interface signals D0-D7 (on the parallel interface) if $\overline{\text{CE}}$ (10) and $\overline{\text{OE}}$ (33) are set to low and R/$\overline{\text{W}}$ (34) to high.
2. This time correlates to the start-up procedure (Initial Handshake) described in the Anybus CompactCom Software Design Guide.

4. Serial Interface Operation

4.1 General Description

The serial interface is a common asynchronous serial interface, which can easily be interfaced directly to a micro controller or UART (For connection examples etc., see “Interfacing to 5V Logic” on page 26).

The serial interface is handled differently depending on which type of module that is used (active or passive), see below.

- **Active Modules**

  On active modules, the serial interface is activated using the ($OM^{[0...2]}$) inputs, which are also used to select the operating baud rate (see “OM[0...2] (Operating Mode)” on page 12).

  Other communication settings are fixed to the following values:

  Data bits: 8
  Parity: None
  Stop bits: 1

- **Passive Modules**

  On passive modules, the serial interface is always active (regardless of the state of the $OM^{[0...2]}$ inputs), and the communication settings are determined by other factors (network specific).

4.2 Serial Interface Signals

The serial interface option uses only two signals:

Signal	Description	Notes
Tx	TTL-compliant asynchronous serial transmit output. This signal must be pulled to VDD on the host application side.	Leave this signal unconnected when unused.
Rx	Asynchronous serial receive[a]. This signal must be pulled to VDD on the host application side.	Tie this signal to VDD when unused.

a. This input is *not* 5V tolerant

Note: It is important to connect the parallel interface signals correctly for proper functioning of the serial interface. See “Parallel Interface Signals” on page 17 for details.

4.3 Baud Rate Accuracy

As with most asynchronous communication devices, the actual baud rate used on the Anybus CompactCom may differ slightly from the ideal baud rate.

The baud rate error of the Anybus module is less than ±1.5%. For proper operation, it is recommended that the baud rate accuracy in the host application lies within ±1.5% from the ideal value.

5. General Purpose I/O

5.1 General

The functionality of these signals is module type dependent. These signals have no dedicated function, but it is still generally recommended to connect these signals to discreet inputs/outputs in the host application to be prepared for future functionality.

Signal	Description	Notes
GIP0	General Input Port 0[a]	Active high general purpose input ports. Preferably, connect these inputs to discreet outputs in the host application. **Note:** These signals should be pulled to VSS on the host application.
GIP1	General Input Port 1[a]	
$\overline{\text{GOP0}}$	General Output Port 0[b]	Active low general purpose output ports. Preferably, connect these outputs to interrupt capable inputs on the host application. **Note:** These signals should be pulled to VDD on the host application. If unused, leave these signals unconnected.
$\overline{\text{GOP1}}$	General Output Port 1[b]	

a. Tie to VSS if unused.
b. If unused, leave these signals unconnected.

Please consult the network appendices for more information.

5.2 Functional Description

As mentioned previously, the function of these signals is different depending on module type. Please check the Implementation Details section in the network appendix for each module for more information.

Active Modules

At the time of writing, some active modules use these signals. For example, the General Purpose IO signals can, together with the LED[1A....2B] outputs, for some networks be used for extended LED functionality. However it is strongly recommended to implement the signals in the host application in order to be prepared for future functionality, whether or not they are used at the time being. Please consult the network appendices for more information.

Passive Modules

The following functionality has been defined for these signals when using passive modules:

Signal	Function	Notes
GIP0	DE	Data Enable; enables data transmission on half duplex networks such as RS-485.
GIP1	(reserved)	Preferably, connect this input to a discreet output in the host application.
$\overline{\text{GOP0}}$	CA	Communication Active; indicates if the connected network is ready for communication.
$\overline{\text{GOP1}}$	(reserved)	Preferably, connect this output to a discreet input in the host application.

A. Implementation Guidelines

A.1 Module Compatibility

General

As mentioned previously, the Anybus CompactCom 30 product family holds two major types of communication modules called 'Passive' and 'Active'. Both types can be supported in the host application by implementing the proper host interface signals, see table below.

Compatibility Chart

<table>
<tr><th colspan="3">Host Interface Implementation</th><th colspan="2">Compatibility</th></tr>
<tr><th>General Purpose I/O</th><th>Serial Interface</th><th>Parallel Interface</th><th>Active Modules</th><th>Passive Modules</th></tr>
<tr><td rowspan="3">Yes</td><td>Yes</td><td>Yes</td><td rowspan="3">Yes</td><td rowspan="2">Yes</td></tr>
<tr><td>Yes</td><td>No</td></tr>
<tr><td>No</td><td>Yes</td><td rowspan="4">No</td></tr>
<tr><td rowspan="3">No[a]</td><td>Yes</td><td>Yes</td><td rowspan="3">(Yes)[a]</td></tr>
<tr><td>Yes</td><td>No</td></tr>
<tr><td>No</td><td>Yes</td></tr>
</table>

a. At the time of writing, the general purpose I/O signals (GIPx & $\overline{GOPx}$) are unused on active modules. However, since future products will utilize these signals for advanced fieldbus functions, it is generally recommended to implement them anyway.

A.2 Additional Address Lines ($A^{[11...13]}$)

At the time of writing, address lines 11-13 are unused. Future products may however utilize these extra address lines to accommodate a larger amount of high speed network I/O. To be able to take advantage of this future functionality, it is recommended to implement as many of the address lines as possible.

Note: Unused address lines must be tied to VDD in order to maintain software compatibility and keep the memory map intact, see table below. If a Safety Module is connected, A12 and A13 must not be tied to VDD, though.

Available Address Lines	Recommendation
11	Implement $A^{[0...10]}$. Tie $A^{[11...13]}$ to VDD
12	Implement $A^{[0...11]}$. Tie $A^{[12...13]}$ to VDD
13	Implement $A^{[0...12]}$. Tie $A^{[13]}$ to VDD
14	Implement $A^{[0...13]}$

A.3 Network Status LED Outputs (LED[1A...2B])

General

The LED[1A....2B] outputs can be used to relay the network status LEDs to elsewhere on the host application.

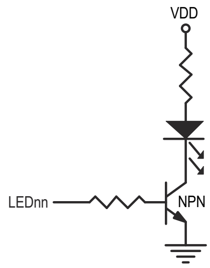
Note that it is the responsibility of the host application to ensure that each LED output is connected to a LED of the correct color (on active modules, it is possible to retrieve this information from the Anybus Object (01h); consult the general Anybus CompactCom Software Design Guide for more information).

An overview of the LED colors used are presented below. Most networks use the standard configuration, but there are a few exceptions.

Network	LED1A	LED1B	LED2A	LED2B
Standard configuration (Profibus DP-V1 and DP-V0, DeviceNet,CANopen, Ethernet Modbus-TCP, CC-Link etc.)	Green	Red	Green	Red
Modbus RTU	Yellow			
RS232	-	-		-
RS422				
RS485				
USB				

Buffering

The outputs are unbuffered, and cannot drive LEDs directly. In this example, a LED is connected to one of the LED outputs of the Anybus module via an NPN transistor.

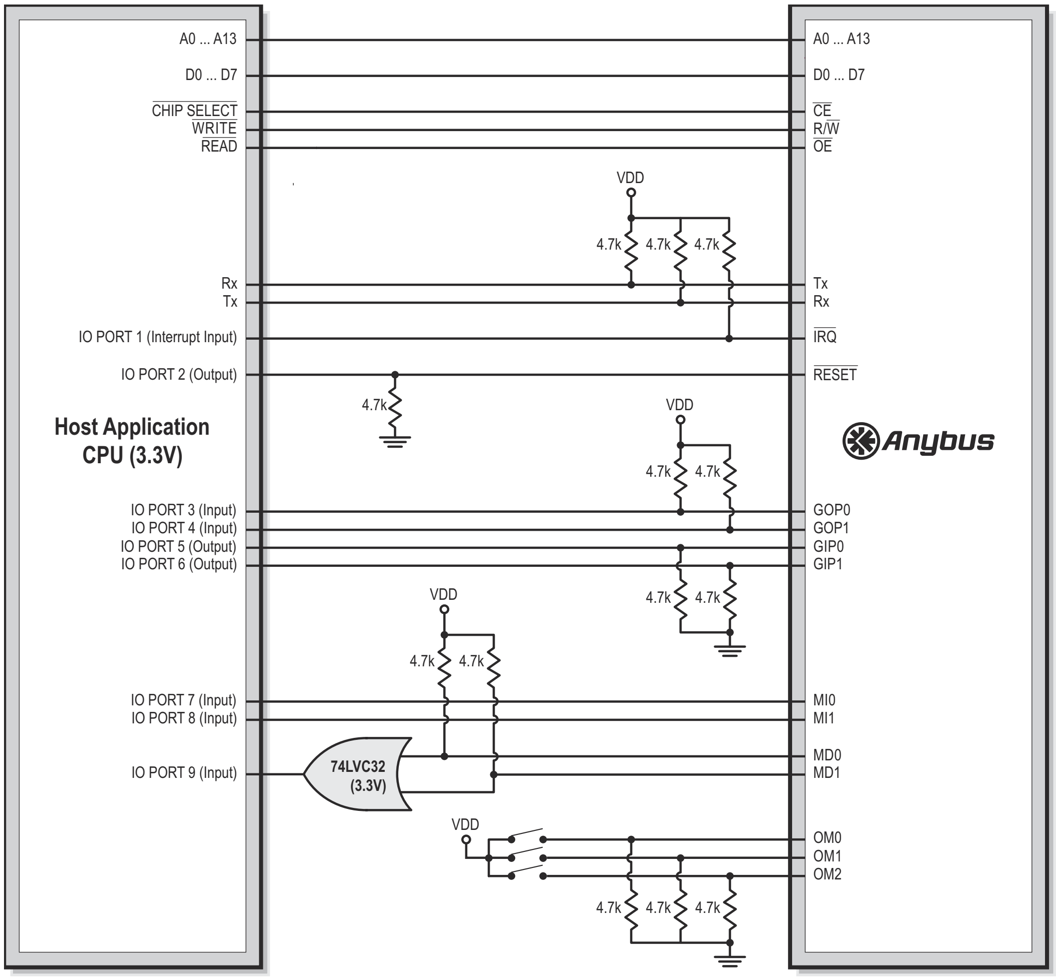


Note: The LED[1A....2B] outputs can, together with the General Purpose IO signals, for some networks be used for extended LED functionality. Please consult the network appendices for more information.

A.4 Typical Implementation (3.3V)

The example in the figure below shows a typical implementation with both parallel- and serial communications, allowing the host application to support passive modules as well as active modules in either serial or parallel mode.

Note that to increase readability, certain signals have intentionally been left out from this example.



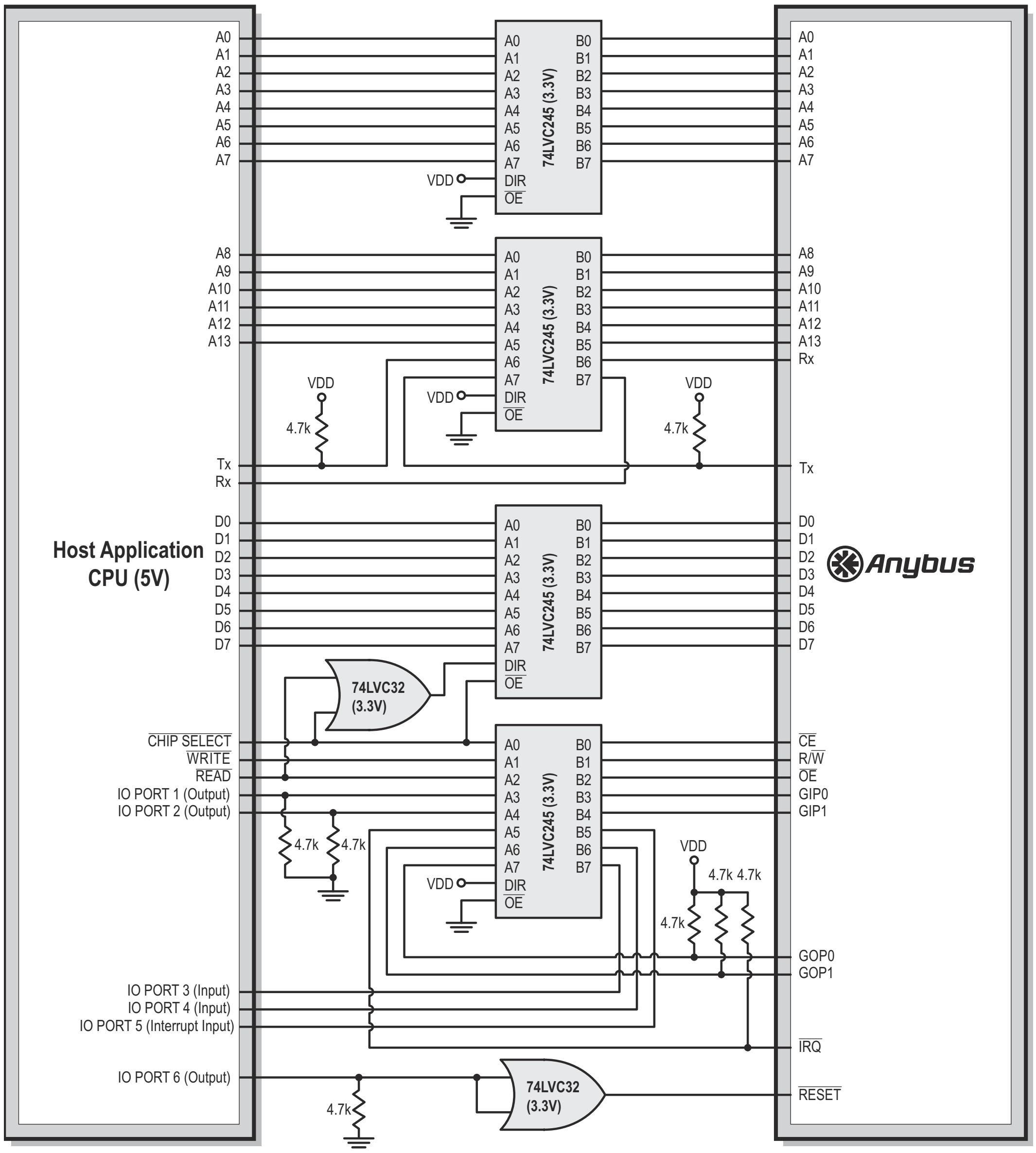
Note: As with many common microcontrollers, the direction of the IO PORT pins on the CPU in this example is determined during power up; hence the pullup/pulldown resistors on the signals marked 'IO PORT (OUTPUT) n'.

A.5 Interfacing to 5V Logic

The Anybus CompactCom is not 5V tolerant. This means that a level shifting circuit of some sort is required when interfacing the module in systems based on 5V logic. To better understand the issues involved when designing mixed voltage systems, it is recommended to read “Low-Cost, Low-Power Level Shifting in Mixed-Voltage (5V, 3.3V) Systems” (Publication: SCBA002A) by Texas Instruments.

The example in the figure below uses four 74LVC245 bus transceivers powered with 3.3V to buffer the signals towards Anybus module. The $\overline{\text{CHIPSELECT}}$ and $\overline{\text{READ}}$ signals from the host application CPU are fed into a 74LVC32 logical ‘OR’ gate (also powered by 3.3V) of which the output is used to control the direction of the bus transceiver that buffers the data bus.

Note that to increase readability, certain signals have intentionally been left out from this example.



Note: As with many common microcontrollers, the direction of the IO PORT pins on the CPU in this example is determined during power up; hence the pullup/pulldown resistors on the signals marked ‘IO PORT (OUTPUT) n’.

A.6 Power Supply Considerations

A.6.1 General

The Anybus CompactCom platform in itself is designed to be extremely power efficient. The exact power requirements for a particular networking systems will however vary a lot depending on to the components used in the actual bus circuitry.

While most systems usually require less than 250 mA of supply current, certain high performance networks, or networks which require the use of legacy ASIC technology, will consume up to 500 mA, or in rare cases even as much as 1000 mA.

As an aid when designing the power supply electronics, the networks have been divided into classes based on their power consumption as follows.

- **Class A**
  This class includes systems which consume less than 250 mA of supply current.
- **Class B**
  This class includes systems which consume up to 500 mA of supply current.
- **Class C**
  This class includes systems which consume up to 1000 mA of supply current.

The following table lists the currently supported networking systems and their corresponding class.

<table>
<tr><th>Network</th><th>Class A</th><th>Class B</th><th>Class C</th></tr>
<tr><td>CANopen</td><td rowspan="14">Yes</td><td rowspan="21">Yes</td><td rowspan="22">Yes</td></tr>
<tr><td>DeviceNet</td></tr>
<tr><td>Modbus RTU</td></tr>
<tr><td>Profibus DP-V1</td></tr>
<tr><td>RS232 (Passive)</td></tr>
<tr><td>RS422/485 (Passive)</td></tr>
<tr><td>USB (Passive)</td></tr>
<tr><td>EtherNet/IP</td></tr>
<tr><td>Profibus DP-V0</td></tr>
<tr><td>CompoNet</td></tr>
<tr><td>Profinet</td></tr>
<tr><td>Modbus-TCP</td></tr>
<tr><td>BACnet MSTP</td></tr>
<tr><td>Bluetooth (Passive)</td></tr>
<tr><td>Sercos III</td><td rowspan="8">No</td></tr>
<tr><td>EtherCAT</td></tr>
<tr><td>Profinet 2-Port</td></tr>
<tr><td>Ethernet/IP 2-Port</td></tr>
<tr><td>CC-Link</td></tr>
<tr><td>BACnet/IP 2-Port</td></tr>
<tr><td>Modbus-TCP 2-Port</td></tr>
<tr><td>ControlNet</td><td>No</td></tr>
</table>

Examples:

A power supply designed to fulfil Class A requirements (250 mA), will be able to support all networks belonging to class A, but none of the networks in Class B and C.

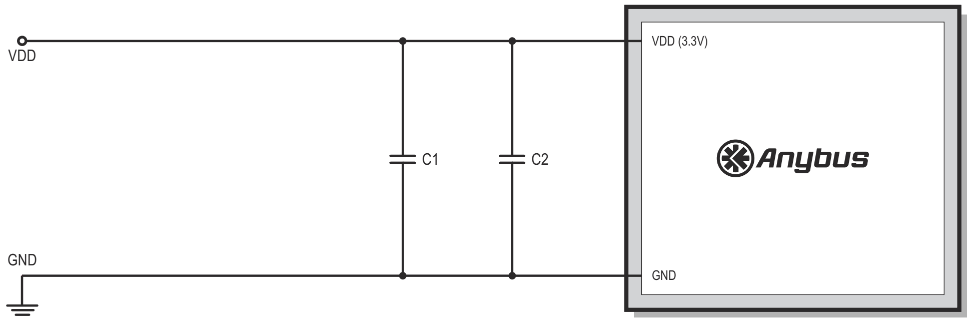
A power supply designed to fulfil Class C requirements, will be able to support all networks.

A.6.2 Bypass Capacitance

The power supply inputs must have adequate bypass capacitance for high-frequency noise suppression. It is therefore recommended to add extra bulk capacitors near the power supply inputs:

Reference	Value (Ceramic)
C1	22 uF / 6.3 V
C2	100 nF / 16 V

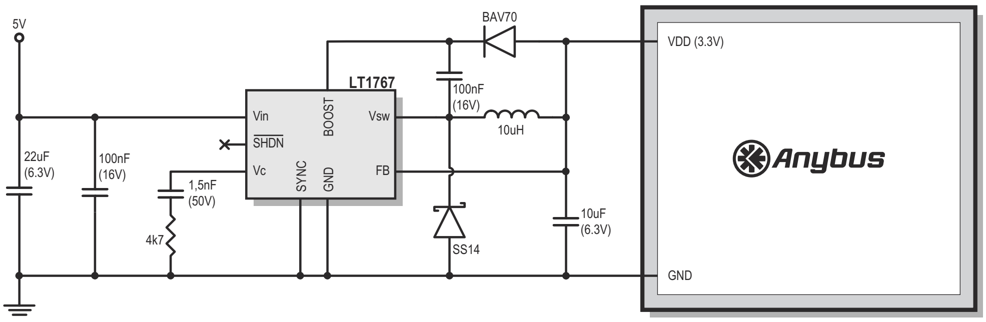
Example:



A.6.3 3.3V Regulation

The following example uses the LT1767 from Linear Technology to provide a stable 3.3 V power source for the module. Note that all capacitors in this example are of ceramic type.

Example:

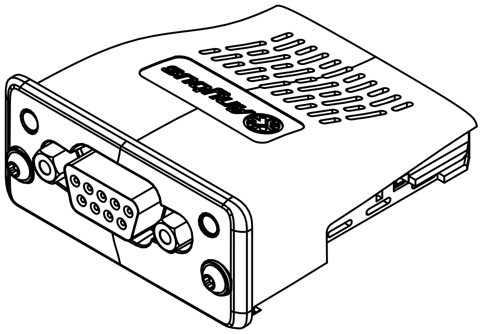


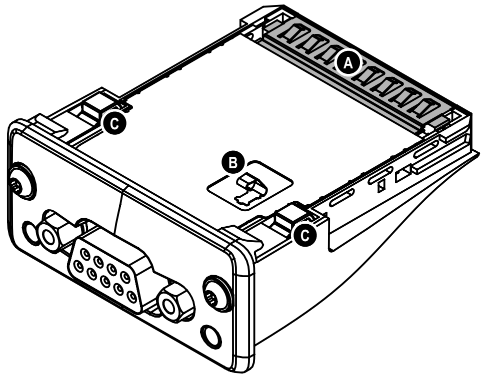
Note: For detailed information regarding this example, consult the data sheet for the LT1767 (Linear Technology).

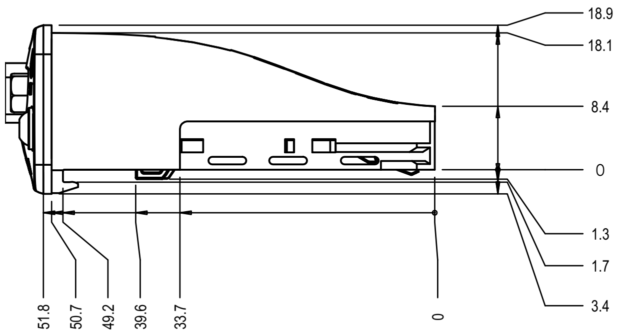
B. Mechanical Specification

B.1 Overview

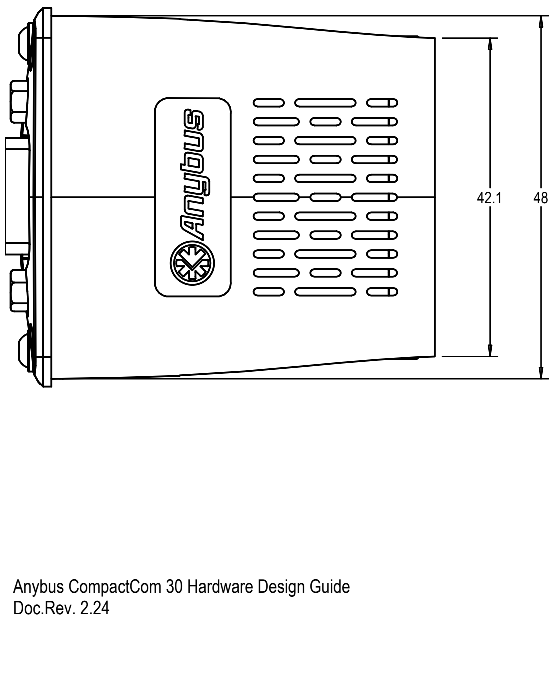
Note: The measurements below are given in millimeters and include a tolerance of ±0.20 mm.

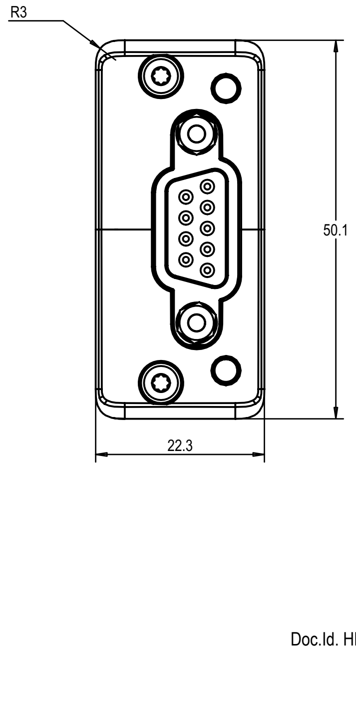






- **A** New Grounding (VSS) Mechanics
- **B** Protective Earth (PE) Mechanics
- **C** Fastening Mechanics

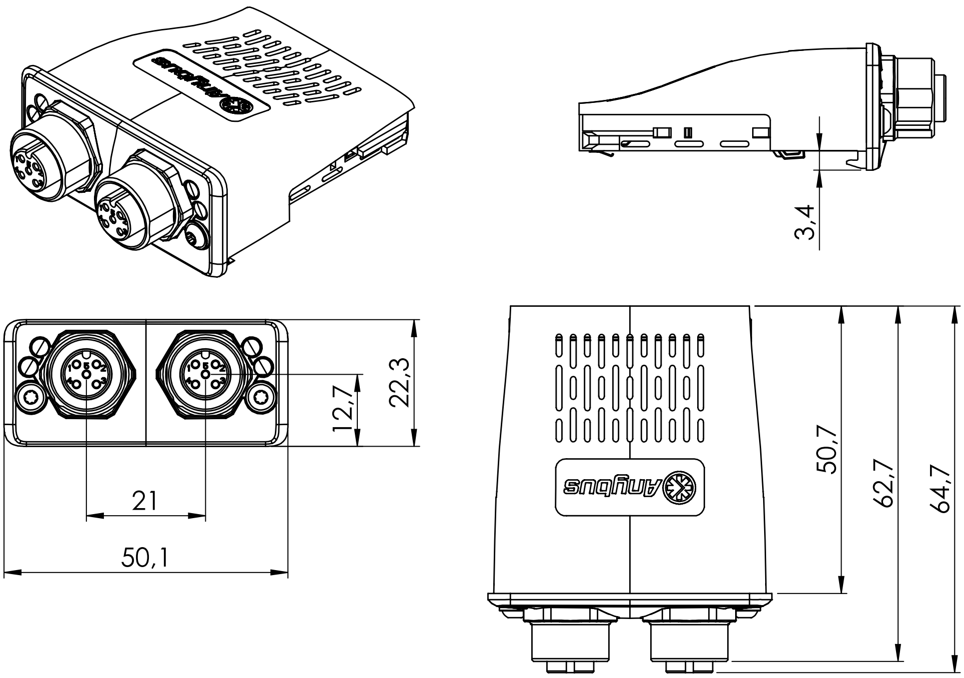


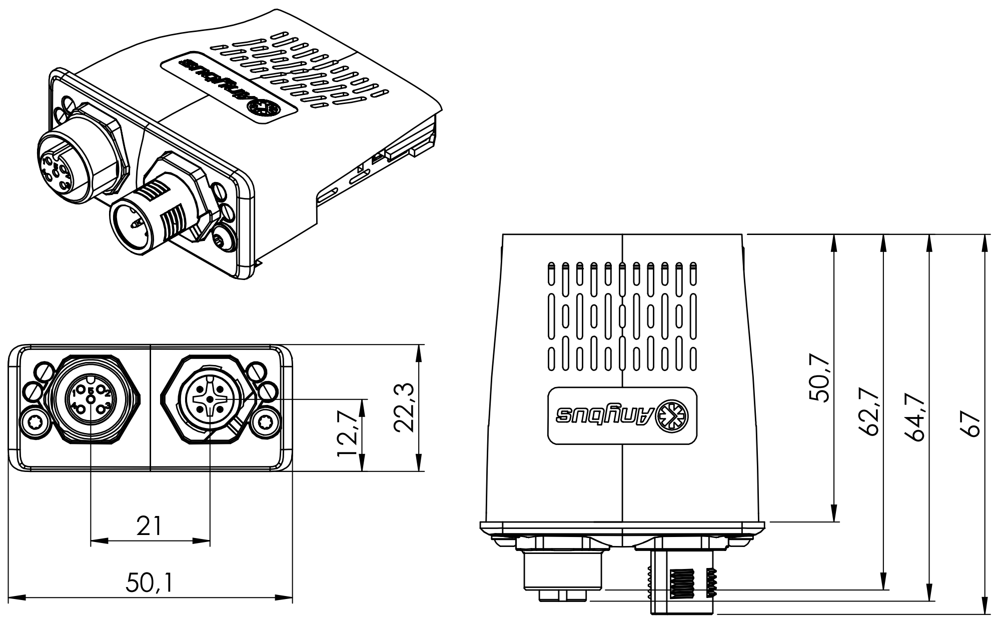


B.2 M12 Connector

The modules that are equipped with M12 connectors, either have two female connectors or one female and one male connector.

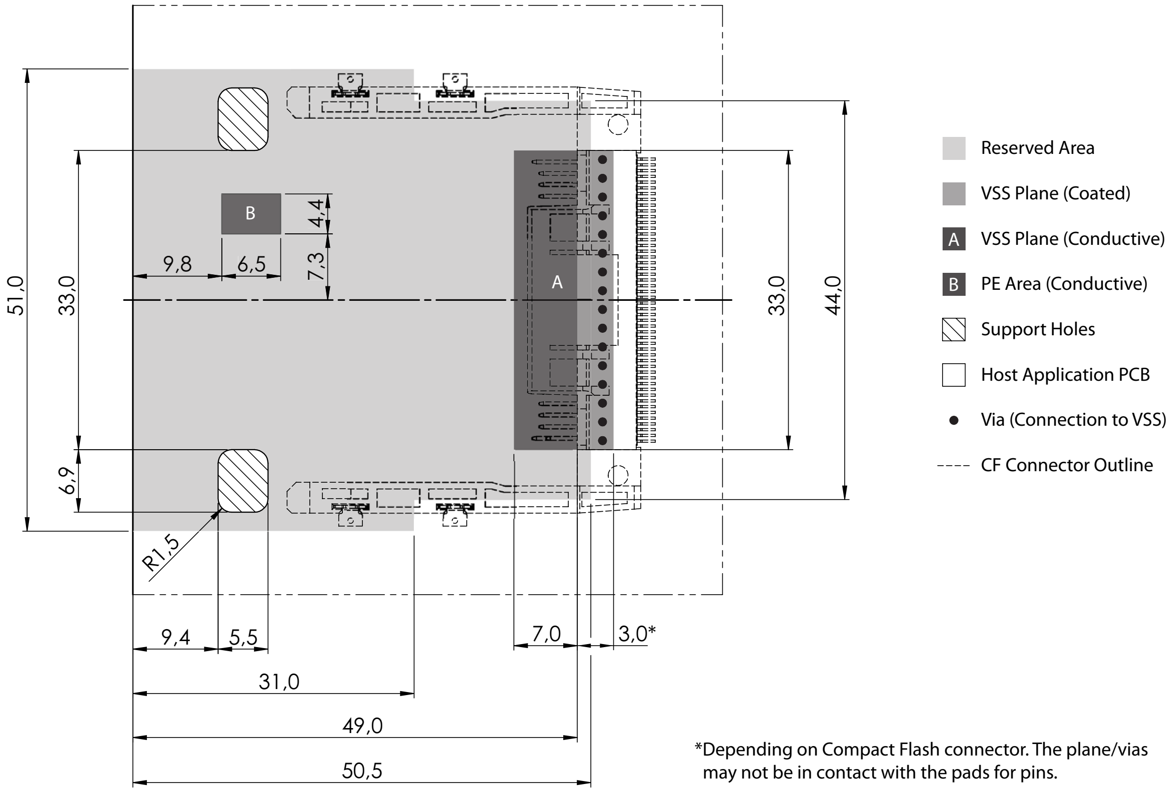
Note: The measurements below are given in millimeters and include a tolerance of ±0.10 mm.





B.3 Footprint

Note 1: The measurements below are given in millimeters and include a tolerance of ±0.10 mm.

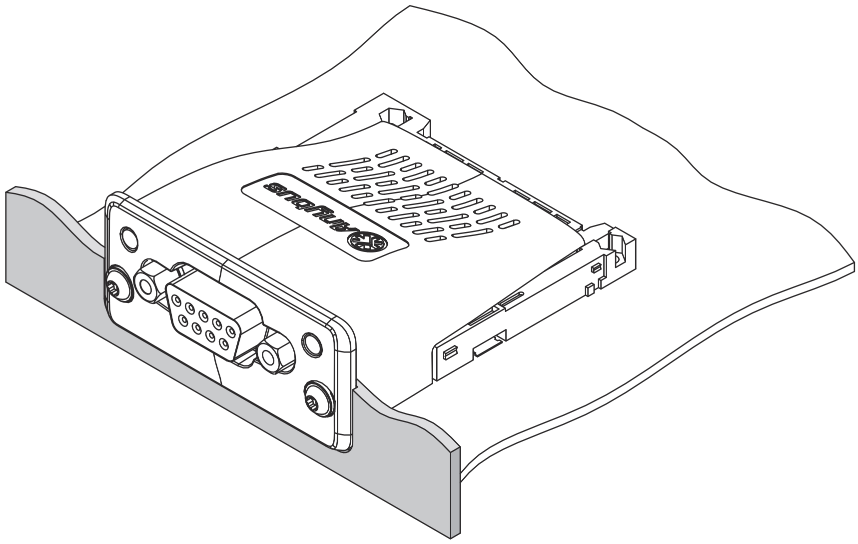


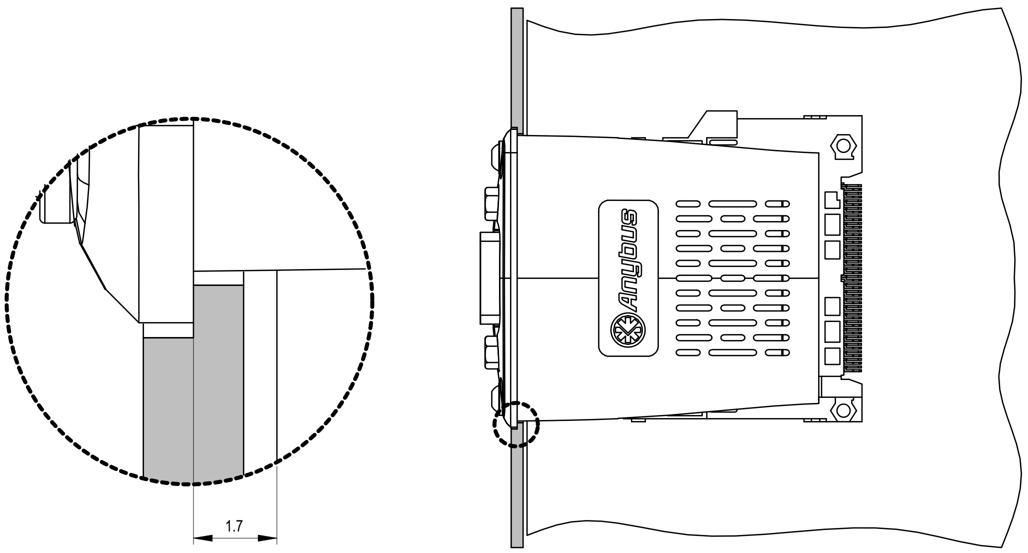
Note 2: Footprint for the recommended Anybus CompactCom 30 host connector can be found in “Host Connector” on page 34.

Area	Description
Reserved Area	To ensure isolation and mechanical compatibility, it is strongly advised that this area is kept completely free from components and signal lines. Under no circumstances may components, via holes, or signal lines, be placed on the PCB layer facing the Anybus module. Failure to comply with this requirement may induce EMC/EMI problems, mechanical compatibility issues, or even short circuit.
PE Area (Conductive)	To achieve proper EMC behavior and to provide support for different cable shielding standards, this area must be tin plated (preferably using Hot Air Levelling technology) and have a stable, low impedance connection to protective earth.
VSS Plane (Coated) VSS Plane (Conductive)	The exact shape of this area depends on the properties of the CompactFlash connector. It is however important to follow these basic design rules: • **The plane must be continuous and have a stable, low impedance connection to VSS (preferably through at least 16 vias as illustrated in the figure)** • **The connection to VSS should be placed beneath the CompactFlash connector as illustrated above (see figure)** • **The plane must follow the signal path through the connector** • **The conductive part must be tin plated, preferably using Hot Air Levelling technology**
Support Holes	These holes are used by the fastening mechanics to secure the module onto the host application.

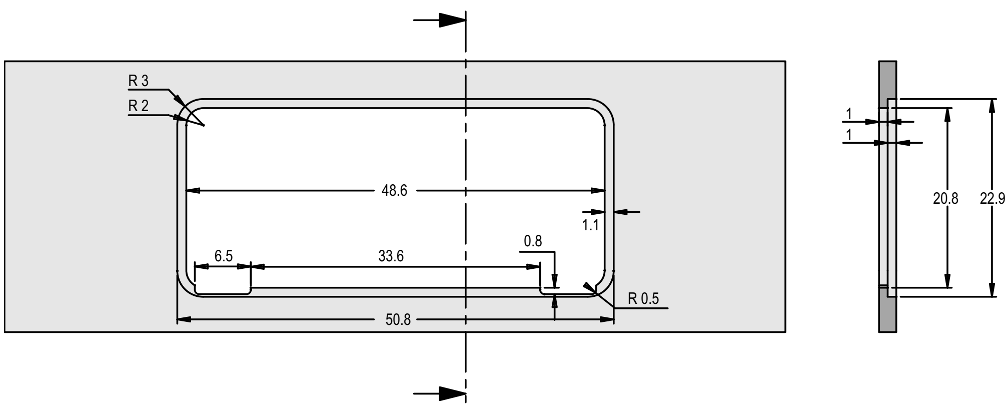
B.4 Housing Preparations

Note: The measurements below are given in millimeters and include a tolerance of ±0.10 mm.





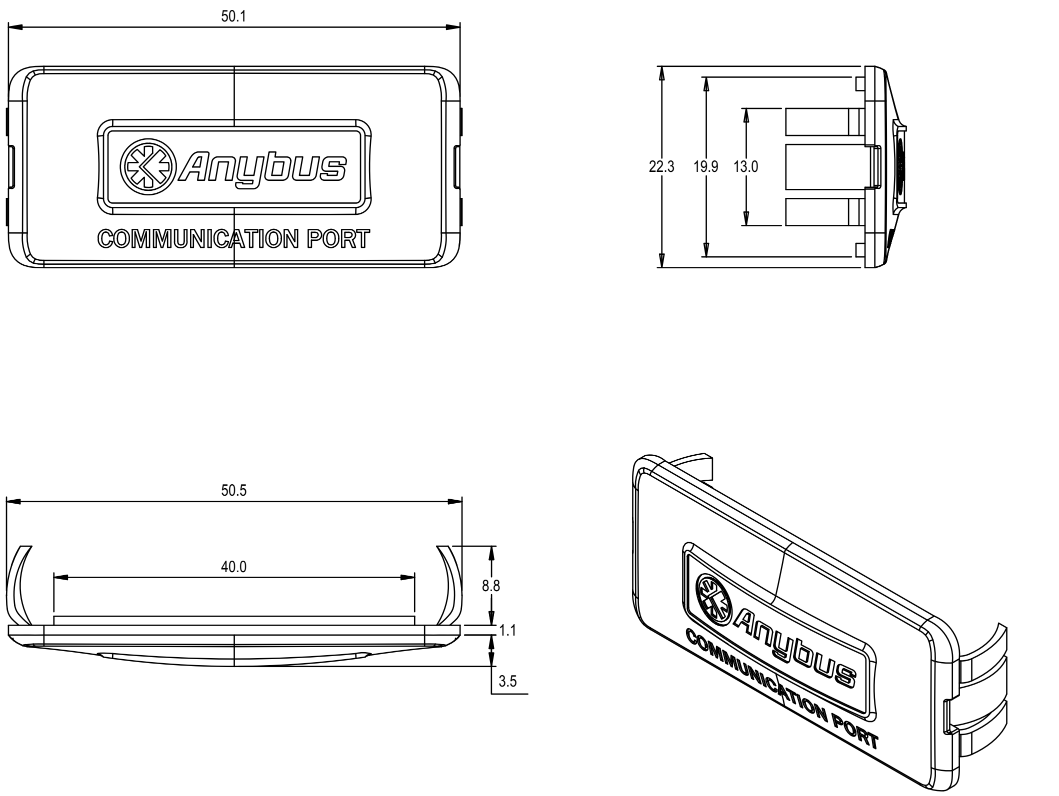
Front



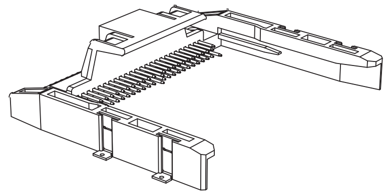
B.5 Slot Cover

HMS can supply a “blind” slot-cover, which may be used to cover the Anybus CompactCom slot when not in use, allowing the Anybus CompactCom module to be supplied as an end-user option instead of being mounted during manufacturing.

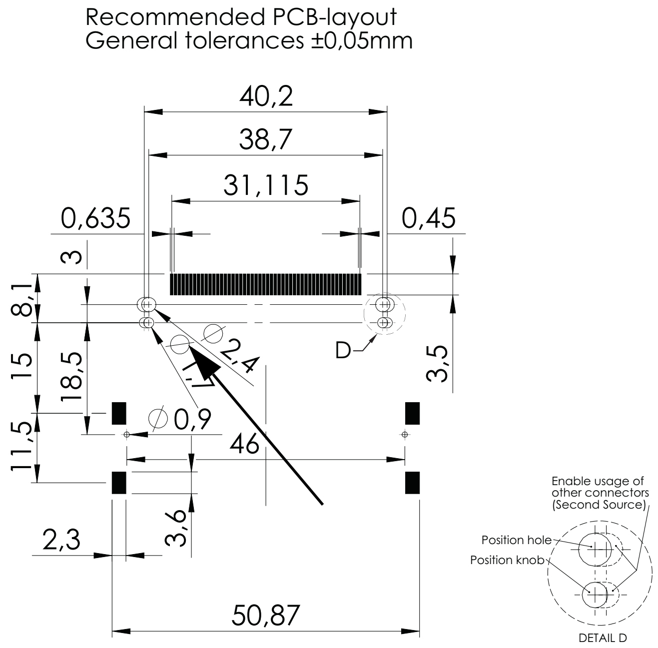
Note: The measurements below are given in millimeters and include a tolerance of ±0.10 mm.



B.6 Host Connector



The Anybus CompactCom 30 is designed to use a compact flash connector as application connector. HMS offers a host connector, that is designed to simplify the mounting and to meet the demands for a secure and stable connection of the Anybus CompactCom 30 modules. The recommended PCB layout is presented in the figures below.

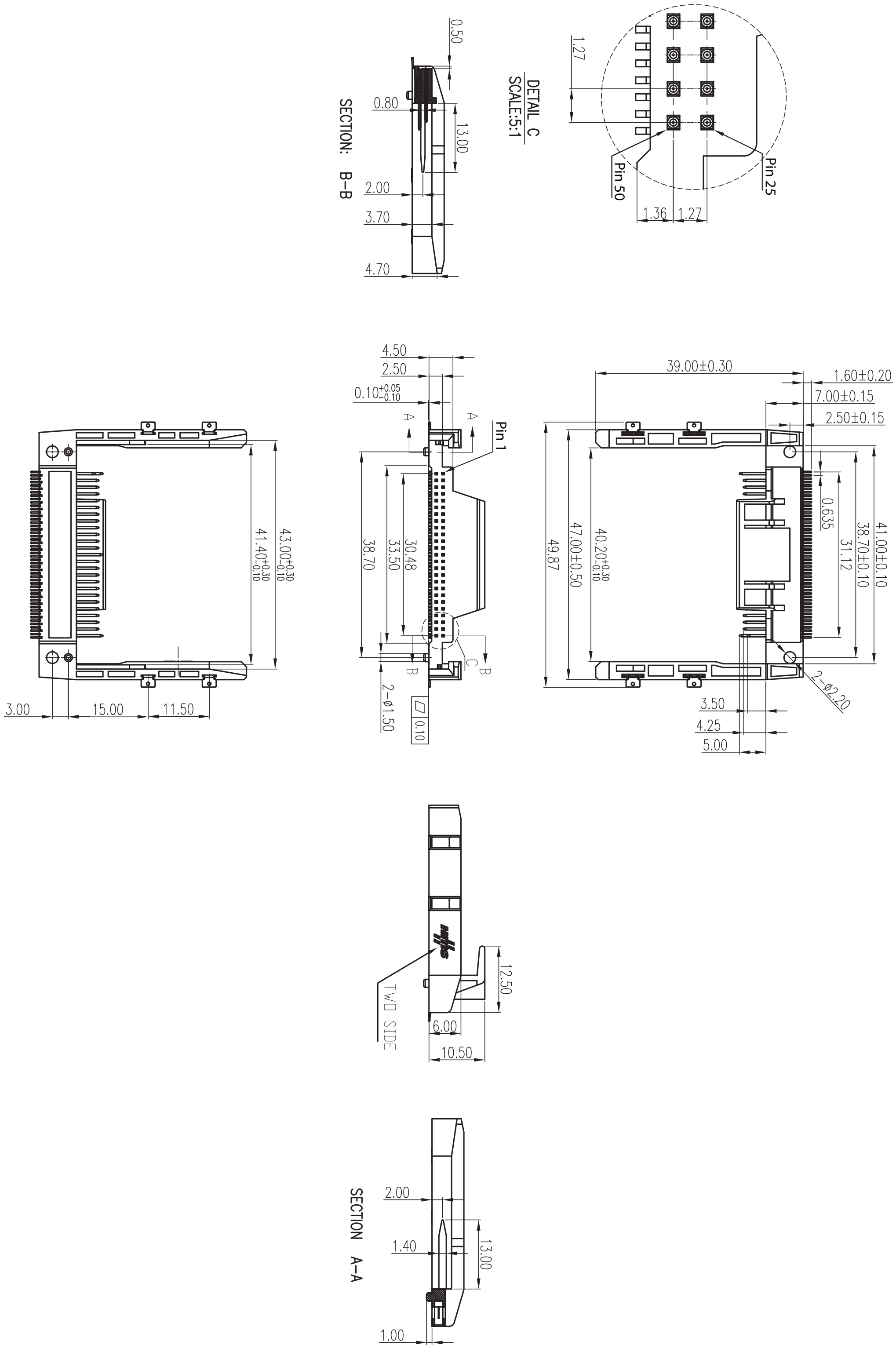


Please note that it is recommended to drill oval holes in the PCB, to enable usage of other connectors.
Warning: Always verify that the dimensions of another connector is compatible with this design.

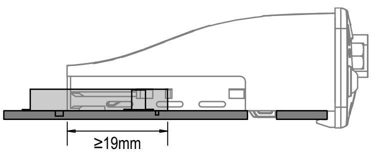
Manufacturer	Part No.	Web
HMS Industrial Networks	SP1137	For more information visit the support pages for Anybus CompactCom 30 at www.anybus.com

The measurements of the connector are presented in the figure below.

Note: To ensure that you receive the correct measurements for the latest version of the connector, please consult the support pages at www.anybus.com, where you will find all the latest available information for the connector.



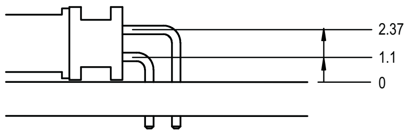
B.6.1 Host Connector Considerations



When using other connectors, the following needs to be considered:

To prevent incorrect insertion and to ensure that the grounding mechanics work as intended, use connectors with guiding rails of sufficient length (preferably longer than 19 mm), or provide an equivalent mechanical solution.

The distance of the connectors to the PCB has to conform to the picture below:



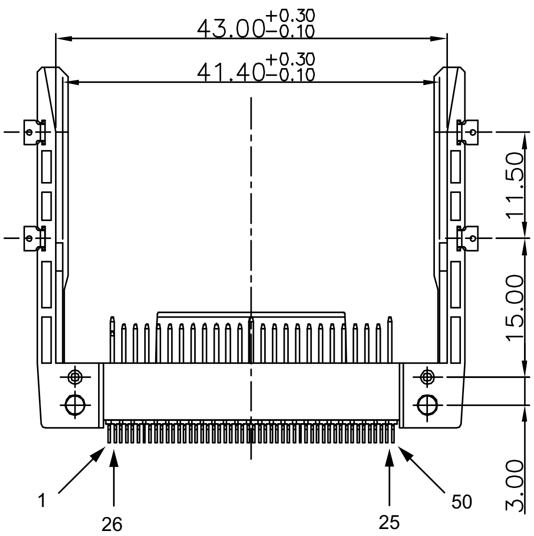
It is recommended to use connectors which can be screwed into the host application board, to minimize mechanical strain on solder joints etc.

The following connectors have been verified for use with the Anybus CompactCom:

Manufacturer	Part No.	Web
Tyco	1734451-1	www.tycoelectronics.com
AllConnectors	101D-TAAB-R	www.allconnectors.de
Suyin	127531MB050XX04NA	www.suyin.com, www.suyin-europe.com, www.suyinusa.com
Harwin	M504-8815042 M504-88 25042	www.harwin.com ***Note**: The dimensions of the holes for the fixing pins of this connector is 1.8 mm, i.e. slightly larger than the dimensions given in the figure above.*

B.6.2 Host Connector Pin Numbering

The surface mounted pins of the compact flash connector are numbered from left to right (see figure below), corresponding to pin numbers 1, 26, 2, 27...... 25, 50 of the host interface connector, see "Host Interface Signals" on page 10.



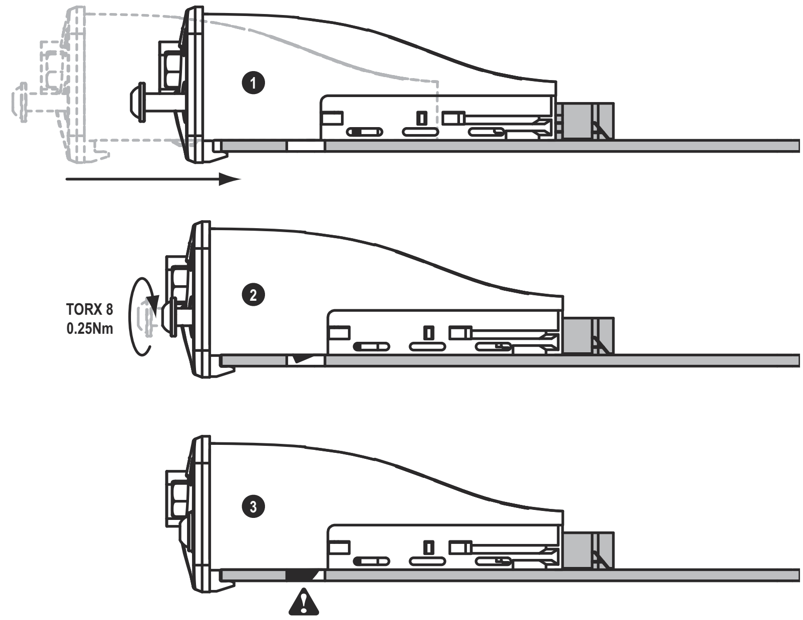
Bottom view of the host connector

B.7 Fastening Mechanics

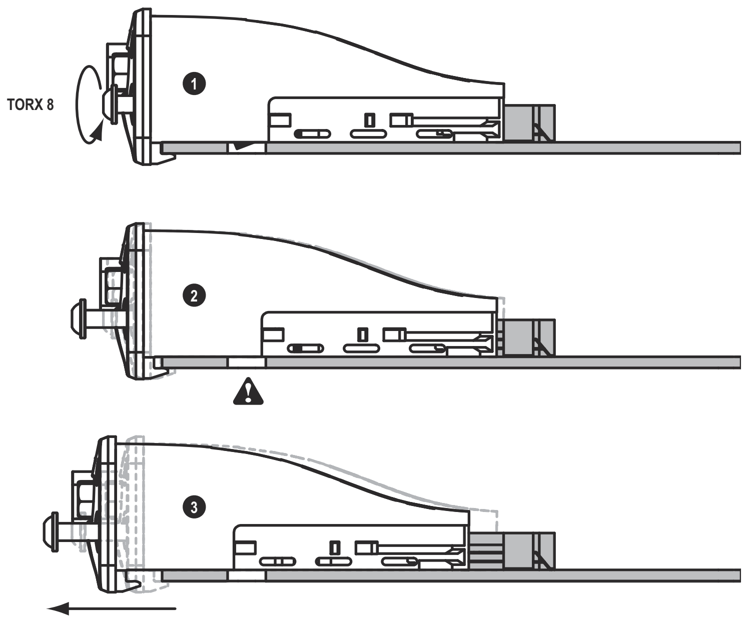
Note 1: To support the fastening mechanism, the host application PCB <u>must</u> be 1.60 (±10%) mm thick.

Note 2: Recommended terminal tightening torque is 0.25 Nm.

Fastening



Removal



IMPORTANT: *When fastening the module into the end product, make sure that the Anybus module is properly aligned into the CompactFlash socket prior to applying any force. Rough handling and/or excessive force in combination with misalignment may cause mechanical damage to the Anybus CompactCom module and/or the end product.*

C. Technical Specification

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

C.1 Environmental

Operating temperature

Active modules: -40 to 70°C (-40 to 158°F)
Passive modules: -40 to 70°C (-40 to 158°F)

(Tests performed according to IEC 60068-2-1 and IEC 60068-2-2)

Storage temperature

Active modules: -40 to 85°C (-40 to 176°F)
Passive modules: -40 to 85°C (-40 to 176°F)

(Tests performed according to IEC 60068-2-1 and IEC 60068-2-2)

Humidity

Active modules: 5 to 95% non-condensing
Passive modules: 5 to 95% non-condensing

(Tests performed according to IEC 60068-2-30)

C.2 Shock and Vibration

- Shock test, operating IEC 68-2-27 half-sine 30g, 11 ms, 3 positive and 3 negative shocks in each of three mutually perpendicular directions
- Shock test, operating IEC 68-2-27 half-sine 50g, 11 ms, 3 positive and 3 negative shocks in each of three mutually perpendicular directions
- Sinusoidal vibration, operating IEC 68-2-6 10-500 Hz, 0.35 mm, 5g, 1oct/min., 10 double-sweep in each of three mutually perpendicular directions.

C.3 Electrical Characteristics

Operating Conditions

Symbol	Parameter	Pin Types	Conditions	Min.	Typ.	Max.	Unit
V_{DD}	Supply Voltage (DC)	PWR	-	3.15	3.30	3.45	V
	Ripple (AC)			-	-	± 100	mV
V_{SS}	Ground reference			0.00	0.00	0.00	V
I_{IN}	Current consumption[a]		Class A	-	-	250	mA
			Class B	-	-	500	mA
			Class C	-	-	1000	mA
V_{IH}	Input High Voltage	I, BI	-	0.7 x V_{DD}	-	V_{DD} + 0.2	V
V_{IL}	Input Low Voltage			-0.2	-	0.2 x V_{DD}	V
I_{OH}	Current, Output High	O, BI	-	-4.0	-	4.0	mA
I_{OL}	Current, Output Low						
V_{OH}	Output High Voltage		I_{OH} = -4mA	2.4	-	-	V
V_{OL}	Output Low Voltage		I_{OL} = 4mA	-	-	0.4	V

a. See also A-27 "Power Supply Considerations"

I = Input, CMOS (3.3V)
O = Output, CMOS (3.3V)
BI = Bidirectional, Tristate
PWR = Power supply inputs

Isolation

Isolation distances for PCB between host, network, and PE (according to EN 60950-1; Pollution Degree 2; Material Group IIIb):

Isolation Barrier	Working Voltage/Transient Voltage		Distance	
	Creepage	Clearance	External	Internal
Host to PE	250V/2500V	250V/2500V	2.5mm	0.4mm
Host to Network	250V/2500V	250V/2500V	2.5mm	0.4mm

Protective Earth & Shielding

All Anybus CompactCom modules features a cable shield filter designed according to each network standard. To be able to support this, the host application *must* have a conductive area connected to protective earth as described in B-29 "Mechanical Specification" (PE Connection Pad).

HMS cannot guarantee proper EMC behavior unless this requirement is fulfilled.

C.4 Regulatory Compliance

EMC Compliance (CE)

Since the Anybus CompactCom (ABCC) is considered a component for embedded applications, it cannot be CE-marked as an end product. However, the ABCC family is pre-compliance tested in a typical installation providing that all modules conforms to the EMC directive in that installation.

Once the end product has successfully passed the EMC test using any of the ABCC modules, the pre-compliance test concept allows any other interface of the same type (see 1-8 "Passive vs. Active") in the ABCC family to be embedded in that product without further EMC tests.

To be compliant to the EMC directive 2004/108/EC, the pre-compliance testing has been conducted according to the following standards:

- **Emission: EN61000-6-4**
  EN55011 Radiated emission
  EN55011 Conducted emission

- **Immunity: EN61000-6-2**
  EN61000-4-2 Electrostatic discharge
  EN61000-4-3 Radiated immunity
  EN61000-4-4 Fast transients/burst
  EN61000-4-5 Surge immunity
  EN61000-4-6 Conducted immunity

Since all ABCC modules have been evaluated according to the EMC directive through the above standards, this serve as a base for our customers when certifying ABCC-based products.

UL/c-UL Compliance

The certification has been documented by UL in file E214107.