Fox Thermal Instruments, Inc.

THERMAL MASS FLOW METER & TEMPERATURE TRANSMITTER

Model FT2A - Anybus: Profibus/DeviceNet/Modbus TCP Ethernet

FOX THERMAL INSTRUMENTS, INC.

www.foxthermalinstruments.com | 399 Reservation Road Marina, CA. 93933

105436
Rev. A

Notice

This publication must be read in its entirety before performing any operation. Failure to understand and follow these instructions could result in serious personal injury and/or damage to the equipment. Should this equipment require repair or adjustment beyond the procedures given herein, contact the factory at:

FOX THERMAL INSTRUMENTS, INC.
399 RESERVATION ROAD
MARINA, CA 93933
TELEPHONE: 831-384-4300
FAX: 831-337-5787
EMAIL: SERVICE@FOXTHERMALINSTRUMENTS.COM

Download Technical Data Sheets from our website:
www.foxthermalinstruments.com

Fox Thermal Instruments believes that the information provided herein is accurate however be advised that the information contained herein is NOT a guarantee for satisfactory results. Specifically, this information is neither a warranty nor guarantee, expressed or implied, regarding performance; merchantability; fitness; or any other matter with respect to the products; nor recommendation for the use of the product/process information in conflict with any patent. Please note that Fox Thermal Instruments, Inc. reserves the right to change and/or improve the product design and specification without notice.

FOX THERMAL INSTRUMENTS, INC.

Fox FT2A Manuals:

- **Model FT2A Instruction Manual**
- **Fox FT2A View™ Instruction Manual**
- **Fox FT2A Modbus and BACnet MS/TP Manual**

Table Of Contents

Introduction

Introduction

Scope
Thank you for purchasing the Model FT2A Thermal Gas Mass Flow meter and Temperature Transmitter from Fox Thermal Instruments. The Model FT2A is one of the most technically advanced flow meters in the world. Extensive engineering effort has been invested to deliver advanced features, accurate measurement performance and outstanding reliability.

This document describes how to connect and use the Profibus/DeviceNet/Modbus TCP Ethernet for the Model FT2A.

Description
The Model FT2A uses a pre-programmed Anybus-IC from HMS-Network to interface to Profibus, DeviceNet or Modbus TCP Ethernet.

Related Documents
Documentation for the Anybus-IC is available on the HMS-Networks Website at www.anybus.com/support. Select Anybus-IC to go to the support documentation. Design guides are available under any single chip selection.

The following documents can be downloaded from the Anybus Website:

- Single chip for Profibus, Design Appendix
- Single chip for DeviceNet, Design Appendix
- Single chip for Ethernet/IP and Modbus TCP, Design Appendix

Other related documents:

- Fox FT2A Instruction Manual
- Fox FT2A View™ Manual
- Fox FT2A Modbus/BACnet MS/TP Manual

Data Organization

Data Organization

Data Organization
Data from the FT2A is updated into the Anybus IC every 300 ms. Data is organized as a set of two 16 bit registers (32 bits) for data and one 16 bit register for status. Table 2.1 defines the FT2A registers.

Table 2.1: FT2A Registers

Byte	Modbus Address	Data Type	Scaling	Comment
00 01 02 03	30001 30002	Flow in Eng units (low register, MSB) Flow in Eng units (low register, LSB) Flow in Eng units (high register, MSB) Flow in Eng units (high register, LSB)	No	Mass flow in selected units
04 05 06 07	30003 30004	Total (low register, MSB) Total (low register, LSB) Total (high register, MSB) Total (high register, LSB)	No	Total in selected units
08 09 10 11	30005 30006	Temperature (low register, MSB) Temperature (low register, LSB) Temperature (high register, MSB) Temperature (high register, LSB)	X 10	Temperature in selected units X 10 (Times ten) High register in not used
12 13 14 15	30007 30008	Elapsed time (low register, MSB) Elapsed time (low register, LSB) Elapsed time (high register, MSB) Elapsed time (high register, LSB)	X 10	Elapsed time in hours X 10 (Times ten)
16 17 18 19	30009 30010	Velocity (low register, MSB) Velocity (low register, LSB) Velocity (high register, MSB) Velocity (high register, LSB)	No	Velocity in nm/hr
20 21	30011	Status (low register, MSB) Status (low register, LSB)	No	Status/Alarm
22 23	30012	Flow *100 (low register, MSB) Flow *100 (low register, LSB)	X 100	Flow X 100
24 25	30013	Total *100 (low register, MSB) Total *100 (low register, LSB)	X 100	Total X 100

Note: Items 22/23 and 24/25 are only used for low flow and total to obtain more precision. Velocity can be used to obtain flow rate in engineering units using pipe area and unit conversion factor.

Data Organization

Status Bits

Table 2.2: Status Bits Definitions

Bit	Definition	Comment
0	Power up indication	Reset when out of the power up sequence
1	Flow rate reached high limit threshold	Set limit to zero to disable
2	Flow rate reached low limit threshold	Set limit to zero to disable
3	Temperature reached high limit threshold	Set limit to zero to disable
4	Temperature reached low limit threshold	Set limit to zero to disable
5	Sensor reading is out of range	Check sensor wiring
6	Velocity flow rate outside of calibration table	Check sensor wiring
7	Incorrect Settings	Check settings
8	In simulation mode	Set simulation value to 0 to disable
9	Frequency output is out of range	Check frequency output settings
10	Analog 4-20 mA for flow is out of range	Check analog output settings
11	Analog 4-20 mA for temperature is out of range	Check analog output settings
12	Anybus error	Check wiring from RS485 to Anybus IC
13	Bridge Shut Down	Check sensor wiring
14	EEPROM CRC error	Check parameters and reset CRC
15	Totalizer Error Detected	Reset the total

Control

One control register is used to reset the total and elapsed time. Data for that register must be set to 0x02 to reset the total. Only a transition from a 0 to 2 will clear the total. Keeping that bit set will not continuously clear the total. This register needs to be cleared after the reset operation.

Wiring: Profibus

Profibus Wiring

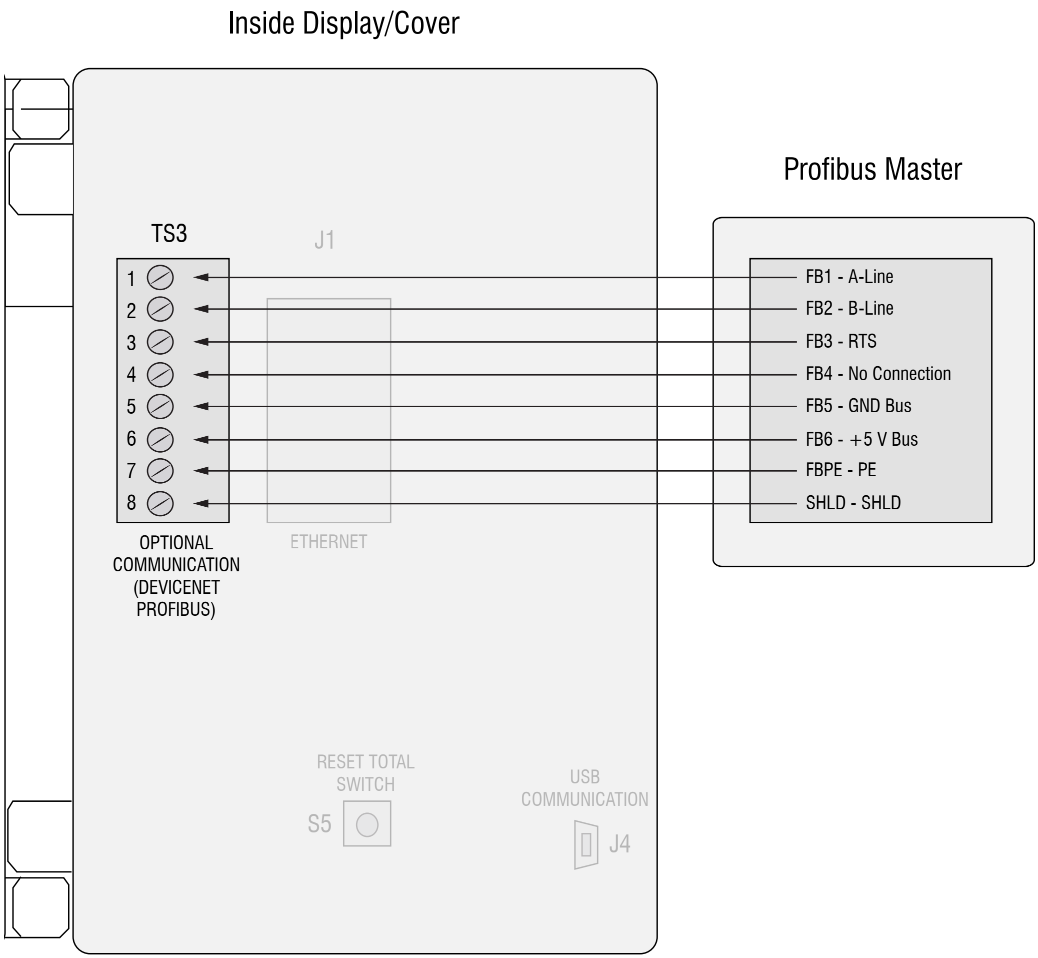
Profibus Wiring from Master

Wiring connections are made to terminal block TS3 for Profibus communication. The following lists the wiring connections.

Display board Connector TS3:

• FB1	A-Line
• FB2	B-Line
• FB3	RTS
• FB4	NC (NC = No Connection)
• FB5	GND BUS
• FB6	+5 V BUS
• FBPE	PE
• SHIELD	NC

Fig. 3.1: Profibus Wiring and Configuration



Configuration: Profibus

Profibus Configuration

Baud Rate - Profibus
The Module supports all standard baud-rates from 9600 bps to 12 Mbps, according to the Profibus specification. The Anybus-IC PDP supports automatic baud rate detection, which means that the actual baud rate is only configured in the Profibus Master.

Configuration File - Profibus
A GSD configuration file is needed by the master and is available from the HMS-Networks Website under the AnyBus-IC/Profibus selection.
An example of the file is included for reference as Attachment A.

http://www.anybus.com/support/support.asp?PID=88&ProductType=AnyBus-IC

Profibus Functions
The following functions are not supported with the Standard GSD-file:

User Parameter Data (Set_Prm).

Extended Diagnostic Data (Slave_Diag).

ID Number - Profibus
The Standard AnyBus-IC Profibus ID number is 1810h. This ID number is related to the GSD file. If the AnyBus IC PDP is to be customized with other functions or names, a new ID-number must be used (ordered from the Profibus organization).

Wiring: DeviceNet

DeviceNet Wiring

DeviceNet Wiring from Master

Wiring connections are made to terminal block TS3 for DeviceNet communication. The following lists the wiring connections.

Display board Connector TS3:

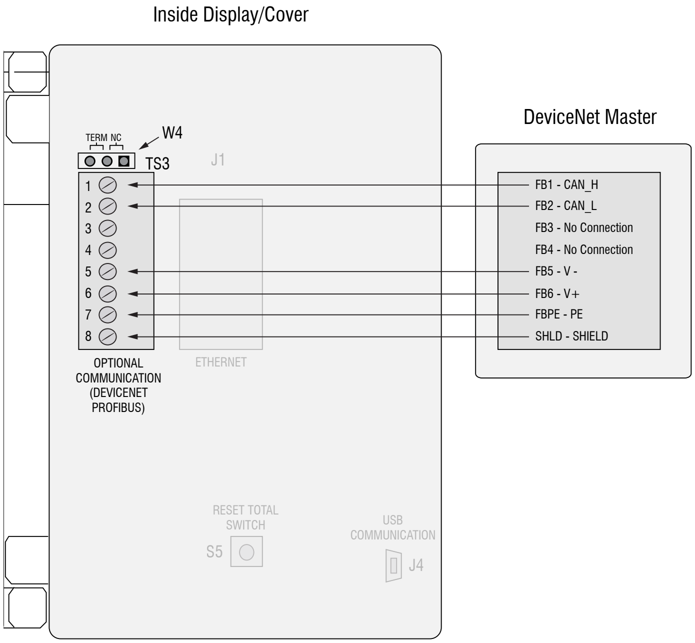
- FB1 CAN_H
- FB2 CAN_L
- FB3 NC
- FB4 NC
- FB5 V- (GND)
- FB6 V+ (24 Volt DC)
- FBPE PE
- SHIELD SHIELD

CAN-H and CAN-L Termination Resistor

Connect a termination resistor across the receive/transmit signals of the last device on the DeviceNet communication line. To connect the 120 ohm termination resistor on the FT2A, set jumper W4 to the TERM position.

The termination resistor of the FT2A is disconnected by setting jumper W4 to the NC (Not Connected) position.

Fig. 3.2: DeviceNet Wiring from Master



Configuration: DeviceNet

DeviceNet Configuration

Baud Rate - DeviceNet
Automatic baud rate detection is not supported. The baud rates that are supported by the Anybus-IC DeviceNet are:

125 kbps
250 kbps
500 kbps

Configuration File - DeviceNet
Electronic Data Sheet (.EDS)
An EDS configuration file used by the master, it can be downloaded from the HMS-Networks Website under the Anybus-IC and DeviceNet selection.
An example of the file is included for reference as Attachment B.

http://www.anybus.com/support/support.asp?PID=88&ProductType=Anybus-IC or a quick Google search for Anybus-IC.

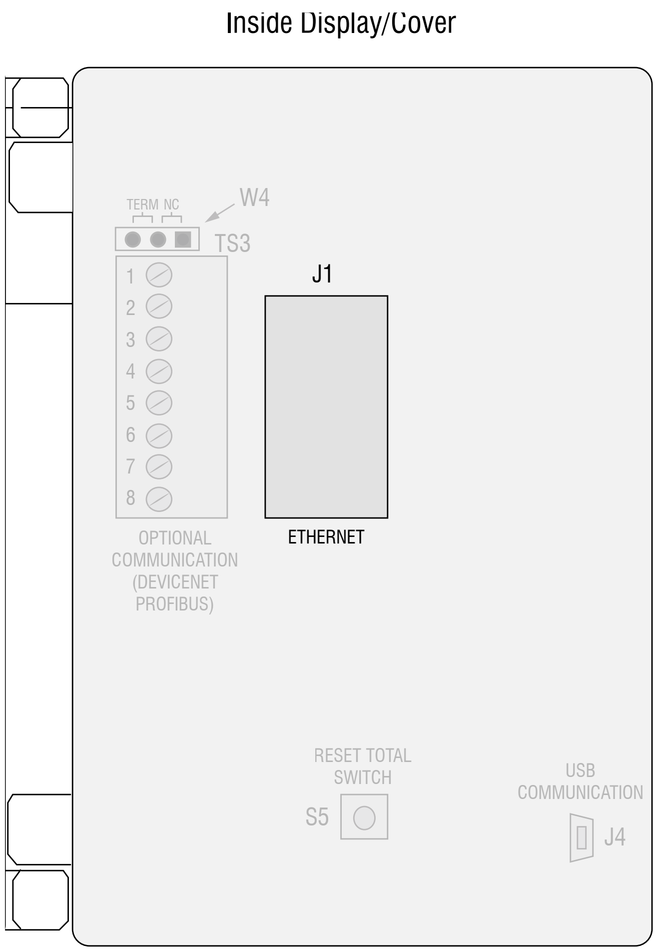
Wiring: Ethernet

Ethernet Wiring

Ethernet Wiring

Connection to the network is accomplished by simply connecting to the Ethernet connector mounted on the local display board (J1). If you are connecting directly to a PC, you will need a crossover Ethernet cable.

Fig. 3.3: Ethernet Connector Location



Configuration: Ethernet

Ethernet Configuration

Manual IP Address Configuration
Set the rotary switch setting to any desired position except zero. The IP address will be set to 192.168.0.x, where x is the setting on the 2 digits of the rotary switches.

Automatic IP Address Configuration
Set the rotary switches to zero. The Anybus chip has been programmed for DHCP.

The control register for Ethernet is at address zero.

The Anybus-IC offers many other ways to operate. See the Anybus-IC Design Guide. Programming of the Anybus-IC can be accomplished by connecting a PC with a terminal emulator to the P2 connector on the local display with a special Fox adapter board. The Anybus document can be downloaded from the web at the following link :
http://www.anybus.com/support/support.asp?PID=88&ProductType=Anybus-IC or a quick Google search for Anybus-IC.

Configuring the FT2A Ethernet IP with a Fixed Address
Set rotary IP address switches located on the local display board to an address (i.e. 2, sw1=2, sw2=0)
Cycle the power and connect a cross-over Ethernet cable to a PC.

Note: Some PC/laptops can use a straight cable as they detect and switch the lines automatically.

Open the web browser and enter 192.168.0.2 for the address and press enter. The HMS Configurator should now be displayed. If not, check the cable and the switch settings. (Addresses other than 2 may be used).

- Enter the IP address, Subnet mask and the gateway address in the HMS Configurator.
- Uncheck “DHCP Enable” box.
- Click on “Save Configuration”.
- Reset the rotary IP switch address to 0 (sw1=0, sw2=0).
- Cycle the power and connect a straight Ethernet cable to the network.
- Ping the device with the IP address entered to verify the communication link.

Configuration: Ethernet

Ethernet Configuration

Protecting Access to FT2A HMS Configurator for Ethernet IP
Access to the HMS Configurator can be protected by creating a file containing user names and passwords and storing it in the FT2A Anybus root directory as specified in section 6-2 of the HMS Anybus Ethernet manual (see note below for manual downloads). The file can be created using Notepad or any other text editor.

For example:

User1:1234
User2:5678

Using Windows Explorer or any FTP program, transfer the file that you just created into the FT2A Anybus root directory (See section 4-2 of the HMS Ethernet manual). First connect to the FT2A by opening Windows Explorer and replace the address with "FTP://xxx.xxx.xxx.xxx (where x is the IP address) and press return. Windows explorer should now show the content of the specified FT2A Anybus directory. Highlight the file that was created and drag it into the folder that has the IP address.

Slave Address
The Slave Address is set using the two BCD rotary switches. Address can be set from 0 to 99, for the Profibus/Modbus TCP Ethernet and from 0 to 63 for the DeviceNet. Power needs to be cycled before the settings take effect. Rotary switch SW1 controls the low digit address, SW2 the high digit address (ie SW1=5, SW2=6, Address=65).

Note: Links to HMS Manual Downloads

http://www.anybus.com/products/abic.shtml

Ethernet:
http://www.hms.se/upload/90-9118-ABIC-EIP_1_56_ROHS_SCM_1200_055.pdf
Ethernet

Profibus:
http://www.hms.se/upload/88-2310-Anybus-IC_PROFIBUS_2_00_SCM-1200-022.pdf

DeviceNet:
http://www.hms.se/upload/89-7638-Anybus-IC_DeviceNet_user_manual.pdf

LED Indicators

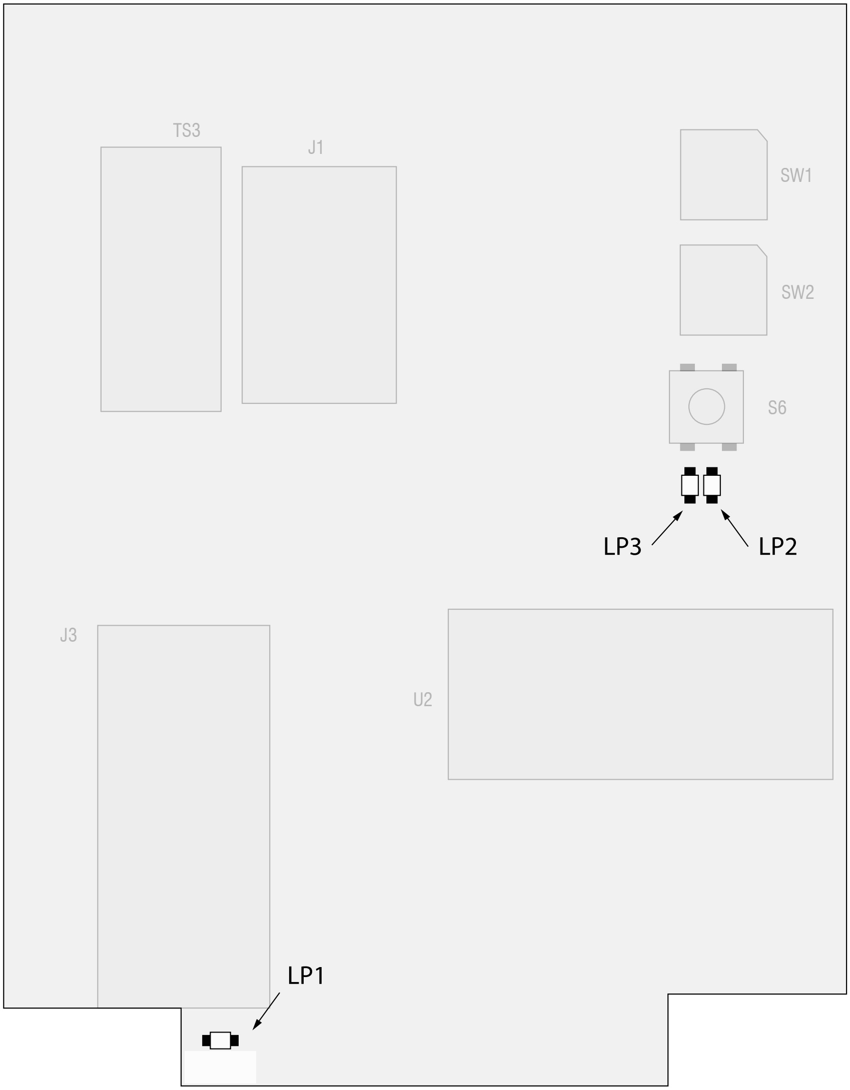
LED Indicators

LED's

The local display board with the Anybus-IC option provides 3 LED's with the following functionality:

- LP1, Green LED: Flashes at 1 Hz indicating normal local display operation
- LP2, Green LED: Showing green when Fieldbus communication/ connection is working properly
- LP3, Red LED: Showing red when Fieldbus communication/connection is not working properly.

Fig. 4.1: LED Locations



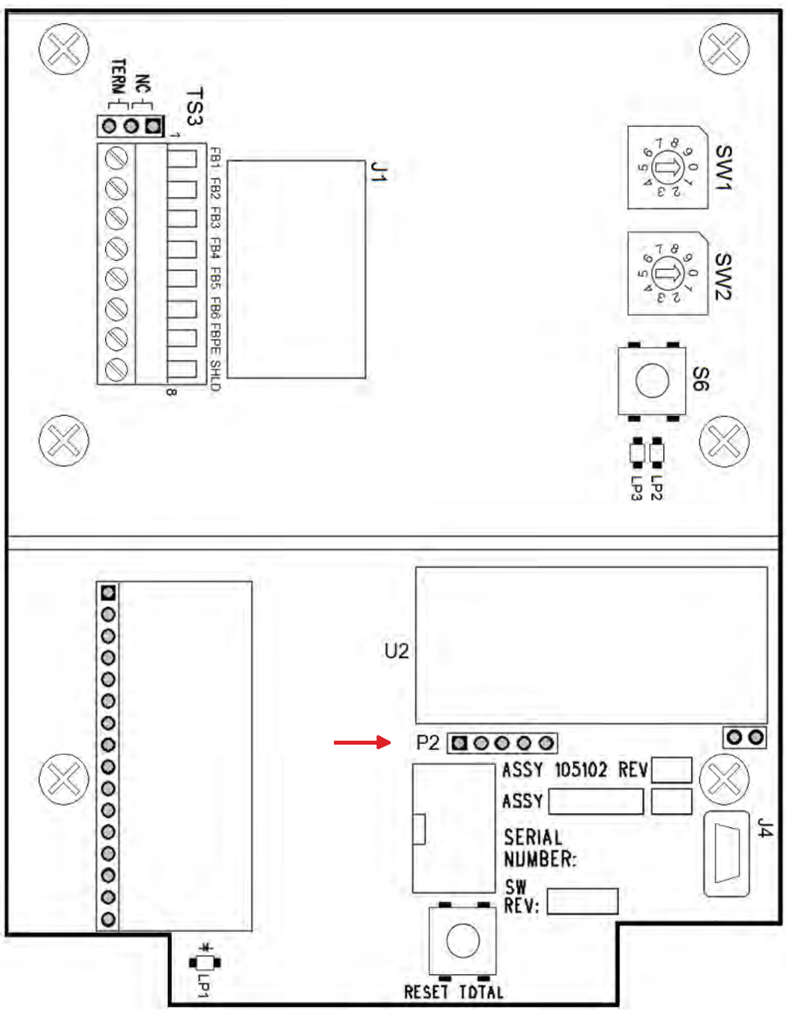
Programming

Anybus Chip Programming

Anybus Chip Programming
The Anybus chip (U2) is shipped pre-programmed. If an AnyBus-IC PDP is used in a customer-specific implementation, the Profibus ID-number and the GSD-file must be changed to match the new implementation. This can be accomplished using a terminal emulator (like "Hyperterminal") through a serial or USB interface to connector P2 (see Fig. 5.1). A special cable is available from FOX. HyperTerminal communication parameters should be set to 9600 Baud, 8 Bits, 1 Stop bit. Refer to the Anybus documentation for programming.

Note: After changing parameters for the Anybus Chip from the local display (i.e baudrate, bus type) the FT2A needs to have the power cycled OFF and back ON twice before the changes can take effect.

Fig. 5.1: Anybus Circuitry



Appendices

Attachment A

APPENDICES

Attachment A

AnyBus_Profibus.gsd

```
;==========================================================================
; Profibus Device Database of HMS Industrial Networks AB
; Model : ANYBUS-IC PDP
; Description : ANYBUS-IC Profibus DP slave
; Language : English
; Date : 30 September 2003
; Author : HMS Industrial Networks AB
;
; MODIFICATIONS:
; 30 September 2003:
; - 'MaxTsdr_xxx' for all baudrates have been optimized for the SPC3 ASIC.
; - 'Revision' upgrade
; - 'Hardware_Release' upgrade
; - 'Software_Release' upgrade
;==========================================================================
#Profibus_DP

GSD_Revision            = 2

; Device identification
Vendor_Name             = "HMS Industrial Networks AB"
Model_Name              = "AnyBus-IC PDP"
Revision                = "Version 1.1"
Ident_Number            = 0x1810
Protocol_Ident          = 0            ; DP protocol
Station_Type            = 0            ; Slave device
FMS_supp                = 0            ; FMS not supported
Hardware_Release        = "Version 1.1"
Software_Release        = "Version 1.1"

;Used bitmap
Bitmap_Device  = "ABIC_DE"
Bitmap_Diag    = "ABIC_DI"
Bitmap_SF      = "ABIC_SF"
```

Appendices

Attachment A

```
; Supported baudrates
9.6_supp        = 1
19.2_supp       = 1
45.45_supp      = 1
93.75_supp      = 1
187.5_supp      = 1
500_supp        = 1
1.5M_supp       = 1
3M_supp         = 1
6M_supp         = 1
12M_supp        = 1

; Maximum responder time for supported baudratesMaxTsdr_9.6 = 15
MaxTsdr_19.2          = 15
MaxTsdr_45.45         = 15
MaxTsdr_93.75         = 15
MaxTsdr_187.5         = 15
MaxTsdr_500           = 15
MaxTsdr_1.5M          = 25
MaxTsdr_3M            = 50
MaxTsdr_6M            = 100
MaxTsdr_12M           = 200

; Supported hardware features
Redundancy            = 0          ; not supported
Repeater_Ctrl_Sig     = 2          ; TTL
24V_Pins              = 0          ; not connected
Implementation_Type   = "SPC3"

; Supported DP features
Freeze_Mode_supp      = 1          ; supported
Sync_Mode_supp        = 1          ; supported
Auto_Baud_supp        = 1          ; supported
Set_Slave_Add_supp    = 1          ; supported

; Maximum polling frequency
Min_Slave_Intervall   = 1          ; 100 us

; Maximum supported sizes
Modular_Station       = 1          ; modular
```

Appendices

Attachment A

```
Max_Module          = 24
Max_Input_Len       = 48
Max_Output_Len      = 48
Max_Data_Len        = 96
Modul_Offset        = 1

Fail_Safe           = 1            ; Data telegram without data in state
CLEAR accepted

Slave_Family        = 0
Max_Diag_Data_Len   = 6

; Definition of modules
Module = "IN/OUT:   1 Byte" 0x30
EndModule
;
Module = "IN/OUT:   2 Byte ( 1 word)" 0x70
EndModule
;
Module = "IN/OUT:   4 Byte ( 2 word)" 0x71
EndModule
;
Module = "IN/OUT:   8 Byte ( 4 word)" 0x73
EndModule
;
Module = "IN/OUT:   16 Byte ( 8 word)" 0x77
EndModule
;
Module = "IN/OUT:   32 Byte (16 word)" 0x7F
EndModule
;
Module = "INPUT:    1 Byte" 0x10
EndModule
;
Module = "INPUT:    2 Byte ( 1 word)" 0x50
EndModule
;
Module = "INPUT:    4 Byte ( 2 word)" 0x51
EndModule
;
```

Appendices

Attachment A

```
Module = "INPUT:    8 Byte ( 4 word)" 0x53
EndModule
;
Module = "INPUT:    16 Byte ( 8 word)" 0x57
EndModule
;
Module = "INPUT:    32 Byte (16 word)" 0x5F
EndModule
;
Module = "OUTPUT:   1 Byte" 0x20
EndModule
;
Module = "OUTPUT:   2 Byte ( 1 word)" 0x60
EndModule
;
Module = "OUTPUT:   4 Byte ( 2 word)" 0x61
EndModule
;
Module = "OUTPUT:   8 Byte ( 4 word)" 0x63
EndModule
;
Module = "OUTPUT:   16 Byte ( 8 word)" 0x67
EndModule
;
Module = "OUTPUT:   32 Byte (16 word)" 0x6F
EndModule
```

Attachment B

Attachment B

89-0754-EDS_ABIC_DEV_3_1.EDS

```
[File]
    DescText = "HMS Anybus-IC DEV";
    CreateDate = 11-22-2001;
    CreateTime = 07:23:00;
    ModDate = 03-14-2007;
    ModTime = 14:30:00;
    Revision = 3.1;
[Device]
    VendCode = 90;
```

Appendices

Attachment B

```
    VendName = "HMS Networks";
    ProdType = 12;
    ProdTypeStr = "Communications Adapter";
    ProdCode = 61;
    MajRev = 3;
    MinRev = 1;
    ProdName = "Anybus-IC DeviceNet";
    Catalog = "Anybus-IC DeviceNet";

    DNetQC =
        0x0001,        $ Quick Connect supported at Powerup
        265;           $ 265 ms Powerup time

[IO_Info]
    Default = 0x0001;          $ Default IO Connection = Poll

    PollInfo =
        0x000F, $ Compatible IO type mask = All connections
        1, $ Input1
        1; $ Output1

    StrobeInfo =
        0x000F, $ Compatible IO type mask = All connections
        1, $ Input1
        1; $ Output1

    COSInfo =
        0x0007, $ Compatible IO type mask = All connections
        1, $ Input1
        1; $ Output1

    CyclicInfo =
        0x000B, $ Compatible IO type mask = All connections
        1, $ Input1
        1; $ Output1

Input1 =
        1, $ 1 byte
        0, $ All bits are significant
        0x000F, $ Compatible IO type mask = All connections
```

Appendices

Attachment B

```
        "ABIC Produce", $ Name
        6, $ Path size
        "20 04 24 64 30 03", $ Assembly object, Inst 100, Attr 3
        "Data produced by the Anybus-IC";

    Output1 =
        1, $ 1 byte
        0, $ All bits are significant
        0x000F, $ Compatible IO type mask = All connections
        "ABIC Consume", $ Name
        6, $ Path size
        "20 04 24 96 30 03", $ Assembly object, Inst 150, Attr 3
        "Data consumed by the Anybus-IC ";


[ParamClass]
    MaxInst = 0; $ Max Instances - total # configuration parameters
    Descriptor = 0x0000; $ Parameter Class Descriptor - No parameters
    CfgAssembly = 0; $ The config assembly is not supported.
```

Definitions

Glossary of Terms and Definitions

EDS	Electronic Data Sheet
IP	Internet Protocol
PC	Personal Computer
TERM	Termination Resistor

Index

Index

Information

Caution

Wiring

Definition of Terms

Troubleshooting Tips