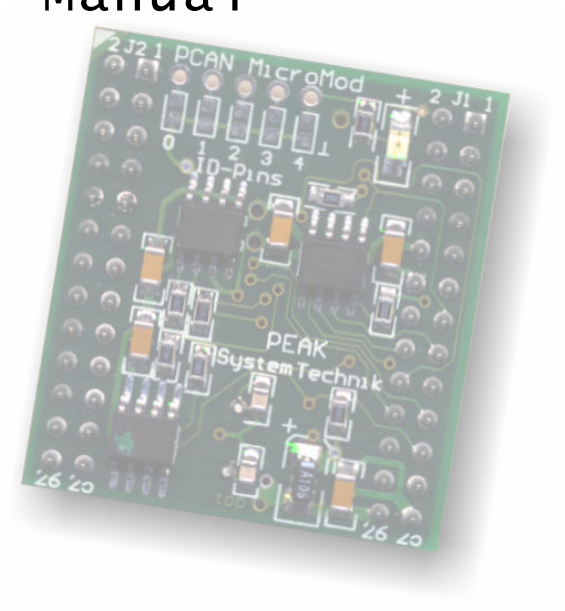
PCAN-MicroMod

Universal I/O Module with CAN Interface

User Manual



PEAK System

Products taken into account

Product Name	Item Number	Model
PCAN-MicroMod	IPEH-002080	Firmware 1.3c

Last Updates

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- Text corrections

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1 Introduction

The PCAN-MicroMod is designed for quick and easy access to distributed I/O systems. Its kernel is the microcontroller MB90-F497 from Fujitsu. With an integrated CAN bus controller and the analog and digital inputs and outputs it is an inexpensive solution for small, intelligent nodes.

The firmware available at delivery allows you to completely configure the MicroMod via CAN by creating a configuration with a graphical user interface on your PC and then sending this configuration to the module.

You can also use an alternative firmware (e.g. for the operation under CANopen) or create own programs for the integrated microcontroller.

Note: The functionality described in this manual refers to the standard firmware available with delivery. For the operation with an alternative firmware please study the corresponding documentation. See also chapter 6 *New/Alternative Firmware* starting on page 17.

1.1 Properties at a Glance

PCAN-MicroMod

- Strips for piggyback connection
- 8 digital inputs, TTL levels
- 8 digital outputs, TTL levels
- 8 analog inputs, 10 bit, reference 5 V
- 4 PWM or 2 frequency outputs with a range of 1 Hz to 10 kHz

- CAN connection via transceiver Philips 82C251

Standard firmware

- Up to 32 MicroMods addressable for configuration within a CAN (regardless of that: normal operation with CAN IDs)
- Transmission of CAN messages periodically or at level change of a digital input
- Logical connective of digital inputs
- Adaptation of analog quantities through characteristic curves
- Direct transfer of analog quantities onto CAN-IDs
- Direct support of rotary encoders

1.2 Scope of Supply

The scope of supply normally consists of the following parts:

- PCAN-MicroMod
- User manual
- Configuration software (running under Windows 98 SE, ME, 2000, XP)

1.3 Special Prerequisites for the Operation

The following prerequisites must be given, so that the PCAN-MicroMod can be used properly:

- Circuit board with socket strips for plugging the PCAN-MicroMod on (e.g. the Evaluation Board or a so-called Motherboard which also is offered by PEAK-System)
- For configuring the MicroMod via CAN: Windows PC with a PC/CAN adapter of the PCAN series (latter is part of supply of the Evaluation Kit)

2 Hardware Settings

On its upper side the PCAN-MicroMod has five positions for solder bridges (indicated by the labels 0 to 4) for setups of different functions depending on the used firmware. With delivery of the MicroMod version described in this manual the solder bridges are used for setup of a module number. This is described more precisely in the following subsection. With the optional CANopen firmware other functions are assigned to the individual positions (see user manual for the CANopen firmware).

2.1 Setting Up the Module Number

The module number is used for the identification of a single MicroMod at the CAN bus, when configurations are sent and received. The MicroMod doesn't use the module number for the reception or transmission of data during normal operation. In the delivery state the MicroMod has the module number 0 (no solder bridge set).

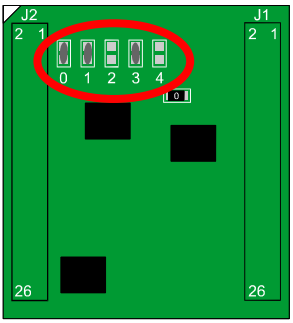

Figure 1: Solder bridge positions on the MicroMod

The module number is put together as follows: Each solder bridge position represents a bit of a binary number (position closed by

solder bridge = bit set). Position 0 is the LSB and position 4 the MSB of this number. Since there are five bits, module numbers between 0 and 31 can be set.

Solder bridge position	0 (LSB)	1	2	3	4 (MSB)
Binary digit	00001	00010	00100	01000	10000
Decimal equivalent	1	2	4	8	16

Example:
In Figure 1 solder bridges are on positions 0, 1, and 3. The corresponding binary number is 01011b (reversed order of positions) being equivalent to decimal 11, the module number.

To do it the other way around: If you like to assign the module number 22 to a MicroMod, you would do following steps:

1. 22 = 1·16 + 0·8 + 1·4 + 1·2 + 0·1 = 10110b
2. MSB (position 4) ⇨ 10110 ⇦ LSB (position 0)
3. Solder bridges to be set: 1, 2, 4 (0 and 3 stay open)

Note: Every MicroMod connected to one CAN bus should have a unique module number. Although it wouldn't be a problem during normal operation to have two or more MicroMods with same module number (CAN messages don't have a specific target address), unpredictable results could occur during configuration of those MicroMods.

2.2 Disconnecting the HS-CAN Transceiver

If you want to use a CAN communication protocol other than High-speed CAN (HS-CAN), the CAN signals from the microcontroller (CAN-RxD, CAN-TxD) may directly be routed to the wanted CAN transceiver. However, in this case the HS-CAN transceiver must be disconnected from the data transfer. This is done by interrupting the RxD line between the microcontroller and the HS-CAN transceiver

on the MicroMod. For this you must unsolder the 0-Ohm resistor on the MicroMod (below and right to the label „4“).

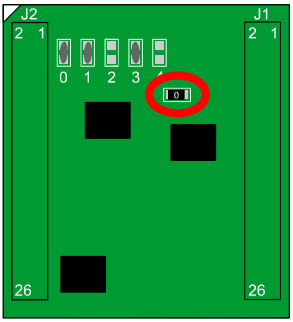

Figure 2: Position of the 0-Ohm resistor
(RxD line to the HS-CAN transceiver)

If you want to use the HS-CAN transceiver on the MicroMod later on, just make a solder bridge at the mentioned position.

3 Connection

The PCAN-MicroMod has two double strips (J1, J2) for connection, each with 26 pins (first column of the following table). Therefore the MicroMod easily can be plugged onto a mother board with corresponding socket strips (either a board from the product line of PEAK-System or a proprietary development). For better orientation during the connection procedure the MicroMod has a white marker on the upper left corner (pin J2:2).

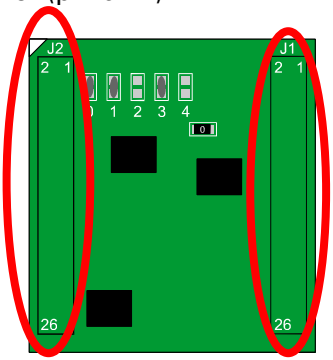

Figure 3: Connection strips
and positioning marker (upper left corner)

In the second column of the table the corresponding pin of the microcontroller is listed, if a direct connection to the MicroMod pin exists.

Pin MicroMod	Pin µC	Name	Function
J1:1	4	AIN 1	Input Analog, 10 bits, 0 to Vref
J1:2	3	AIN 0	Input Analog, 10 bits, 0 to Vref
J1:3	6	AIN 3	Input Analog, 10 bits, 0 to Vref
J1:4	5	AIN 2	Input Analog, 10 bits, 0 to Vref
J1:5	8	AIN 5	Input Analog, 10 bits, 0 to Vref
J1:6	7	AIN 4	Input Analog, 10 bits, 0 to Vref
J1:7	10	AIN 7	Input Analog, 10 bits, 0 to Vref
J1:8	9	AIN 6	Input Analog, 10 bits, 0 to Vref
J1:9	12	Vref	Reference Voltage Analog 2.7 to 5 V
J1:10	11	Avcc	Power Supply Analog
J1:11	24, 49	GND	Ground Digital
J1:12	13	AGND	Ground Analog
J1:13	63	CAN-TxD	CAN Transmit, TTL
J1:14	64	CAN-RxD	CAN Receive, TTL
J1:15		CAN_H	Differential HS-CAN Signal CAN_H
J1:16		CAN_L	Differential HS-CAN Signal CAN_L
J1:17	62	TxD	Serial V24 Transmit
J1:18	60	RxD	Serial V24 Receive
J1:19	51	SCL (SPI or I2C)	Serial Clock, function dependent on firmware
J1:20	50	SDO (SPI) or SDA (I2C)	Serial Data Out, Serial Data
J1:21	19	Reset_In	Reset, low-active
J1:22	52	SDI (SPI)	Serial Data In
J1:23	18	M0	Run mode: 5 V (internal pull-up) Prog mode: 0 V
J1:24	21	M2	Run mode: 0 V Prog mode: 5 V (internal pull-up)
J1:25	56	Vcc	Power Supply 5 V
J1:26	24, 49	GND	Ground Digital

Pin MicroMod	Pin µC	Name	Function
J2:1	48	DO 7	Output Digital TTL
J2:2	47	DO 6	Output Digital TTL
J2:3	46	DO 5	Output Digital TTL
J2:4	45	DO 4	Output Digital TTL
J2:5	44	DO 3	Output Digital TTL
J2:6	43	DO 2	Output Digital TTL
J2:7	42	DO 1	Output Digital TTL
J2:8	41	DO 0	Output Digital TTL
J2:9	40	FO 3	Output Frequency/PWM
J2:10	39	FO 2	Output Frequency/PWM
J2:11	38	FO 1	Output Frequency/PWM
J2:12	37	FO 0	Output Frequency/PWM
J2:13	24, 49	GND	Ground Digital
J2:14		N/C	Not Connected
J2:15	36	FI 3	Input Frequency, TTL
J2:16	35	FI2	Input Frequency, TTL
J2:17	34	FI 1	Input Frequency, TTL
J2:18	33	FI 0	Input Frequency, TTL
J2:19	32	DI 7	Input Digital, TTL
J2:20	31	DI 6	Input Digital, TTL
J2:21	30	DI 5	Input Digital, TTL
J2:22	29	DI 4	Input Digital, TTL
J2:23	28	DI 3	Input Digital, TTL
J2:24	27	DI 2	Input Digital, TTL
J2:25	26	DI 1	Input Digital, TTL
J2:26	25	DI 0	Input Digital, TTL

4 Software Installation

With the enclosed Windows software MicroMod Configuration Tool you can create, edit and then transfer configurations comfortably to one or more MicroMods via CAN.

For transmission the Configuration Tool needs access to a CAN. For this purpose the computer must have a PC/CAN adapter of the PCAN series (e.g. PCAN-USB). However, you can create and edit a configuration with the Configuration Tool on a computer without PCAN environment and transfer it with another computer to the corresponding MicroMod in a CAN later.

Do the following to setup the software:

1. Make sure that you are logged in as user with Administrator priviliges when using an NT-based Windows like Windows XP (not necessary later on at normal use of the software).
2. Insert either the delivered CD-ROM or the first of two diskettes in the corresponding drive.
3. If you are using a CD-ROM, the setup program will start by itself. If this doesn't happen or if you are using a diskette, please start the program `Setup.exe` from the respective medium.
   You will be guided through the installation process by the setup program.

You can find further information about the use of the MicroMod Configuration Tool in the help which you can invoke in the program.

5 Operation

5.1 Status LED / Operation Status

LED	Status	Description
Flashing at 1 Hz	Normal operation	
Flashing at 2 Hz	Invalid configuration existing	This may be the case after a firmware update because the new firmware is possibly expecting another data format. You can solve this problem by sending a new configuration.
Flashing at 5 Hz	Configuration mode	Occurs during sending or receiving a configuration via CAN.
Continuously lighting	Internal MicroMod error	This may be the case after uploading a faulty or incompatible firmware.
Continuously off	No power supply; MicroMod in programming mode	If the MicroMod is in normal or in programming mode (for the firmware upload), is determined by the status of the MicroMod pins M0 and M2 (see table in chapter 3 *Connection*).

5.2 Reserved CAN ID 0x7E7

In order to configure a MicroMod the CAN ID 0x7E7 is used. The MicroMod Configuration Tool exchanges the according data with the MicroMod via the CAN bus.

When designing your CAN, make sure not to use the CAN ID 0x7E7 in any way.

5.3 Overview of Existing Services

PCAN-MicroMod provides various functions called services being of the following types:

- Inputs
- Outputs
- Function units
- CAN message handling

Service	Remark
Message Settings / Internal Variables	Internal variables are useful for communication between services (in principle corresponds to CAN messages)
Digital Input	It can be indicated for CAN message transmissions which kind of signal change is considered.
Digital Output	Power-up and timeout values can be defined (e.g. at problems with CAN communication).
Analog Input	The A/D value can be adjusted with scale and offset. Further more a software low-pass can be activated.
Frequency Input	Frequencies between 1 Hz and about 10 kHz can be measured.
PWM and Frequency Output	Either the pulse width is influenced at a predefined frequency by the incoming CAN messages or the frequency is influenced at a fixed pulse width (50%).
Digital Function	All digital inputs may be logically connected. The result may either be passed on as a CAN message or to a digital output.
Constant Value / Statistical Data	Constant values or statistical data generated by the MicroMod can be put into CAN messages. Latter is useful for remote monitoring the MicroMod.
Curve	Analog input data can be adjusted with the help of a curve.

Service	Remark
Rotary Encoder	The service interprets the signals from a manual rotary encoder (standard quadrature with 2 bits) connected to digital inputs.
Analog Hysteresis	For converting analog to digital signals (e.g. in order to avoid jitter)

You learn more details on the operation and the application of the services in the help to the MicroMod Configuration Tool.

6 New/Alternative Firmware

With its integrated microcontroller PCAN-MicroMod is flexible at use, since the functionality may be adapted or changed through suitable controlling software, also called firmware. This chapter describes possible alternatives and the procedure for a firmware update.

6.1 CANopen Support

As an alternative for the standard firmware described in this user manual PEAK-System provides a CANopen firmware for the PCAN-MicroMod free of charge. With this the MicroMod falls into the category of off-the-shelf CANopen generic I/O devices. The whole CANopen software package implements the CANopen standard DS301 “Application Layer and Communication Profile” version 4.02 and specifically the device profile DS401 “Device Profile for Generic I/O Modules” version 2.1. Therefore the correspondingly set up MicroMod can be directly used as standardized CANopen generic I/O module.

Please contact us regarding the CANopen firmware (contact information on page 2).

6.2 Creating Own Firmware

The PCAN-MicroMod contains the microcontroller MB90-F497 from Fujitsu. The C compiler available to this (Softune Workbench) allows you to create own firmware for the PCAN-MicroMod.
Homepage for the controller:
http://www.fme.gsdc.de/gsdc.htm?products/mb904950.htm

6.3 Firmware Upload

The firmware available at delivery can change regarding functionality and error correction so that an update becomes necessary. On the other hand perhaps you would like to use an alternative firmware for the MicroMod. In both cases you must transmit the desired firmware to the MicroMod via a serial port (upload).

For a firmware upload you need:

- A serial port in a computer running under Windows.
  The V24 signals for serial data communication (see table in chapter 3 Connection) can be transmitted to an appropriate driver chip (e.g. MAX232). For example, this driver chip and the connector for a serial cable could be integrated on a mother-board for the MicroMod.
- A facility for setting the MicroMod to programming mode.
  The inputs M0 and M2 of the MicroMod must be switched according to the table in chapter 3. This could be done with a jumper on a motherboard.
- A facility for resetting the MicroMod.
  The corresponding input Reset_In at the MicroMod could be switched to GND with a push button.
- The upload software (part of the delivered PCAN-MicroMod package)

Do the following to transmit a new firmware:

1. Connect the MicroMod or the corresponding motherboard respectively and a serial port (RS-232) of your computer.
2. **Before** applying power to the MicroMod, make sure that it will start in programming mode.
3. Apply power. The LED on the MicroMod stays off.
4. Make sure that the digital inputs 0 and 1 are inactive.
5. Reset the MicroMod.

6. If not already done unpack the ZIP file with the upload software in a directory of your choice.
7. From there start the program `flash.exe`.
8. Select **Set Environment** in order to check that the indicated serial port is corresponding to the actually used one. Confirm with **OK**.
9. Following settings are necessary:
   - Target Microcontroller: MB90F497/G
   - Crystal Frequency: 4 MHz
10. Select the firmware file to be transfered (field **Hex File**).
11. Start the transfer sequence by clicking on **Full Operation (D+E+B+P+R)**. It lasts for approximately one minute. Subsequent a message is shown confirming the proper process.
12. Disconnect the power from the MicroMod.
13. Setup the normal operation mode (Run mode) for the MicroMod again.

Note: If after updating the standard firmware the LED on the MicroMod doesn't blink with **1 Hz** anymore, please refer to section 5.1 *Status LED / Operation Status* for possible causes.

Tipp: An easy way to do a firmware upload is using the Evaluation Board (from the optionaly available MicroMod Evaluation Kit). The Evaluation Board has necessary connectors and switches.

7 Frequently Asked Questions (FAQ)

Problem/Question	Answer
The MicroMod **doesn't start**.	Apart from the necessary power supply the MicroMod must be set up for normal operation mode (Run mode). This is done with the inputs M0 and M2 (see table in chapter 3 *Connection*).
Is the **source code** of the enclosed firmware freely accessible for customize-tions?	No.
Can the PCAN-MicroMod also be used as a **CANopen** node?	Yes. We offer a special firmware available for free. The software for a firmware upload is already contained in the scope of supply.

8 Technical Specifications

Supply voltage	+5 V DC
Current consumption	max. 160 mA
Operating temperature	-40 – +85 °C -40 – +185 °F
Dimension	32 x 35 x 14 mm 1 1/4 x 1 3/8 x 9/16 Inches
Microcontroller	Fujitsu MB90F497G
CAN connection	HS-CAN 2.0A/B, transceiver Philips 82C251
Digital inputs	8, TTL
Frequency inputs	4, TTL, measuring range 1 Hz – 10 kHz (maximum dependent on work load, yet at least 4 kHz)
Analog inputs	8, resolution 10 bits, reference voltage 5 V, input impedance 3.2 kΩ
Digital outputs	8, TTL
Frequency outputs	4 PWM (32 – 100 Hz, 4 – 10 kHz) *– or –* 2 Frequency (1 Hz – 10 kHz)
Firmware	Configuration via reserved CAN ID 0x7e7

Design and specifications are subject to change without notice.