PCAN-MicroMod

Universal I/O Module
with CAN Interface

User Manual

PEAK
System

Relevant Products

Product Name	Part number	Model
PCAN-MicroMod	IPEH-002080	with firmware 2.x

Contents

1 Introduction

The PCAN-MicroMod is designed for quick and easy access to distributed I/O systems. Its kernel is the microcontroller MB90F497 by Fujitsu. With an integrated CAN bus controller and the analog and digital inputs and outputs it is an inexpensive solution for small, intelligent nodes.

At delivery the MicroMod has a standard firmware. The configuration is done by a Windows program transferring the configuration data to the module via CAN.

It is also possible to use an alternative firmware (e.g. for the operation under CANopen®) or to 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* on page 18.

1.1 Properties at a Glance

PCAN-MicroMod

- Strips for piggyback connection
- 8 digital inputs, CMOS levels
- 8 digital outputs, CMOS levels
- 8 analog inputs, reference voltage 5 V (resolution 10 bits, sampling rate 1 kHz)
- 4 frequency/PWM outputs (depending on firmware)

- 4 inputs for frequency measurement

- CAN connection with NXP 82C251 transceiver

- CAN bit rates from 10 kbit/s to 1 Mbit/s

- Extended operating temperature range of -40 to +85 °C (-40 to +185 °F)

Standard firmware

- Up to 32 MicroMods configurable on a single CAN bus

- Transmission of CAN messages periodically or at level change of a digital input

- Logic operations for digital inputs

- Adaptation of analog quantities through characteristic curves

- Direct transfer of analog quantities onto CAN IDs

- Direct support of rotary encoders up to 100 Hz (e.g. rotary switch for manual operation)

- 4 PWM outputs, 8-bit, 32 Hz - 100 Hz and 4 - 10 kHz
  - or -
  2 PWM outputs, 16-bit, 1 Hz - 10 kHz (from firmware 2.5)
  - or -
  2 frequency outputs, 1 Hz - 10 kHz

1.2   Scope of Supply

- PCAN-MicroMod

- Configuration software for Windows

- Manual in PDF format

1.3 Prerequisites for Operation

⌐ Board with socket strips for holding the PCAN-MicroMod (Evaluation Board, motherboard by PEAK-System, or proprietary development)

⌐ For transferring configurations:

  - Computer with Windows 10, 8.1 (32/64-bit)

  - PC-CAN interface from PEAK-System

  - CAN cabling between the PC-CAN interface and the PCAN-MicroMod (on a motherboard) with correct termination (each 120 Ohms on both ends of the CAN bus)

2   Hardware Settings

2.1   Setting the Module Number

On its upper side, the PCAN-MicroMod has five positions for solder jumpers (indicated by the labels 0 to 4) for setups of different functions depending on the used firmware. Using the standard firmware the solder jumpers are determining the module number. This is described in the following. With the optional CANopen® firmware other functions are assigned to the individual positions (see user manual for the CANopen® firmware).

The module number is used for the identification of a single Micro-Mod at the CAN bus when configurations are sent and received. The MicroMod does not use the module number for the reception or transmission of data during normal operation. At delivery status the MicroMod has the module number 0 (no solder jumper set).

Figure 1: Soldering positions for module number

Each MicroMod connected to the CAN bus must have a unique module number for configuring, otherwise unpredictable results could occur when configuring those MicroMods. As well, it isn't possible to send a configuration to several MicroMods at the same time.

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

solder jumper = bit set). Position 0 is the LSB and position 4 the MSB of this number. Because there are 5 bits, module numbers between 0 and 31 can be set.

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

Example:

Solder jumpers 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) $\Rightarrow$ 10110 $\Leftarrow$ LSB (position 0)

3. Solder jumpers to be set: 1, 2, 4 (0 and 3 stay open)

2.2 Disconnecting the High-speed CAN Transceiver

If you want to use another mode of CAN transmission but High-speed CAN (ISO 11898-2), the CAN signals CAN-RxD and CAN-TxD from the microcontroller or the MicroMod respectively can directly be lead to the desired CAN transceiver. The High-speed CAN transceiver on the MicroMod must be disconnected from the data transfer in this case. This is done by interrupting the RxD line between the microcontroller and the CAN transceiver. 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 High-speed CAN transceiver)

If you want to use the High-speed CAN transceiver on the MicroMod later on, set a solder jumper at the mentioned position.

3 Connectors

The PCAN-MicroMod has two double strips (J1, J2), each with 26 pins (first column in the following table). Thus, the MicroMod can be plugged onto boards with matching socket strips (100-mil/2.54-mm grid, see also dimension drawing in Appendix B on page 27). For better orientation at the plug-in process the MicroMod has a white marker on the upper left corner (pin J2:2).

Figure 3: Positions of the connection strips
and the positioning marker (upper left)

In the second column of the table the corresponding pin of the MB90F497 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-bit, 0 - Vref
J1:2	3	AIN 0	Input Analog, 10-bit, 0 - Vref
J1:3	6	AIN 3	Input Analog, 10-bit, 0 - Vref
J1:4	5	AIN 2	Input Analog, 10-bit, 0 - Vref
J1:5	8	AIN 5	Input Analog, 10-bit, 0 - Vref
J1:6	7	AIN 4	Input Analog, 10-bit, 0 - Vref
J1:7	10	AIN 7	Input Analog, 10-bit, 0 - Vref
J1:8	9	AIN 6	Input Analog, 10-bit, 0 - Vref
J1:9	12	Vref	Reference voltage Analog, 2.7 - 5 V

Pin MicroMod	Pin µC	Name	Function
J1:10	11	Avcc	Supply Analog
J1:11	24, 49	GND	Ground Digital
J1:12	13	AGND	Ground Analog
J1:13	63	CAN-TxD	CAN Transmit, CMOS
J1:14	64	CAN-RxD	CAN Receive, CMOS
J1:15		CAN_H	High-speed CAN signal CAN_H
J1:16		CAN_L	High-speed CAN signal CAN_L
J1:17	62	TxD	Serial Transmit, TTL
J1:18	60	RxD	Serial Receive, TTL
J1:19	51	SCL (SPI or I²C)	Serial clock, function depending 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	Supply 5 V
J1:26	24, 49	GND	Ground Digital
J2:1	48	DO 7	Output Digital, CMOS
J2:2	47	DO 6	Output Digital, CMOS
J2:3	46	DO 5	Output Digital, CMOS
J2:4	45	DO 4	Output Digital, CMOS
J2:5	44	DO 3	Output Digital, CMOS
J2:6	43	DO 2	Output Digital, CMOS
J2:7	42	DO 1	Output Digital, CMOS
J2:8	41	DO 0	Output Digital, CMOS
J2:9	40	FO 3	Output Frequency/PWM, CMOS
J2:10	39	FO 2	Output Frequency/PWM, CMOS
J2:11	38	FO 1	Output Frequency/PWM, CMOS
J2:12	37	FO 0	Output Frequency/PWM, CMOS

Pin MicroMod	Pin µC	Name	Function
J2:13	24, 49	GND	Ground Digital
J2:14		N/C	Not used
J2:15	36	FI 3	Input Frequency, CMOS
J2:16	35	FI2	Input Frequency, CMOS
J2:17	34	FI 1	Input Frequency, CMOS
J2:18	33	FI 0	Input Frequency, CMOS
J2:19	32	DI 7	Input Digital, CMOS
J2:20	31	DI 6	Input Digital, CMOS
J2:21	30	DI 5	Input Digital, CMOS
J2:22	29	DI 4	Input Digital, CMOS
J2:23	28	DI 3	Input Digital, CMOS
J2:24	27	DI 2	Input Digital, CMOS
J2:25	26	DI 1	Input Digital, CMOS
J2:26	25	DI 0	Input Digital, CMOS

4 Installing the Configuration Program

With the enclosed configuration program PCAN-MicroMod Configuration for Windows you can create, edit, and then transfer configurations to one or more MicroMods via CAN.

Figure 4: Configuration program PCAN-MicroMod Configuration for Windows

For transmission the program needs access to a CAN network. For this purpose the computer must have a CAN interface of the PCAN series (e.g. PCAN-USB). However, you can create and edit a configuration with the program on a computer without PCAN environment and transfer it with another computer to the corresponding Micro-Mod in a CAN network later.

➡ For downloading and installing the software, do the following:

1. Download the software package for PCAN-MicroMod Configuration from our website. Use the corresponding entry on the following download page: www.peak-system.com/quick/DL-Software-E

2. Open the downloaded file `micromodconfig.zip`.

3. Start the setup.exe file and confirm any prompts for running and for "Changes to the computer".

4. Follow the instructions of the installation program.

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

5 Operation

5.1 Status LED

LED	Status	Description
Blinking at 1 Hz	Normal operation	
Blinking at 2 Hz	Invalid or no configuration	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.
Blinking at 5 Hz	Configuration mode	Occurs during sending or receiving a configuration via CAN.
Continuously on	Internal MicroMod error	This may be the case after uploading a faulty or incompatible firmware.
Continuously off	No voltage supply; MicroMod in programming mode	Whether 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 on page 10).

5.2 Reserved CAN ID 0x7E7

For configuring the MicroMod the CAN ID 0x7E7 is used. The program PCAN-MicroMod Configuration exchanges the according data with the MicroMod via the CAN bus.

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

5.3 Overview of Existing Services

With the standard firmware, the PCAN-MicroMod provides various functions, called services.

Service	Remark
Message Settings / Internal Variables	Internal variables are useful for communication between services (in principle corresponds to CAN messages)
Digital input	For the event-controlled transmission of CAN messages it can be determined which kind of signal change is considered as trigger.
Digital output	Power-up and timeout values can be defined (e.g. for problems with CAN communication).
Analog input	The A/D value can be adjusted with scale and offset. Furthermore, a software low-pass can be activated.
Analog Output	This service is only available with the appropriate connection of a D/A converter to the MicroMod (e.g. with the motherboard Analog 2).
Frequency input	Frequencies between 1 Hz and about 10 kHz can be measured.
PWM and frequency output	By the incoming CAN messages either the pulse width is influenced at a predefined frequency 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 values / statistical data	Constant values or statistical data generated by the MicroMod can be put into CAN messages.
Curve	Analog input data can be converted with the help of a curve.
Rotary encoder	The service interprets the signals from a manual rotary encoder (standard quadrature with 2 bits) connected to digital inputs. Input frequency max. 100 Hz.
Analog hysteresis	For converting analog to digital signals (e.g. in order to avoid jitter).

Find more details about the functionality and the application of the services in the help of the configuration program PCAN-MicroMod Configuration.

6 New/Alternative Firmware

With its integrated microcontroller the PCAN-MicroMod is flexible at use, because 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 to the standard firmware we provide 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 CiA® 301 "Application Layer and Communication Profile" version 4.02 and specifically the device profile CiA® 401 "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.

The CANopen firmware (incl. documentation) is part of the software package for the PCAN-MicroMod. You can download the package with the following download link:

www.peak-system.com/fileadmin/media/files/pcanmicromod.zip

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6.2   Creating Own Firmware

The PCAN-MicroMod contains the microcontroller MB90F497 by Fujitsu (now: Cypress). With the C development environment Softune Workbench (available separately) you can create own firmware for the PCAN-MicroMod.

Website of the microcontroller manufacturer: www.cypress.com

6.3   Uploading Firmware to the MicroMod

The standard firmware can change regarding functionality and error correction so that an update can be necessary. On the other hand perhaps you would like to use an alternative firmware for the Micro-Mod. In both cases you must transmit the desired firmware to the MicroMod via a serial RS-232 port (upload).

For a firmware upload you need:

- a motherboard for the MicroMod with the following features:

  - an RS-232 connector (with a driver connected ahead)

MicroMod pin	Name	Function
J1:17	TxD	Serial transmit (TTL levels)
J1:18	RxD	Serial receive (TTL levels)

  - a switch or jumper to set the MicroMod to programming mode

MicroMod pin	Name	Programming mode	Normal operation mode
J1:23	M0	0 V	5 V (internal pull-up)
J1:24	M2	5 V (internal pull-up)	0 V

  - a pushbutton to reset the MicroMod

MicroMod pin	Name	Status for reset
J1:21	Reset_In	0 V

- the possibility to set the digital inputs 0 and 1 to Low state

MicroMod pin	Name	Status for firmware upload
J2:25	DI 1	0 V
J2:26	DI 0	0 V

Tip: An easy way to do a firmware upload is using the PCAN-MicroMod Evaluation Board (optionally available). It has the necessary connectors and switches.

- a serial RS-232 port on a computer running Windows

- a serial 1:1 cable with male D-Sub connectors

- the Windows software FLASH MCU Programmer for the F^{2}MC-16LX microcontroller family.
  You can download a setup program of the current version from the Cypress website (www.cypress.com). Search for "mcu programmer" there.

- the firmware file (`*.mhx`)

Do the following to upload a new firmware:

1. Make sure that the motherboard with the MicroMod is switched off.

2. Connect the motherboard and the serial port of your computer with the serial cable.

3. Set the corresponding switch or jumper so that the MicroMod will start in programming mode.

4. Apply power.

   The LED on the MicroMod stays off.

5. Make sure that a Low level is applied to digital inputs 0 and 1.

6. Reset the MicroMod.

7. Under Windows, start the FUJITSU FLASH MCU Programmer (FMC16LX).

8. Select **Set Environment** in order to check that the indicated serial port is corresponding to the actually used one. Confirm with **OK**.

9. Do the following settings:

   Target Microcontroller: MB90F497/G

   Crystal Frequency: 4 MHz

10. Use the **Open** button behind the **Hex File** field to select the firmware file that shall be used for upload.

11. Start the transfer sequence by clicking on **Full Operation (D+E+B+P+R)**.

   The process takes approximately one minute. At its end a message is shown that confirms the proper sequence.

Full Operation - Downloading

3 / 8

Full Operation - Erasing

2 / 5

Full Operation - Programming

Cancel

35 / 128

It ended normally completely

Ok

128 / 128

12. Disconnect the power from the motherboard.

13. Setup the normal operation mode (Run mode) for the MicroMod, before applying power again.

The upload procedure is finished and you can use the MicroMod normally now.

LED-Status After Updating the Standard Firmware

If after an update the LED on the MicroMod is **blinking fast** (2 Hz) in normal operation mode, the current configuration is not compatible to the new firmware version. In this case, transfer the configuration to the MicroMod again, with adaptation if needed.

If the LED stays **off** after the update, the firmware does not work. Repeat the upload procedure in this case or use another version of the standard firmware.

7 Technical Specifications

Power supply	
Supply voltage	+5 V DC
Current consumption	max. 160 mA

Connectors	
Connection strips	2 double strips, each with 26 pins
Grid	100 mil (2.54 mm)

Control and communication	
Microcontroller	Fujitsu MB90F497G
Standard firmware	Configuration via reserved CAN ID 0x7e7

CAN	
Specification	ISO 11898-2, High-speed CAN 2.0A (standard format) 2.0B (extended format) (from firmware 2.0)
Bit rates	10 kbit/s - 1 Mbit/s (see also "Properties with standard firmware" below)
Transceiver	NXP PCA82C251 (disconnectable for use of an alternative transceiver on the motherboard)
Termination	none

Inputs/outputs	
Digital inputs	8, CMOS
Frequency inputs	4, CMOS
Analog inputs	8, reference voltage 5 V, resolution 10 bits, sample rate 1 kHz, input impedance 3.2 kΩ
Digital outputs	8, CMOS
Frequency/PWM outputs	4 (depending on firmware)

Properties with standard firmware	
Frequency inputs	Measuring range 1 Hz – 10 kHz (maximum depends on work load, min. 4 kHz)
Frequency/PWM outputs	4 PWM (8-bit mode): 32 - 100 Hz, 4 - 10 kHz, frequency-dependent resolution 1.3 - 1.0 % *- or -* 2 PWM (16-bit mode, from firmware 2.5): 1 Hz - 10 kHz, frequency-dependent resolution 0.205 - 0.005 % (see also diagram in Appendix A on page 26) *- or -* 2 frequency: 1 Hz - 10 kHz, minimum step width 1 Hz
Configurable CAN bit rates (kbit/s)	10; 20; 33.3; 47.6; 50; 83.3; 95.2; 100; 125; 250; 500; 800; 1000

Measures	
Size	32 x 35 x 13 mm (W x L x H) See also dimension drawing in Appendix B on page 27
Weight	9 g

Environment	
Operating temperature	-40 - +85 °C (-40 - +185 °F)
Temperature for storage and transport	-40 - +100 °C (-40 - +212 °F)
Relative humidity	15 - 90 %, not condensing

Conformity	
RoHS 2	Directive 2011/65/EU DIN EN 50581 VDE 0042-12:2013-02

Appendix A Frequency/Resolution Diagram

Figure 5: Frequency-dependent resolution PWM 16-bit mode

Appendix B Dimension Drawing

Figure 6: Top view and side view PCAN-MicroMod