VFPS Watch Dog Module

Preliminary !

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Content

Introduction

The main purpose of the VFPS Watch Dog Module is to supervise the experiment computer, which moves the Roman Pots via step motors and reads their position via Heidenhain linear encoder. The Watch Dog is connected to the computer by CAN bus and expects to be repeatedly triggered with a given maximum time difference between two triggers. If a time-out condition occurs, all Roman Pots are moved out to their end position. Therefore it is assured, that in case of a computer hang-up or a CAN bus malfunction the Roman Pots are retracted out of the beam to a safe position. A block diagram of the VFPS Watch Dog Supervision System is given in Appendix 6.
The Module has been designed as VME Board of 6 height units, which uses connector P1 only for power supply.

Block Diagram

Fig.1 shows a block diagram of the Watch Dog Module. Main Part of the circuit is a micro controller of type PIC18F448 (Microchip) with integrated CAN interface. It is connected to the CAN bus by a dedicated driver chip PCA82C250 (Philips).

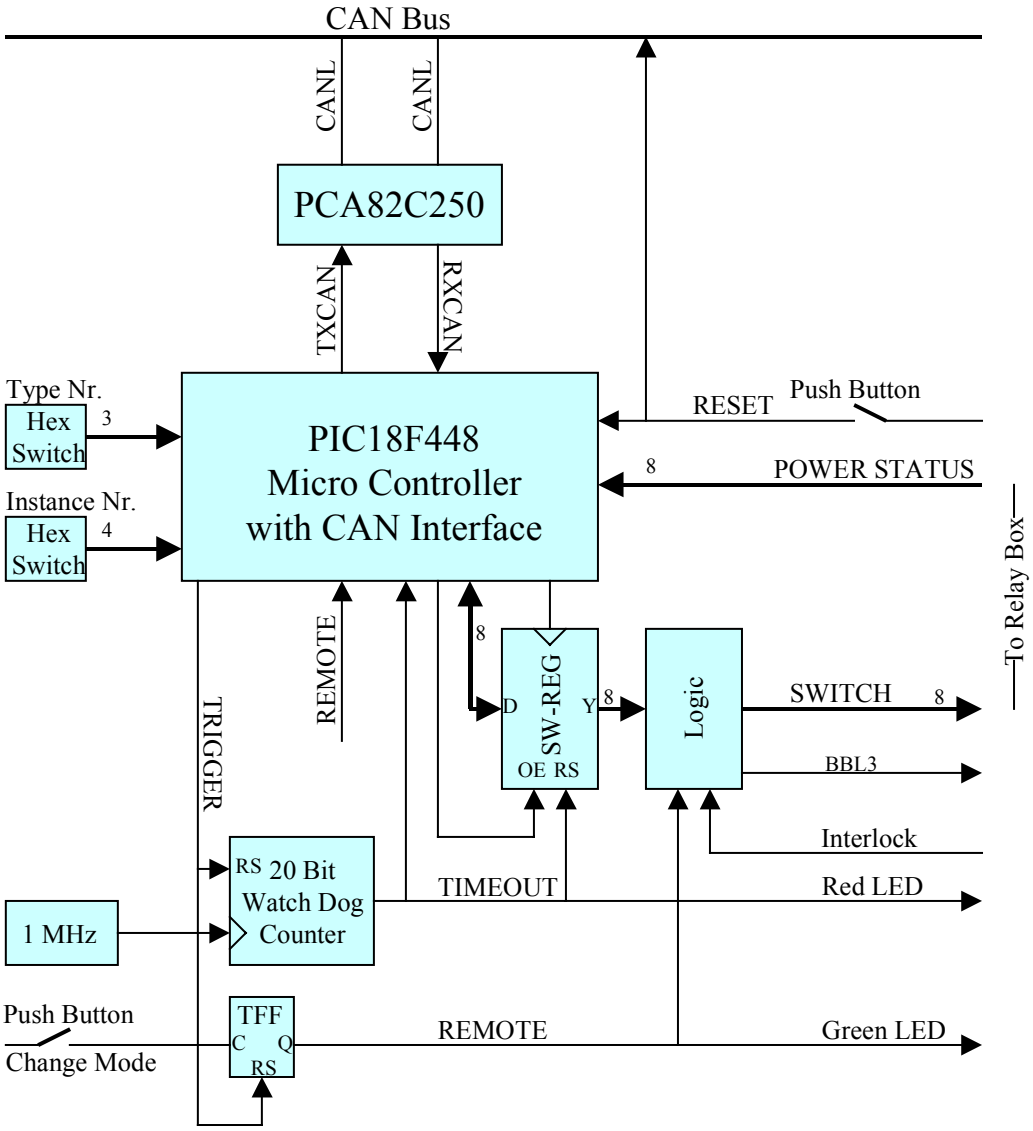


Fig. 1: VFPS Watch Dog Block Diagram

The Watch Dog function has been realised by a 20 bit counter, which is incremented by a 1 MHz oscillator and reset by the trigger signal **TRIGGER**. So time intervals between

2 µsec and 1 sec can be configured by firmware. The trigger signal is issued by the micro controller after receiving the corresponding command via CAN Bus.
The overflow condition of the counter sets the **TMEOUT** flag, which resets all bits in the Switch Register **SW-REG**. It is displayed by a red LED at the front panel.
The **SWITCH** output level depend on the actual operation mode, which can be toggled by means of a push button **Mode** on the front panel. In **Local** Mode all **SWITCH** level are set to **on**. In **Remote** mode (green LED on the front panel is on) the **SWITCH** output is determined by the Switch Register. In case of no time-out each bit of that register can be set individually via the CAN bus. The **Remote** mode is forced by each **Trigger** signal.

A potential free switched output signals the alarm state to the H1 BBL3 system.
Additionally an input for the common H1 BBL3 system has been implemented. An Interlock signal in case of a BBL3 alarm resets all bits in the Switch Register and forces the module to **Remote** mode. So by a time-out condition or by an Interlock signal, all **SWITCH** level are reset and remain off, until they are set again via CAN bus after disappearance of the alarm condition.
Another push button **RESET** generates a reset signal, which is applied to the micro controller and - via private part of the CAN bus cable – to the VFPS Heidenhain Readout modules and the VFPS Temperature Monitor.
The seven most significant bits of the CAN Identifier can be selected by two hexadecimal rotary switches **Type Nr.** and **Instance Nr.** For more details see the following chapter.

CAN Higher Level Protocol

For computer access the widely used CAN bus interface has been implemented. Devices connected to a CAN bus have to follow a so called CAN Higher Level Protocol, which includes the Baud rate and the Identifier definition. For the Watch Dog Module the following parameters are fixed by firmware:

- Baud Rate: 125 kHz
- Identifier: 11 Bit Standard: ID10..ID0
- Identifier Definition: Device Type: ID10..ID8
  Device Instance: ID7..ID4
  Device Function: ID3..ID0

The Device Type (3 bits) and the Instance Number (4 bits) are selected on the board by means of two rotary switches.
Three functions are defined:

- Function F1: Trigger Watch Dog
- Function F2: Switch Relays
- Function F3: Read Status

All messages are data messages (RTR Bit = 0) with at least one data byte (argument).
The controller responds to the requests by sending a data message with an identifier, containing the same Type Number and Instance Number, and the Function Number incremented by 8.
In the following the functions and the controllers response are described in more detail.

Function F1: Trigger Watch Dog

Identifier	RTR	DLC	Byte 1	Function
$TI1	0	1	1	Trigger Watch Dog

T: Type Number (3 Bit)
I: Instance Number (4 Bit)

Function F1 generates the following response:

F1(1) Trigger Watch Dog:

Identifier	RTR	DLC	Byte 1	Byte 2
$TI9	0	2	1	**Status**

Status: ST0: REMOTE
ST1: TIMEOUT
The Status Byte reflects the status **before** the Trigger is issued.

Function F2: Read CAN Parameter

Identifier	RTR	DLC	Byte 1	Function
$TI2	0	1	1	Read CAN Error
$TI2	0	1	2	Read Firmware Version Number

T: Type Number (3 Bit)
I: Instance Number (4 Bit)

Function **F2** generates the following response:

F2(1) Read CAN Error:

Identifier	RTR	DLC	Byte 1	Byte 2	Byte 3	Byte 4
$TIA	0	4	1	**CEB**	**TEC**	**REC**

CEB: C0: Error Warning Bit (C1 or C2 are set)
C1: Receiver Warning Bit (95 < REC < 128)
C2: Transmitter Warning Bit (95 < TEC < 128)
C3: Receiver Bus Passive Bit (127 < REC)
C4: Transmitter Bus Passive Bit (127 < TEC)
C5: Transmitter Bus Off Bit (255 < TEC)
C6: Receiver Buffer 1 Overflow Bit
C7: Receiver Buffer 0 Overflow Bit
TEC: Transmitter Error Counter
REC: Receiver Error Counter

For more details of the CAN error handling please consult the CAN Bus Specification manual (CAN Specification, Version 2.0, Robert Bosch GmbH, 1991).

F2(2) Read Firmware Version Number:

Identifier	RTR	DLC	Byte 1	Byte 2	Byte 3
$TIA	0	3	2	**VNH**	**VNL**

VNH: MS-Byte of Version Number
VNL: LS-Byte of Version Number

Function F3: Switch Relays

Identifier	RTR	DLC	Byte 1	Byte 2	Function
$TI3	0	2	1	RN	Switch Individual Relay on
$TI3	0	2	2	RN	Switch Individual Relay off
$TI3	0	1	3		Switch all Relays on
$TI3	0	1	4		Switch all Relays off

T: Type Number (3 Bit)
I: Instance Number (4 Bit)
RN: Relay Number $0 \le RN \le 7$
This function has effect only, if there is no time-out condition and no BBL3 alarm. In **Local** Mode all Switch Level are **on**.

Function **F3** generates the following response:

F3(1) Switch Individual Relay on

Identifier	RTR	DLC	Byte 1	Byte 2	Byte 3	Byte 4
$TIB	0	4	1	**Status**	**SREG**	**PSTA**

Status:	Status Register	ST_0:	0: Local Mode 1: Remote Mode
		ST_1:	0: No Time-out 1: Time-out
SREG:	Switch Level	SL_n:	0: Level #n off 1: Level #n on
PSTA:	Power Status	PS_n:	0: Power #n off 1: Power #n on

F3(2) Switch Individual Relay off

Identifier	RTR	DLC	Byte 1	Byte 2	Byte 3	Byte 4
$TIB	0	4	2	**Status**	**SREG**	**PSTA**

F3(3) Switch all Relays on

Identifier	RTR	DLC	Byte 1	Byte 2	Byte 3	Byte 4
$TIB	0	4	3	**Status**	**SREG**	**PSTA**

F3(4) Switch all Relays off

Identifier	RTR	DLC	Byte 1	Byte 2	Byte 3	Byte 4
$TIB	0	4	4	**Status**	**SREG**	**PSTA**

Function F4: Read Status

Identifier	RTR	DLC	Byte 1	Function
$TI4	0	1	**1**	Read Status

T: Type Number (3 Bit)
I: Instance Number (4 Bit)

Function **F4** generates the following response:

F4(1) Read Status:

Identifier	RTR	DLC	Byte 1	Byte 2	Byte 3	Byte 4
$TIC	0	4	**1**	**Status**	**SREG**	**PSTA**

Status:	Status Register	ST_0:	0: Local Mode 1: Remote Mode
		ST_1:	0: No Time-out 1: Time-out
SREG:	Switch Register	SR_n:	0: Relay #n off 1: Relay #n on
PSTA:	Power Status	PS_n:	0: Power #n off 1: Power #n on

Appendix

1) Jumpers

J100: CAN Bus Termination

The CAN bus has to be terminated at the last node of the bus. The termination is activated by closing jumper J100.

J101: CAN GND

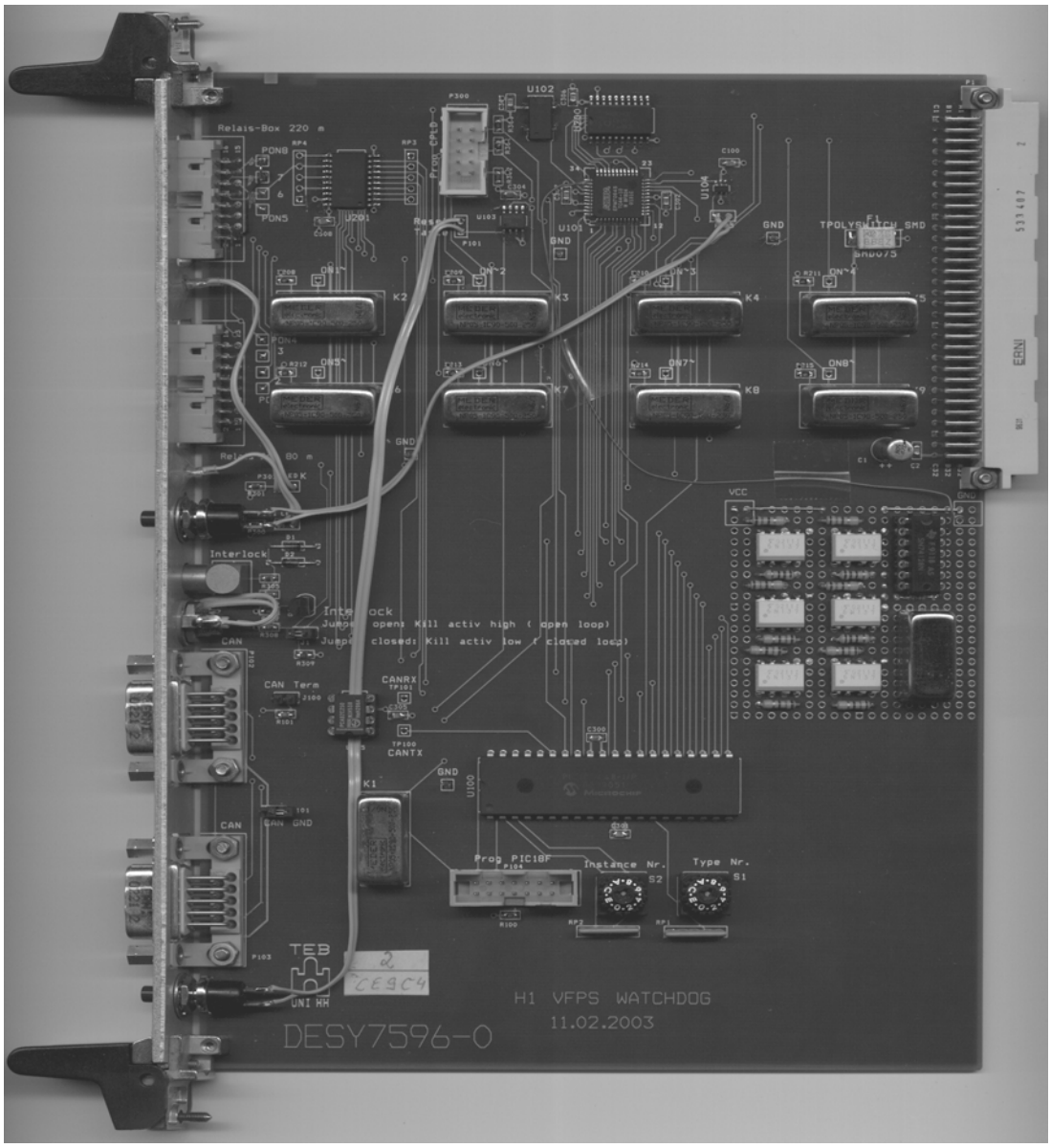
By means of J101, the ground potential of the module can be connected to the ground line of the CAN bus

J1: Interlock

Open:	Open Loop:	No Alarm	
	Closed Loop:	Alarm	
Closed:	Open Loop:	Alarm	(Default)
	Closed Loop:	No Alarm	

The jumper location is marked in the following Board Layout

2) Board Layout



3) Rotary Switches

a) **Type #:** Type Number Selection (3 Bit): Range: 0..7

b) **Instance #:** Instance Number Selection (4 Bit): Range: 0..15

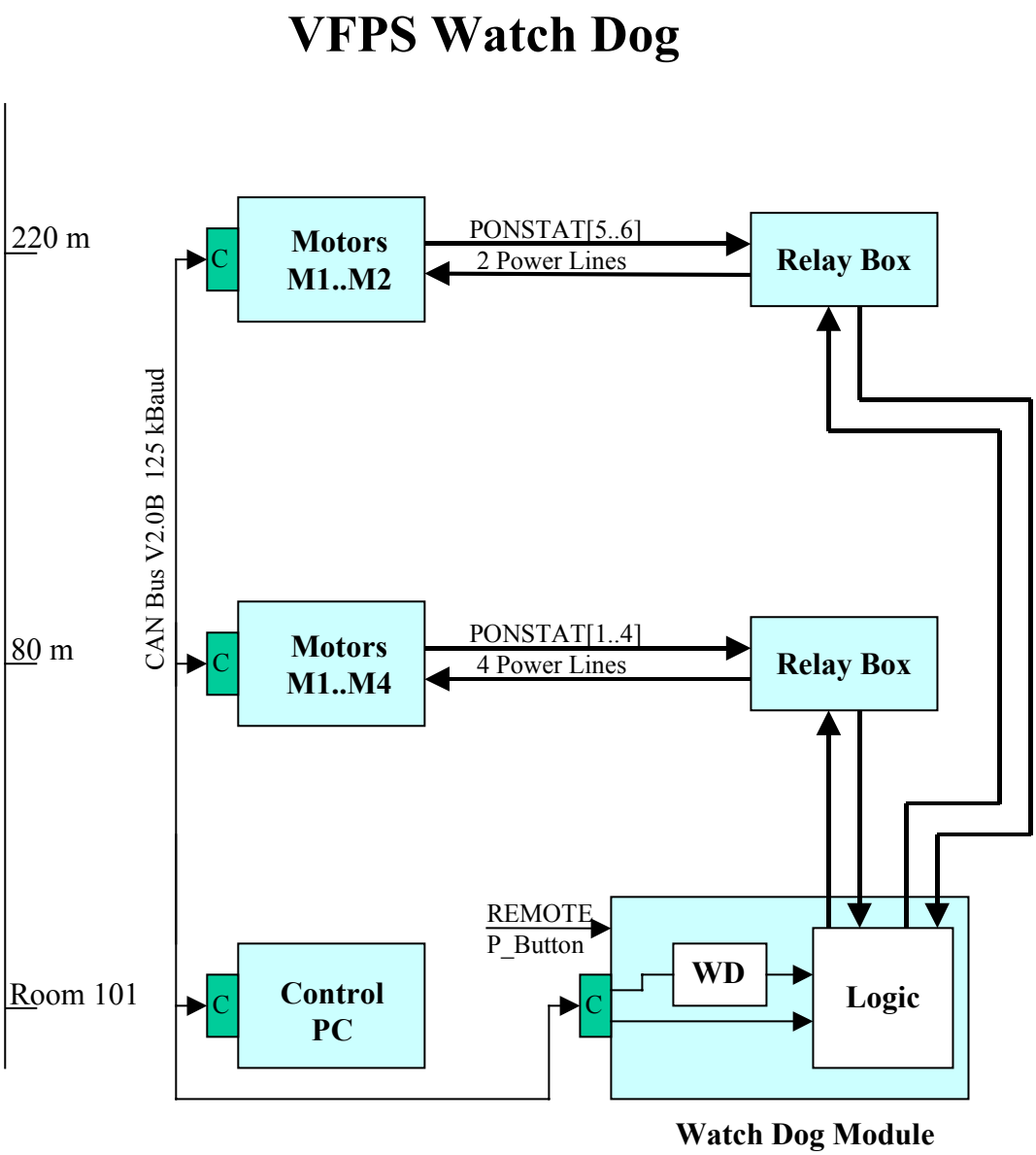
4) Front Panel

Push Button **Change Mode:**	Toggles between operation modes **LOCAL** and **REMOTE**
Push Button **RESET:**	Resets Micro Controller and - via CAN Bus – VFPS Heidenhain Readout Modules and VFPS Temperature Monitors
Red LED:	off: No Time-out on: Time-out
Green LED:	off: Operation Mode **LOCAL** on: Operation Mode **REMOTE**
LEMO Connectors:	Interlock (BBL3 system Input) Jumper J1 open: Closed Loop generates Alarm Jumper J1 closed: Open Loop generates Alarm BBL3 alarm potential free switched output Closed for non alarm status

5) Switch Numbers in H1 Forward Proton Spectrometer

Switch Nr.	Detector
0	P64H
1	P80H
2	P80V
3	P90V
4	P220
5	P226

6) VFPS Watch Dog Supervision System



Motor Power-on Condition:
PON[n] = /REMOTE or REMOTE & /WDALARM & SWON[n]