The Embedded I/O Company

TEWS TECHNOLOGIES

TIP810

CAN Bus IP

Version 3.0

User Manual

Issue 3.0.5

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Style Conventions

Hexadecimal characters are specified with prefix 0x, i.e. 0x029E (that means hexadecimal value 029E).

For signals on hardware products, an ‚Active Low' is represented by the signal name with # following, i.e. IP_RESET#.

Access terms are described as:

W	Write Only
R	Read Only
R/W	Read/Write
R/C	Read/Clear
R/S	Read/Set

Issue	Description	Date
1.0	Initial Issue	October 2001
1.1	Addressing description modified	November 2001
1.2	Changed Block Diagram and General Revision	October 2002
1.3	New address TEWS LLC	September 2006
3.0.4	New notation of User Manual Issue	March 2009
3.0.5	General Revision	August 2014

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1 Product Description

The TIP810 is an IndustryPack® compatible module with a complete CAN bus interface using the Philips SJA1000 CAN controller. The Philips SJA1000 CAN controller is a stand-alone controller for the Controller Area Network (CAN) used within automotive and general industrial environments.

It is the successor of the PCA82C200 CAN controller (Basic CAN) from Philips Semiconductors which was used on the TIP810-10R V1.0. Additionally, a new mode of operation (PeliCAN) is implemented on the SJA1000 which supports the CAN 2.0B protocol specification with several new features. The SJA1000 has the capability to transmit, receive and perform message filtering on standard and extended messages.

The TIP810 supports a 8 bit bus interface which permits byte accesses to the internal registers of the SJA1000 controller. The physical interface supports both, CAN high-speed (according to ISO11898) and modified RS485. Both physical interfaces are optically isolated from the CAN controller. An on board DC/DC converter supplies the isolated parts of the TIP810.

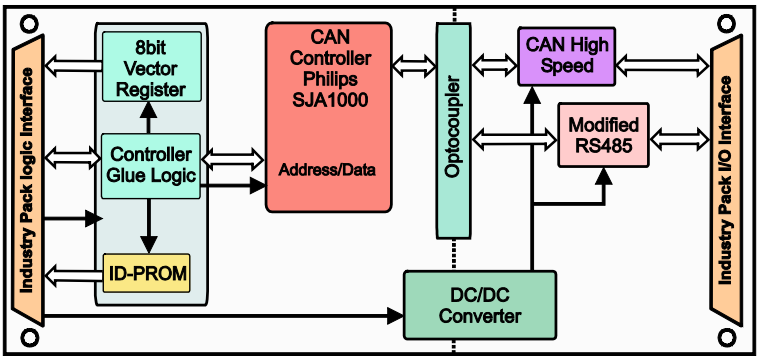

Figure 1-1: Block Diagram TIP810

2 Compatibility with TIP810 V1.0, V2.0

The TIP810 V3.0 uses the SJA1000 CAN controller as a replacement of the PCA82C200 CAN controller which was used on the TIP810 V1.0. The TIP810 V2.0 also had used the SJA1000 CAN controller, but only in a PCA82C200 compatible way.

The SJA1000 CAN controller on the TIP810 is register-, pin- and function-compatible with the PCA82C200 if operating in the **“BasiCAN" Mode**. This mode is the default mode for the SJA1000 CAN controller after power-on.

In the **“PeliCAN" Mode** the SJA1000 CAN controller supports the full CAN2.0B protocol specification plus additional features.

Setting the SJA1000 Operation Mode:

The modes can be switched via bit 7 in the Clock Divider Register if the controller is in reset mode.

For a detailed description of the SJA1000 CAN controller, it’s operating modes and additional features please refer to the SJA1000 data sheet.

3 Technical Specification

Interface	Single Size IndustryPack® Logic Interface	
CAN Controller	Philips SJA 1000	
Physical Interface	CAN High Speed (according to ISO11898) Modified RS485	
Wait States	IDSEL#: No wait state IOSEL#: No wait state (read/write access to the vector register) 1 wait state (read/write access to the SJA1000) INTSEL#: No wait state MEMSEL#: 1 wait state (read/write access to the SJA1000)	
Interface	50-conductor flat cable	
Power Requirements	220mA typical @ +5V DC	
Physical Data		
Temperature Range	Operating Storage	-40° C to +85 °C -55°C to +125°C
MTBF	362160 h MTBF values shown are based on calculation according to MIL-HDBK-217F and MIL-HDBK-217F Notice 2; Environment: G_B 20°C. The MTBF calculation is based on component FIT rates provided by the component suppliers. If FIT rates are not available, MIL-HDBK-217F and MIL-HDBK-217F Notice 2 formulas are used for FIT rate calculation.	
Humidity	5 – 95 % non-condensing	
Weight	27 g	

Table 3-1 : Technical Specification TIP810

4 ID PROM Contents

Address	Function	Contents
0x01	ASCII 'I'	**0x49**
0x03	ASCII 'P'	**0x50**
0x05	ASCII 'A'	**0x41**
0x07	ASCII 'C'	**0x43**
0x09	Manufacturer ID	**0xB3**
0x0B	Model Number	**0x01**
0x0C	Revision	**0x10**
0x0F	Reserved	**0x00**
0x11	Driver-ID Low - Byte	**0x00**
0x13	Driver-ID High - Byte	**0x00**
0x15	Number of bytes used	**0x0C**
0x17	CRC	**0x11**

Table 4-1 : ID PROM Contents TIP810 V1.0

Address	Function	Contents
0x01	ASCII 'I'	**0x49**
0x03	ASCII 'P'	**0x50**
0x05	ASCII 'A'	**0x41**
0x07	ASCII 'C'	**0x43**
0x09	Manufacturer ID	**0xB3**
0x0B	Model Number	**0x01**
0x0C	Revision	**0x20**
0x0F	Reserved	**0x00**
0x11	Driver-ID Low - Byte	**0x00**
0x13	Driver-ID High - Byte	**0x00**
0x15	Number of bytes used	**0x0C**
0x17	CRC	**0x9D**

Table 4-2 : ID PROM Contents TIP810 V2.0

Address	Function	Contents
0x01	ASCII ‘I’	**0x49**
0x03	ASCII ‘P’	**0x50**
0x05	ASCII ‘A’	**0x41**
0x07	ASCII ‘C’	**0x43**
0x09	Manufacturer ID	**0xB3**
0x0B	Model Number	**0x01**
0x0C	Revision	**0x30**
0x0F	Reserved	**0x00**
0x11	Driver-ID Low - Byte	**0x00**
0x13	Driver-ID High - Byte	**0x00**
0x15	Number of bytes used	**0x0C**
0x17	CRC	**0x19**

Table 4-3 : ID PROM Contents TIP810 V3.0

5 TIP810 Addressing

TIP810 Address range:

SJA1000 CAN Controller Register Set:

ip_io_base_address + (0x01 to 0x3F) (lower 32byte register space)

ip_mem_base_address + (0x01 to 0xFF) (complete register space)

Interrupt Vector Register INTVEC:

ip_io_base_address + (0x41)

5.1 "BasiCAN" Mode Register Set

The lower 32bytes of the SJA1000 register space (address offset 0x01 – 0x3F) are accessible in the **IP I/O Space**. This covers the complete "BasiCAN" mode register set.

All registers are byte sized. Read accesses to write-only registers will result in a value of 0xFF on the data bus.

Register (function in Operating/Reset Mode)	Address	Access
Control Register (control/control)	0x01	R/W
Command Register	0x03	W
Status Register (status/status)	0x05	R
Interrupt Register (interrupt/interrupt)	0x07	R
Acceptance Code Register (0xFF/acceptance code)	0x09	R/(W)
Acceptance Mask Register (0xFF/acceptance mask)	0x0B	R/(W)
Bus Timing Register 0 (0xFF/Bus Timing 0)	0x0D	R/(W)
Bus Timing Register 1(0xFF/Bus Timing 1)	0x0F	R/(W)
Output Control Register (0xFF/Output Control)	0x11	R/(W)
Test Register	0x13	R
Transmit Buffer Identifier (identifier 10 to 3/0xFF	0x15	R/W
Transmit Buffer RTR, Data length (identifier 2 to 0/0xFF)	0x17	R/W
Transmit Buffer Byte 1 (data byte 1/0xFF)	0x19	R/[W]
Transmit Buffer Byte 2 (data byte 2/0xFF)	0x1B	R/[W]
Transmit Buffer Byte 3 (data byte 3/0xFF)	0x1D	R/[W]
Transmit Buffer Byte 4 (data byte 4/0xFF)	0x1F	R/[W]
Transmit Buffer Byte 5 (data byte 5/0xFF)	0x21	R/[W]
Transmit Buffer Byte 6 (data byte 6/0xFF)	0x23	R/[W]
Transmit Buffer Byte 7 (data byte 7/0xFF)	0x25	R/[W]
Transmit Buffer Byte 8 (data byte 8/0xFF)	0x27	R/[W]
Receive Buffer Identifier (identifier 10 to 3/identifier 10 to 3)	0x29	R/W
Receive Buffer RTR, Data length (identifier 2 to 0/identifier 2 to 0)	0x2B	R/W
Receive Buffer Byte 1 (data byte 1/data byte 1)	0x2D	R/W
Receive Buffer Byte 2 (data byte 2/data byte 2)	0x2F	R/W
Receive Buffer Byte 3 (data byte 3/data byte 3)	0x31	R/W
Receive Buffer Byte 4 (data byte 4/data byte 4)	0x33	R/W
Receive Buffer Byte 5 (data byte 5/data byte 5)	0x35	R/W
Receive Buffer Byte 6 (data byte 6/data byte 6)	0x37	R/W
Receive Buffer Byte 7 (data byte 7/data byte 7)	0x39	R/W
Receive Buffer Byte 8 (data byte 8/data byte 8)	0x3B	R/W
Reserved (0xFF/0xFF)	0x3D	R
Clock Divider Register	0x3F	R/W

Table 5-1 : "BasiCAN" Mode Register Set

5.2 "PeliCAN"-Mode Register Set

The complete SJA1000 “PeliCAN" mode register set is accessible in the **IP Memory Space.** (Only the lower 32bytes of the "PeliCAN"-Mode register set are accessible in IP I/O Space.) All registers are byte sized. Read accesses to write-only registers will result in a value of 0xFF on the data bus.

Register (function in Operating/Reset Mode)	Address	Access
Mode Register (mode/mode)	0x01	R/W
Command Register	0x03	W
Status Register (status/status)	0x05	R
Interrupt Register (interrupt/interrupt)	0x07	R
Interrupt Enable Register (interrupt enable/interrupt enable)	0x09	R/W
Reserved (0x00/0x00)	0x0B	R
Bus Timing Register 0 (Bus Timing 0/Bus Timing 0)	0x0D	R/(W)
Bus Timing Register 1(Bus Timing 1/Bus Timing 1)	0x0F	R/(W)
Output Control Register (Output Control /Output Control)	0x11	R/(W)
Test Register	0x13	R
Reserved (0x00/0x00)	0x15	R
Arbitration Lost Capture Register (ALC/ALC)	0x17	R
Error Code Capture Register (ECC/ECC)	0x19	R
Error Warning Limit Register (EWL/EWL)	0x1B	R/(W)
RX Error Counter Register (RX Error Counter/RX Error Counter)	0x1D	R/(W)
TX Error Counter Register (TX Error Counter/TX Error Counter)	0x1F	R/(W)
TX,RX Frame information Register (TX,RX Frame information/ Acceptance Code)	0x21	R/W
TX,RX Identifier 1 Register (TX,RX Identifier 1/Acceptance Code 1)	0x23	R/W
TX,RX Identifier 2 Register (TX,RX Identifier 2/Acceptance Code 2)	0x25	R/W
TX,RX Identifier 3 Register (TX,RX Identifier 3/Acceptance Code 3)	0x27	R/W
TX,RX Identifier 4 Register (TX,RX Identifier 3/Acceptance Mask 0)	0x29	R/W
TX, RX Data 1 Register /Acceptance Mask 1	0x2B	R/W
TX, RX Data 2 Register /Acceptance Mask 2	0x2D	R/W
TX, RX Data 3 Register /Acceptance Mask 3	0x2F	R/W
TX, RX Data 4 Register /0x00	0x31	R/W
TX, RX Data 5 Register /0x00	0x33	R/W
TX, RX Data 6 Register /0x00	0x35	R/W
TX, RX Data 7 Register /0x00	0x37	R/W
TX, RX Data 8 Register /0x00	0x39	R/W
RX Message Counter Register (RX Message Counter/ RX Message Counter)	0x3B	R
RX Buffer Start Address Register (RX Buffer Start Address/ RX Buffer Start Address)	0x3D	R/W
Clock Divider Register (Clock Divider/ Clock Divider)	0x3F	R/W
Internal RAM address 0 (FIFO)	0x41	R/W
Internal RAM address 1 (FIFO)	0x43	R/W
Internal RAM address 2 (FIFO)	0x45	R/W
.	.	.

Register (function in Operating/Reset Mode)	Address	Access
.	.	.
.	.	.
Internal RAM address 63 (FIFO)	0xBF	R/W
Internal RAM address 64 (TX buffer)	0xC1	R/W
.	.	.
.	.	.
.	.	.
Internal RAM address 76 (TX buffer)	0xD9	R/W
Internal RAM address 77 (free)	0xDA	R/W
Internal RAM address 78 (free)	0xDB	R/W
Internal RAM address 79 (free)	0xDC	R/W
0x00	0xDD	R
0x00	0xDE	R
.	.	.
.	.	.
.	.	.
0x00	0xFF	R

Table 5-2 : "PeliCAN"-Mode Register Set

R/(W) : These Registers can only be written in Reset Mode!

R/[W] : These Register can only be written in Operating Mode!

R : Read only

W : Write only

When operating in "PeliCAN"-Mode the Interrupt Vector Register is still mapped to address offset 0x41 in the IP I/O Space.

5.3 Interrupt Vector Register

The Interrupt Vector Register INTVEC of the TIP810 is a byte wide read/write register located at address ip_io_base_address + (0x41).

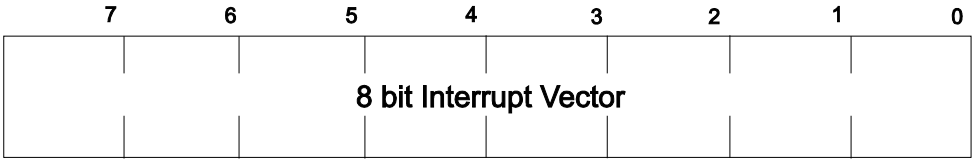

Figure 5-1: Interrupt Vector Register INTVEC

The 8-bit interrupt vector must be loaded by software during initialization of the TIP810.

The Philips SJA1000 CAN controller can generate interrupts on interrupt request line INTREQ0/ of the IP bus.

Detailed Interrupt Status information can be obtained by read accesses to the Interrupt Register of the SJA1000 at offset 0x07. Read accesses will reset all interrupt status bits except for the receive interrupt bit.

Each single interrupt source of the SJA1000 CAN controller can be enabled/disabled in the Interrupt Enable Register of the SJA1000 at offset 0x09.

6 Programming

6.1 Initialization of the Hardware

The Output Control Register of the Philips SJA1000 CAN controller must be programmed for the two physical interfaces.

Set the SJA1000 Output Control Register (Offset 0x11) to value 0xDA for CAN High Speed and Modified RS485.

6.2 Programming of the SJA1000 Controller

For programming the SJA1000 CAN controller please refer to the SJA1000 data sheet.

7 Installation

7.1 Configuration of the TIP810

The TIP810 must be configured by the jumper field J1 for the desired physical interface:

CAN High Speed	Jumper 1 – 3 and 2 – 4 installed.
mod. RS485	Jumper 3 – 5 and 4 – 6 installed.

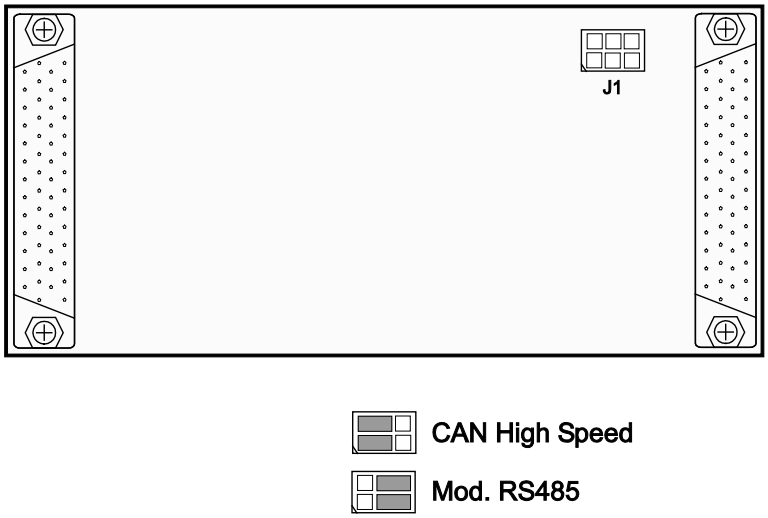

Figure 7-1: Jumper Configuration

7.2 Bus Line Termination

To reduce the stub length of the TIP810 to a minimum, the CAN bus lines for high speed and for mod. RS485 are connected twice to the IP I/O connector. This means that the CAN bus is routed through the TIP810.

No termination is provided on board of the TIP810. If the TIP810 is located at one extreme end of the CAN bus lines then external termination must be provided.

The CAN bus lines must be terminated at both extreme ends of the cable with a resistor, connected between both CAN bus lines (CAN_H and CAN_L). Resistor value should be equal to the impedance of the twisted pair (typical 120 ohms).

8 Pin Assignment

8.1 Pin Assignment of 50 pin I/O flat cable

The 50-pin flat cable from the IP carrier board will be split into four 9-pin sections. Two sections of the 50 pin flat cable are routed to the CAN High Speed driver and the other two sections are routed to the modified RS485 driver.

8.1.1 CAN High Speed (Pin 01 - 18) TIP810

The line 1 – 9 fit directly to a 9 pin SUB-D male connector. The assignment of the 9 pin SUB-D connector meets the suggestion of the CiA (CAN in Automation). Line 1 – 9 is connected on board with line 10 – 18. With this it is very easy to connect the TIP810 to the CAN bus.

I/O Line	9 pin SUB-D	Description according to CIA
1	1	Reserved
2	6	(GND, Optional Input Ground)
3	2	CAN_L bus line CAN High Speed
4	7	CAN_H bus line CAN High Speed
5	3	GND (Ground)
6	8	Reserved (Error line)
7	4	Reserved
8	9	(V+, Optional Input Power)
9	5	Reserved
++		
10	1	Reserved
11	6	(GND, Optional Input Ground)
12	2	CAN_L bus line CAN High Speed
13	7	CAN_H bus line CAN High Speed
14	3	GND Ground
15	8	Reserved
16	4	Reserved
17	9	(V+, Optional Input Power)
18	5	Reserved

Table 8-1 : Pin Assignment for CAN High Speed

8.1.2 CAN with modified RS485 (Pin 33 – 50) TIP810

The line 42 – 50 fit directly to a 9 pin SUB-D male connector. The assignment of the 9 pin SUB-D connector meets the suggestion of the CiA (CAN in Automation). Lines 42 – 50 are connected on board with line 33 – 41. With this it is very easy to connect the TIP810 to the CAN bus.

I/O Line	9 pin SUB-D	Description according to CIA
33	1	Reserved
34	6	(GND, Optional Input Ground)
35	2	CAN_L bus line RS485
36	7	CAN_H bus line RS485
37	3	GND (Ground)
38	8	Reserved (Error line)
39	4	Reserved
40	9	(V+, Optional Input Power)
41	5	Reserved
++		
42	1	Reserved
43	6	(GND, Optional Input Ground)
44	2	CAN_L bus line RS485
45	7	CAN_H bus line RS485
46	3	GND (Ground)
47	8	Reserved (Error line)
48	4	Reserved
49	9	(V+, Optional Input Power)
50	6	Reserved

Table 8-2 : Pin Assignment for CAN Mod. RS485