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MICRONAS

Application Note

HAL® 1820, HAL 24xy, HAL 28xy, HAL 36xy, HAL 38xy

Application Board HAL-APB V1.x

3D HAL® by Micronas

vario HAL® by Micronas

Edition Oct. 8, 2012
APN000055_003EN

License Note

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Contents

Release Note:	**Revision bars indicate significant changes to the previous edition.**

1. Introduction

1.1. General Information

The hardware and software description in this document is valid for the Application Board HAL-APB V1.x.

Fig. 1–1: Application Board HAL-APB V1.x

1.2. Introduction

The Application Board HAL-APB V1.x (HAL-APB) is an board for programming the Micronas Hall-effect sensor families with analog and digital output formats. The board is equipped with a Micronas Flash micro controller CDC 3207G. It provides an application software supporting a command interface for the communication with a PC. This allows the implementation of specific PC software for engineering purposes or in-line calibration. The HAL-APB can be ordered with a housing or as a PCB version.

In the case of a housing, an additional extension board with two sockets for the connection of up to two Hall sensors (depending on the sensor type) is supplied.

Two versions of the Application Board HAL-APB are in use: version 1.3 and the updated version 1.5. Both versions are free to be used in laboratories for engineering purposes.

Note: For usage in the production, board version 1.5 is mandatory.

1.2.1. Supported HAL Sensors

The HAL-APB supports the sensors listed in Table 1–1.

Table 1–1: Supported sensors

Sensor	Remark
HAL 1820	Linear sensor with analog output
HAL 242x	Linear sensor with analog output
HAL 2810	Linear sensor with LIN 2.0 Interface
HAL 283x	Linear sensor with SENT Interface
HAL 2850	Linear sensor with fast PWM output
HAL 3625	Direct angle sensor with analog output
HAL 3675	Direct angle sensor with PWM output
HAL 385x	2D position sensor with analog output
HAL 387x	2D position sensor with PWM output

Please refer to the corresponding Programming Guides Application Notes for detailed information on the sensors listed or contact the Application Support Sensors (support_sensor@micronas.com).

1.2.2. Sensor-specific PC Software

Micronas GmbH provides easy-to-use PC software (LabView) for each supported sensor.

1.3. Board Block Diagram

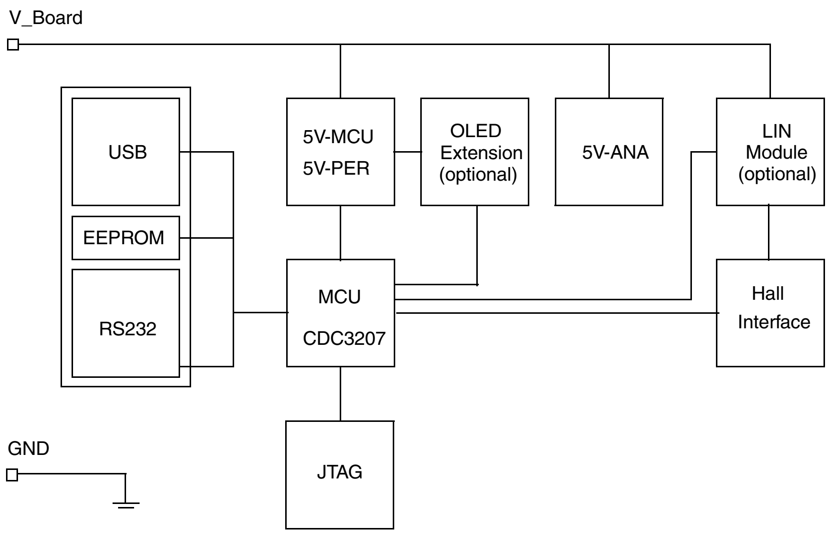


Fig. 1–2: HAL-APB block diagram

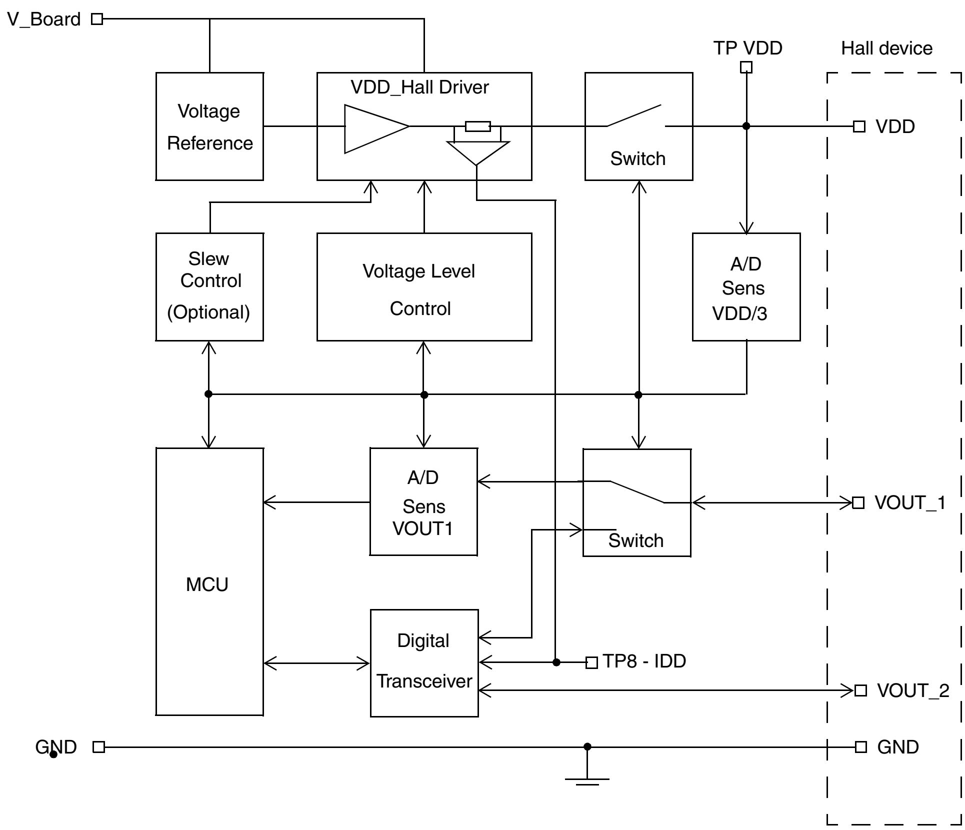


Fig. 1–3: Detailed view of HAL Interface

2. Getting started

2.1. First Steps

2.1.1. Check HAL-APB V1.x

– Connect the HAL-APB to the supply voltage.

– Check if the power-on self-test was passed successfully. (ERROR LED is switched off after power on. Exception: LIN mode)

Board Supply

The HAL-APB requires a stabilized power supply. For this purpose, either when using it without housing, the connector X2 (DC jack) or the terminal beneath it can be used.

Power-On Self-Test

The HAL-APB firmware provides a power-on self-test. The self-test is started after connecting the board supply. During the self-test, the status LEDs including the Error LED, will flash.

In case of a detected error, the ERROR LED remains illuminated after the self-test. In LIN mode the ERROR LED is switched on as long as the Vsupply of the sensor is not set to 12 V.

2.1.2. Check Communication with PC and Hall Sensor Connection

Connect a Hall sensor with the HAL-APB.

(a) directly into the socket HAL 1

or

(b) into one of the sockets of the HAL-APB extension board (housing version).

Note: For the first communication check, we recommend using the sensor specific Programming Environment LabView software provided by Micronas for the specific HAL sensor.

you can also

– set up a Hyperterminal connection (see Section 6 on page 18)

– switch Vdd on using the “vho1” command (see Section 7.2 on page 21).

– try to read out a register (see chapter of the used sensor type).

3. Board Configuration

3.1. Jumper Settings

For changing between LIN-Bus and Biphase-M communication, jumpers need to be set differently. For non-housed (optional) application boards it may be necessary to switch jumper for USB/RS-232 connection. The following pictures show how to set the jumpers correctly.

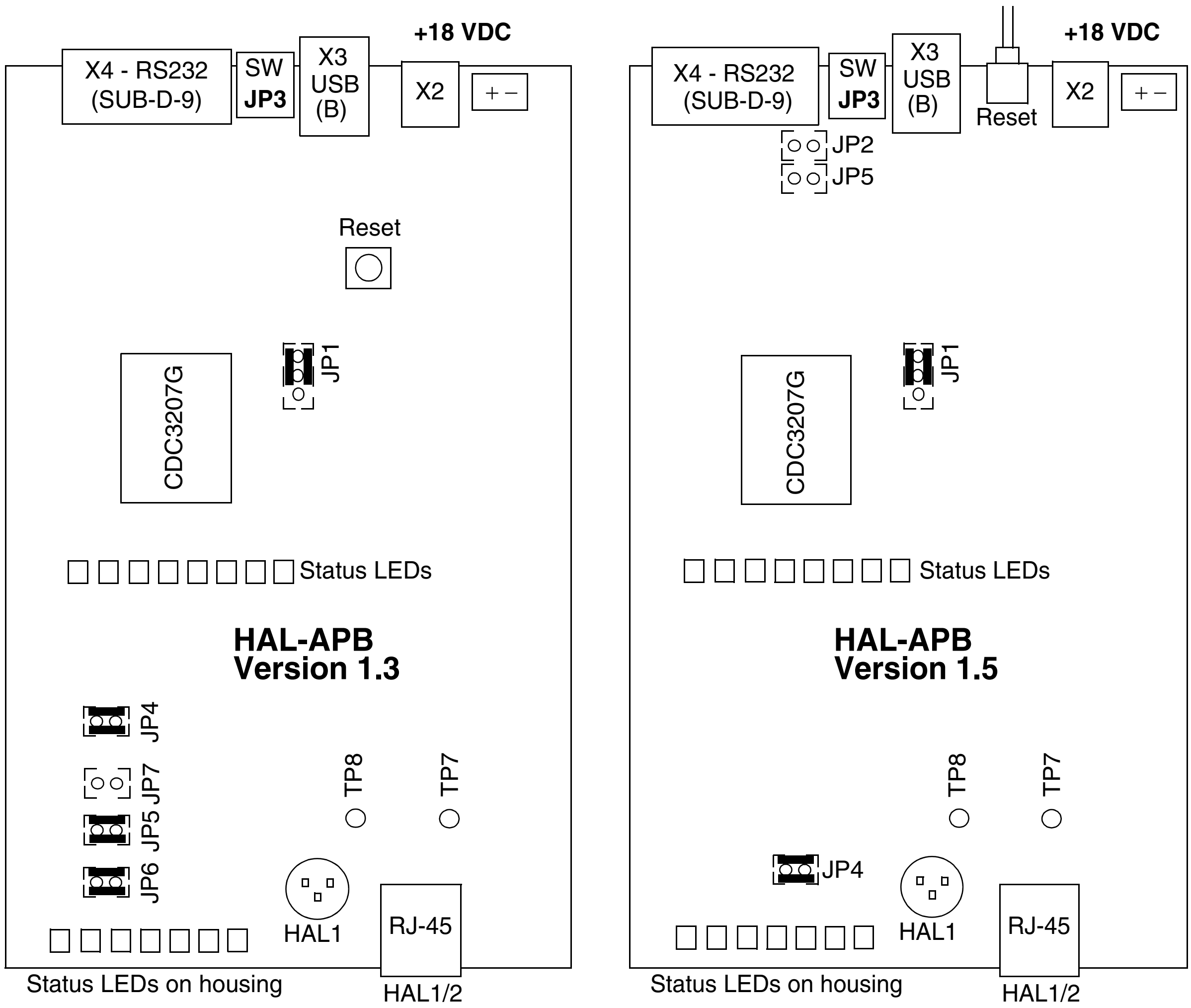


Fig. 3–1: Jumper settings HAL-APB V1.x

The default jumper position Pos1 is indicated by black bars in Fig. 3–1.

Note: For board versions higher than v1.3, no manual adjustment is required. The HAL-APB firmware automatically detects the appropriate protocol to be used for the Hall sensor.

Table 3–2: Jumper settings

Jumper	Setting	Function
JP1	pos1 (default) pos2	debug normal operation
JP2	**V1.5** open (default) close	communication via **RS232** manual MCU reset during firmware flash automatic MCU reset during firmware flash
	V1.3 pos1 (default) pos2	 normal operation reserved
JP3	close (default) open	USB RS-232
JP4	close (default) open	VDD_Hall equals GND when Vsup is switched off VDD_Hall is floating when Vsup is switched off
JP5	**V1.5** open (default) close	communication via **USB** manual MCU reset during firmware flash automatic MCU reset during firmware flash
	V1.3 close (default) open	 normal operation only for LIN Bus applications
JP6 (only V1.3)	close (default) open	normal operation only for LIN Bus applications
JP7 (only V1.3)	open (default) close	normal operation only for LIN bus applications

Note: JP7 must not be set in combination with JP4 and JP5 (only V1.3)

Table 3–3: Board LED description

LED Name	Function
ERROR	On, in case of communication error
READY	On, after power-on of board
PCCOM	On, in case of communication between PC and HAL-APB
HAL_RD	Telegram on VOUT
HAL_PR	reserved
HAL_WR	Telegram high level on Hall VDD
HAL_ON	Hall VDD on

3.2. HAL Interface Connector

Depending on the sensor type, up to two sensors can be connected to the board. For this purpose, a 6-pin connector HAL1/2 is provided. Alternatively, one Hall Sensor can be inserted in the 3-pin socket HAL beneath the connector HAL1/2 (only available for boards without housing).

The following pin's are connected in parallel Pin No. 1(V_{SUP}Sensor1) and 4 (V_{SUP}Sensor2) and Pin No. 2 (Common Sensor GND) and Pin No. 5 (Common Sensor GND). The male plug (modular RJ-12, OST (MMJ) coding) corresponding to the fawn connector HAL1/2 can be ordered from every electronics store. The pinning of the interface is described in Table 3–4.

Table 3–4: Pinning of the HAL interface HAL1/2

Pin No.	Description
1	Sensor input V_{SUP} Sensor 1
2	Common Sensor GND
3	Sensor output $V_{OUT/DIO}$ Sensor 1
4	Sensor input V_{SUP} Sensor 2
5	Common Sensor GND
6	Sensor output $V_{OUT/DIO}$ Sensor 2

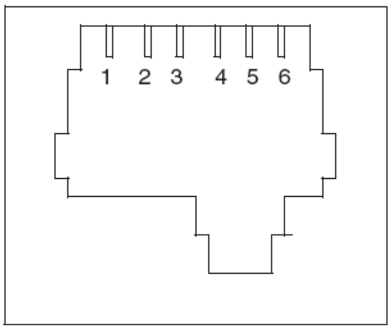


Fig. 3–2: Modular connector HAL1/2, front view

3.3. Firmware update

The procedure for a firmware update of the HAL-APB V1.x is provided in the Application Note “Firmware Update HAL-APB V1.x”

4. Specification

4.1. Recommended Operating Conditions

All voltages are referenced to GND (-VB pin at X1 = GND at X2)

Table 4–5: Board conditions

Symbol	Parameter	Connector	Limit Values			Unit	Test Conditions
			Min.	Typ.	Max.		
I_{SUP}	Supply Current	X2	-	180	-	mA	
V_{SUP}	Supply Voltage	X2	16	18	20	V	
C_L	Load Capacitance	HAL1/2	-	-	100	nF	

4.2. Recommended Wiring

We recommend connecting the application to the board using shielded wires.

In order to minimize the risk of electromagnetic disturbances, the cable should be as short as possible.

Note: Especially in noisy environments beneath power switches, electromagnetic actuators, and the like, EMI-compliant layout of the wiring is mandatory.

For recommended cable parameters, please refer to Table 4–6.

4.3. Maintenance and Calibration

We recommend sending the programmer board back to the supplier for maintenance and calibration of the voltage levels after one year of operation.

The Hall programmer board must not be maintained or repaired by the customer. In case of any problems or defects, please contact your supplier.

WARNING: Do not modify any part of the Hall programmer board V 1.x, nor readjust any trimming potentiometer. Otherwise, the board may be damaged, the sensor programming may be insufficient, and the reliability of the sensor reduced.

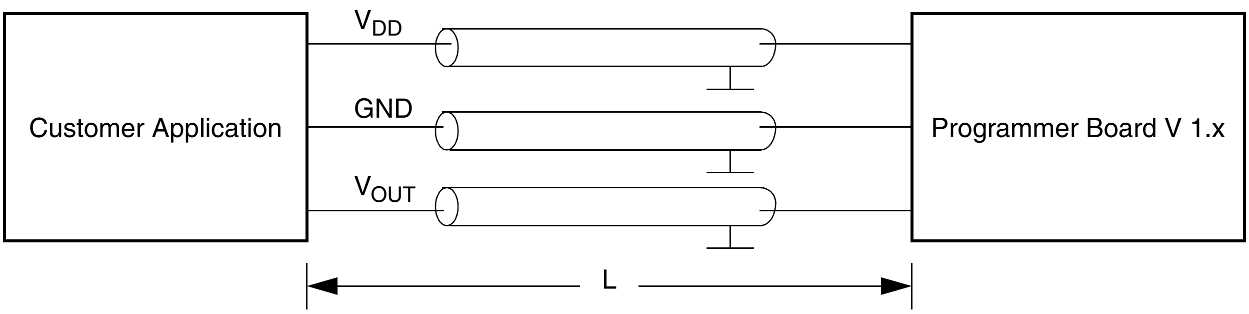


Fig. 4–3: Recommended wiring - schematic sketch

Table 4–6: Recommended cable parameters

Symbol	Parameter	Min.	Typ.	Max.	Unit	Conditions
R_0	Ohmic Resistance per Wire	–	1	5	Ω	$I \leq 10$ mA
C_0	Capacitance	–	80	120	pF	
Z	Impedance	–	50	–	Ω	
L	Length	–	–	1	m	

4.4. Characteristics

All voltages are referenced to GND (-VB pin at X1 = GND at X2)

Table 4–7: Board characteristics

Symbol	Parameter	Connector	Limit Values			Unit	Test Conditions
			Min.	Typ.	Max.		
I_{SUP_HAL}	Output Load Current	HAL1/2	-	-	40	mA	Supply current per device
V_{OUT_HAL}	Output Voltage of Hall Device	HAL1/2	0 0	-	5 18	V V	Standard configuration (default) LIN configuration only!
$V_{SUP\_HAL\_NORM}$	NORM Level of HAL Supply Voltage	HAL 1/2	4.9	5	5.1	V	
$V_{SUP\_HAL\_LOW}$	LOW Level of HAL Supply Voltage	HAL 1/2	5.8	6.0	6.6	V	
$V_{SUP\_HAL\_HIGH}$	HIGH Level of HAL Supply Voltage	HAL 1/2	6.8	7.3	7.8	V	

Note: The voltage levels are trimmed by the manufacturer. If any of the levels listed are found to be outside the specification limits, please contact the manufacturer or the Application Support Sensors Team.

The RS232 cable should be a standard serial cable. Also called straight cable.

5. USB Driver Installation

Note: When using the serial cable you do not need to install this drivers. They are only necessary for connecting the Application Board HAL-APB V1.x via USB cable to the PC.

5.1. Installing the USB VCP Drivers

Plug in the Application Board HAL-APB V1.x (Power supply also connected) into a spare USB port and plug in the power supply.

Windows 7 will automatically search latest driver if the PC is connected to the internet. If there are problems with the installation follow the application note: “AN_119_FTDI_Drivers_Installation_Guide_for_Windows7.pdf”

The application note: “AN_104_FTDI_Drivers_Installation_Guide_for_WindowsXP.pdf” can be used to install the driver on a windows xp system.

The application note can be either found on the Micronas Service Portal (https://service.micronas.com/workgroups/) or on the FTDI homepage.

Note: Sometimes the installer repeats the whole procedure. If this happens please do the same as explained above again.

6. Board Functions

6.1. Serial Command Interpreter

This board provides a serial command interpreter for the interaction with a PC, connected via USB or RS232.

The serial communication protocol applies a software handshake:

– The PC acts as a master, the HAL-APB V1.x as slave,

– The HAL-APB V1.x responds to each master **COMMAND** frame with a **RESPONSE** frame.

6.1.1. Serial Interface Configuration

When using a hyperterminal communication please set the following parameters.

Table 6–8: parameter settings of serial interface

Parameter	Value
Bits per second	38400
Data bits	8
Parity	Even
Stop bits	1
Flow control	none

6.1.2. Definition of the COMMAND Frame

The command frame is of variable length. There are basically two types of commands:

1. for board configuration
2. for communication with connected Hall device

The command string has to end with <CR> (ASCII character 0x0D), optionally with <CR><LF> (ASCII characters 0x0D, 0x0A).

6.1.3. Definition of the RESPONSE Frame

The **response** frame consists of 7...10 characters plus 1 finishing <LF>

<ST>:<R9><R8>....<R2><R1><R0> <LF>

ST is non-zero in case of errors (see Table 6–9)

The Rx-characters contain the received data depending on the command (see device-dependent command lists in section 9, 10,...).

6.1.4. Analog Measurements

Its also possible to measure analog voltages, as the HAL_VDD or the HAL_VOUT with the ADC of the HAL-APB. The HAL_OUT is only correctly measurable when HAL_VDD equals 5 V.

Example

ftvdl0 (set VDD to 5 V)
ftana1 (measure HAL_VDD)
ftana2 (measure HAL_VOUT)

V_{DD} = DATA / 1024 x 3 x 5V

V_{OUT} = DATA / 1024 x 5V

DATA is measured by ftana command as explained in Table 7–11.

6.1.5. Error Codes

Table 6–9: Error codes

STATUS	Error
0	no error
1	acknowledge error
2	2'nd Acknowledge error
3	invalid command for selected Mode
4	PID in running table cannot be modified (LIN)
5	LIN communication Error
6	LIN interface connection Error
7	no PWM (at PWM Duty Cycle read command)
8	reserved
9	reserved
10 (0xA)	reserved
11 (0xB)	reserved
12 (0xC)	reserved
13 (0xD)	data read error
14 (0xE)	invalid command parameter
15 (0xF)	invalid command

7. Board Mode Settings

7.1. Board Operation Modes

In order to meet the different requirements of the various Hall devices, the board can be run in different operation modes. When a particular device is used, the corresponding board mode has to be selected first. The mode list can be displayed by sending the board command “?m”.

Table 7–10: Board modes

Mode	Description
8	HAL 2810 – LIN Mode
9	HAL 283x/50 – Biphase via DIO- Pin
A	HAL 1820 – Biphase via V_{SUP} Pin HAL 24xy – Biphase via V_{SUP} Pin HAL 3625 – Biphase via V_{SUP} Pin HAL 3675 – Biphase via V_{SUP} Pin HAL 38xy – Biphase via V_{SUP} Pin
C	HAL 24xy – Biphase via OUT - Pin HAL 3625 – Biphase via OUT - Pin HAL 3675 – Biphase via OUT - Pin HAL 38xy – Biphase via OUT - Pin

7.2. Board Configuration Commands

The board configuration commands shall be used to

– select the board mode
– set/read configuration data like the bit time or firmware version
– control the power supply V_{DD_HAL} of the connected sensor

Table 7–11: Board configuration

Action	Command	Parameter	Remarks
get firmware version	?v	return <ST>:*[Version]*	firmware release version Example => ?v <= 0:v2.32
show available board modest	?m	-	returns a list of board modes available

Table 7–11: Board configuration

Action	Command	Parameter	Remarks
set board mode	sm**N**	**N** see Table 7–10 on page 21 for details return value: <ST>:0000**N**	switch board to device specific mode Example => smA <= 0:0000A
Switch V_{SUP_HAL} on	vho1	return value: <ST>:00001	supply voltage on (default 6 V; see voltage levels for details) Example => vho1 <= 0:00001
Switch V_{SUP_HAL} off	vho0	return value: <ST>:00000	supply voltage off => vho0 <= 0:00000
For factory tests only			
set low voltage level	ftvdl**X**	**X** = 0: V_{SUP}= 5V **X** = 1: V_{SUP} = 6V	normal V_{SUP} low level for Biphase-M protocol, if programming via V_{SUP}-Pin
set high voltage level	ftvdh**X**	X = 0: V_{SUP} = 5V X = 1: V_{SUP} = 7.5V (if ftvdl0) X = 1: V_{SUP} = 8V (if ftvdl1)	high level for Biphase-M protocol, if programming via V_{SUP}-Pin
set programming voltage	ftvdp**X**	X = 0: V_{SUP}= 5V (if ftvdl0 and ftvdh0) X = 1: V_{SUP} = 12V (if ftvdl0 and ftvdh0) X = 1: V_{SUP} = 12.5V (if ftvdl1 and ftvdh0) X = 1: V_{SUP} = 14.5V (if ftvdl0 and ftvdh1) X = 1: V_{SUP} = 15V (if ftvdl1 and ftvdh1)	for LIN-Mode
force output voltage	ftsme**X**	**X** = 1: force output voltage to high state X = 0: release output	
switch output pull-up resistor on/off	ftpon**X**	X = 0: pull-up off X = 1: pull-up on	for open-drain devices you need the pull-up resistor
select I/O channel	ftses**N**	N = 1 or 2 return value: <ST>:0000N	N = 1 HAL1 N = 2 HAL 2 only possible in combination with programming via OUT-Pin.
set Bit time	sbt**BT**	BT = 000A... 0D48 (10us...3.4ms) return value: <ST>:00000	bit time in µs as 4-digit hex No. (defaul=0x03E8)
measure V_{SUP}	ftana1	ftana1 "\n" return value: <ST>:000000	measure the supply voltage with HAL-APB's ADC Example => ftana1 <= 0:00177 0x00177 = 375(dec) * 15 / 1024 = 5.49 V

Table 7–11: Board configuration

Action	Command	Parameter	Remarks
measure VOUT_HAL	ftana2	ftana1 "\n" return value: <ST>:000000	measure the analog output voltage of sensor 1 with HAL-APB's ADC Example => ftana2 <= 0:00200 0x00200 = 512(dec) * 5 / 1024 = 2.5 V only for Sensor 1 available
read PWM-Period and Pulse width[1)]	pr**N**	**N** = 0 / 1 return value: <ST>:<P4><P3><P2><P1><P0><W4><W3><W2><W1><W0>	**N** trigger on falling/rising PWM edge <ST> board status <P> 5 digit Period <W> 5 digit Pulse width *Example* => pr1 (OP-bit=0) <= <ST>:013AE00A00 - Conversion of PWM-Period: 0x013AE = 5038_{dec} / 10000 = 0,5ms - Conversion of Pulse width: 0x00A00 = 2560_{dec} / 10000 = 0,26ms - Calculation of Duty-Cycle: 2560/ 5038 = 50,8%
get Bit time	?bt	return value: <ST>:**BT**	BT as a 5-digit hex No.
get last acknowledge time	?ack	return value: <ST>:0x**ACK**	ACK as a 4-digit hex No. returns the width of last acknowledge pulse

[1)]Available with firmware versions greater then 2.32. With firmware versions less then 2.32 this command is only available in mode 9.

<ST> = Board Status character see from Section 6.1.5 on page 20 onwards for details

8. HAL 1820

The HAL 1820 is a universal magnetic field sensor with a linear output, based on the Hall effect. Magnetic field, perpendicular to the branded side of the sensor provides a output voltage direct proportional to the applied magnetic flux through the Hall plate and proportional to the supply voltage (ratiometric behavior). Details on features and specification are described in the data sheet.

8.1. Programming interface

The sensor is programmed via supply voltage modulation. After detecting a command, the sensor reads or writes the memory and answers with a digital signal on the output pin.

A logical “0“ is coded as no level change within the bit time. A logical “1“ is coded as a level change of typically 50% of the bit time. After each bit, a level change occurs (see Fig. 8–1).

The serial telegram is used to transmit the EEPROM content, error codes and digital values of the magnetic field from and to the sensor.

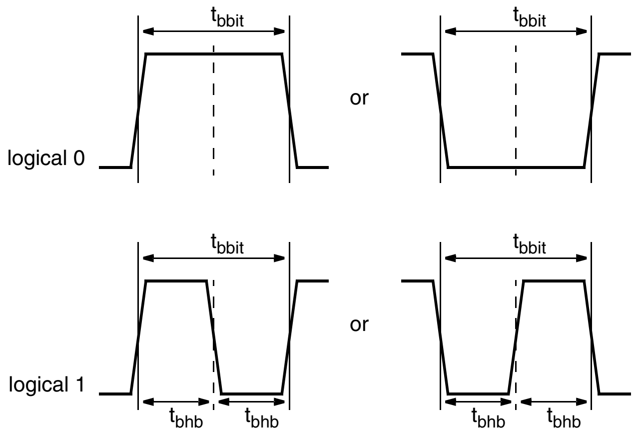


Fig. 8–1: Definition of logical 0 and 1 bit

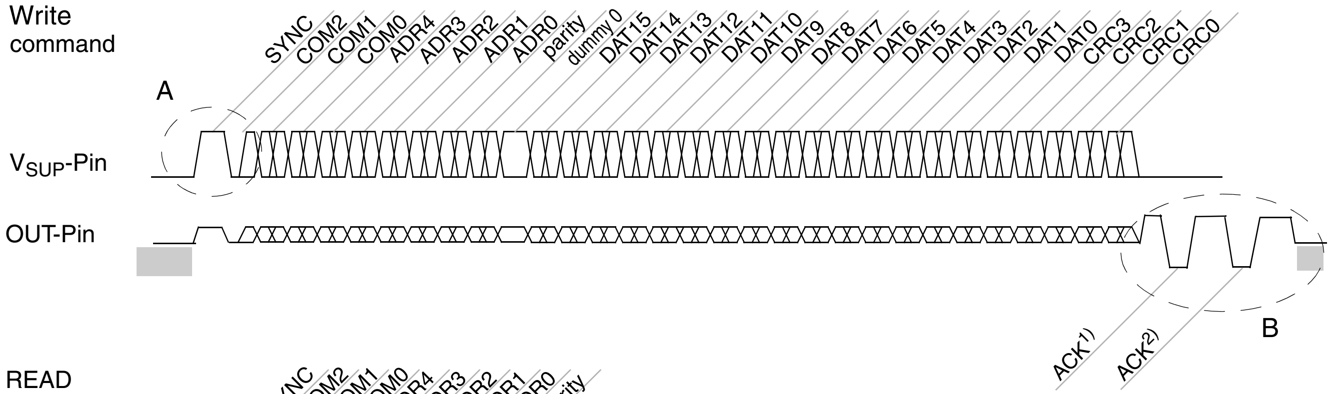
8.2. Command Structures of Protocol

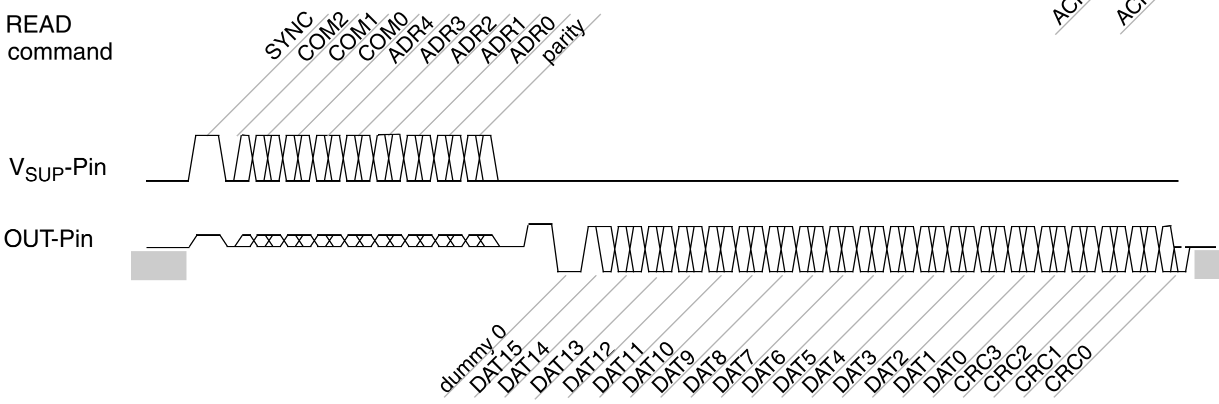
COM: command bit
ADR: address bit
parity: command and address check bit
dummy: dummy bit (always 0)

SYNC: start bit (always 0)
DAT: data bit
CRC: CRC bit

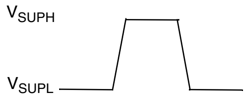
ACK: acknowledge
: Analog Output

Communication via V_{SUP}-Pin (Biphase-In = V_{SUP}-Pin / Biphase-Out = OUT-Pin)

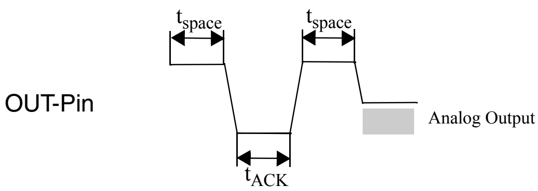




Detail A

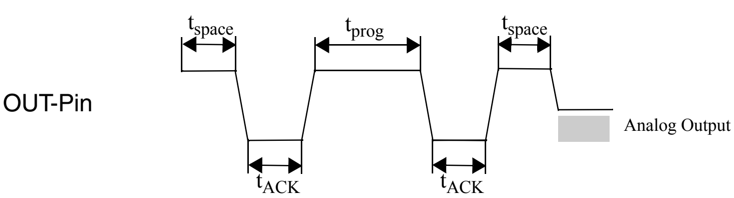


Detail B



[1)]One Acknowledge if a register is written (except the NVPROG register)

Detail B



[2)]2nd Acknowledge only if the NVPROG register is written and the erasing or programming was successful