



How to Program TLI4970 – Quick Instruction Guide

Scope:

The following instructions describe the sequence of commands how the TLI4970 current sensors can be programmed.

Interface:

The communication with the sensor is performed by the one wire SICI interface. In Addition, during the programming commands a voltage of 20.5V has to be provided at the CS pin.

Physical Layer

Serial Inspection and Configuration Interface (SICI)

This chapter gives an overview about the Serial Inspection and Configuration Interface (SICI). This interface is available and functional in parallel with the SPI interface mode. For this, the OCD pin is used.

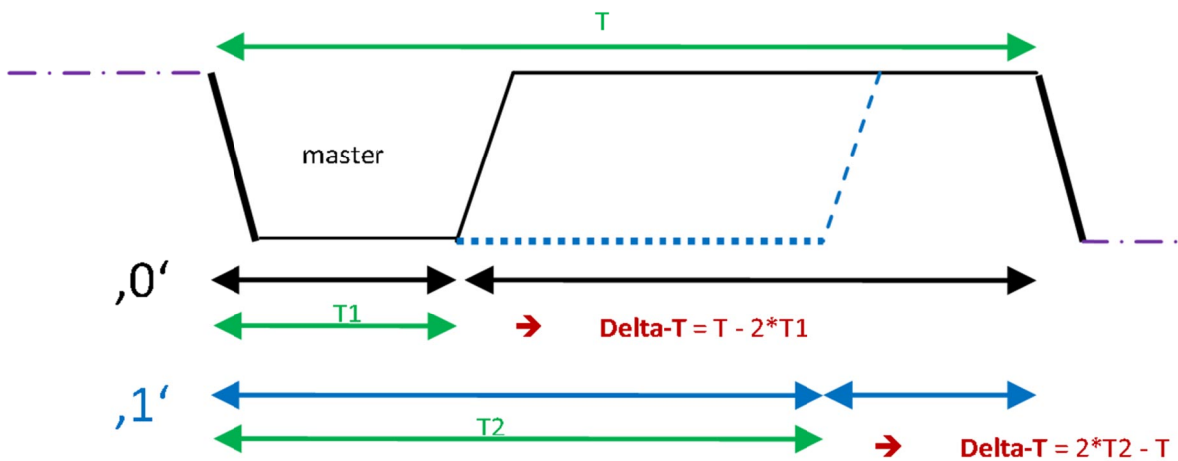
The transmission is based on transmitting a single bit to the sensor and immediately receiving a bit. These bits form a 16bit command word, similar to the SPI interface. This makes the interface bit-synchronous (and thus robust) and very flexible in timing (within some quite large boundaries).

Communication Timing

A microcontroller needs to perform the following steps 16 times to send/receive 16 bits (starting with MSB).

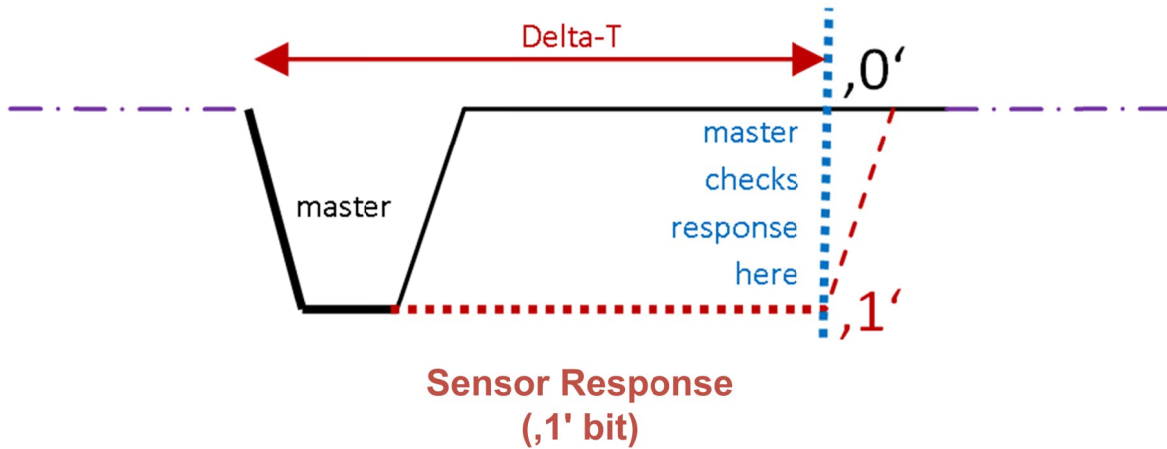
- Send a single low/high PWM transmission, with at least 30/70 (or 70/30) duty cycle:
 - 0 is sent as a short low and long high PWM pulse (e.g. 2us low, 6us high)
 - 1 is sent as a long low and short high PWM pulse (e.g. 6us low, 2us high)

The initial pulse length (T1/T2) and the overall period T determines the read-out time "Delta-T". An example of a 1 bit transmission can be seen in below:

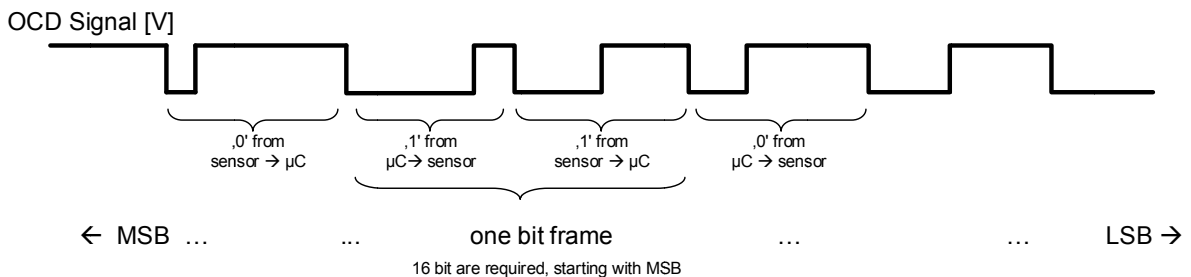


- Send a short low pulse (marks the end of the transmitted PWM and syncs the sensor to send a bit)
- If the sensor transmits a 1, it pulls the output low for the time difference given by the transmitted PWM (see figure above: $6\mu s - 2\mu s = 4\mu s$)
- If the sensor transmits a 0, it does not pull the output low

By checking the output after the read-out time (determined by the time given by the previous PWM transmission of a bit "Delta-T", for this case $4\mu s$), the microcontroller can determine if a 0 or 1 is transmitted by the sensor. See below a 1 bit response example from the TLI4970:



The figure below shows a transmission through the OCD pin as could be seen using an oscilloscope:

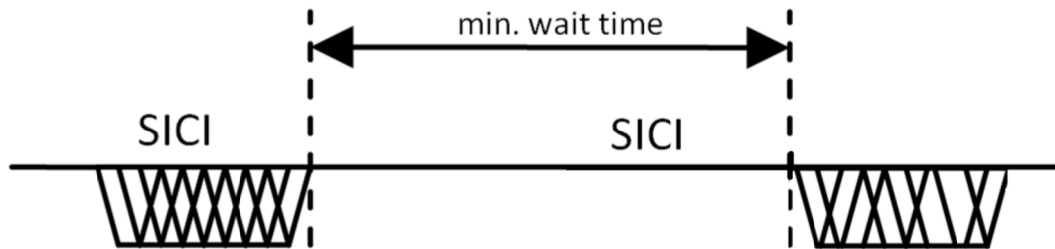


- Typical bit transmission speed (PWM) is: $\sim 0.4\mu s$ / $\sim 1.6\mu s$, check after $\sim 1.1\mu s$, wait $\sim 0.4\mu s$ (gives $\sim 285\text{ kBit/s}$).

- Slowest bit transmission (PWM) is: $\sim 60 \mu\text{s}$ / $\sim 90 \mu\text{s}$, check after $\sim 29 \mu\text{s}$, wait $\sim 21 \mu\text{s}$ (gives $\sim 5 \text{ kBit/s}$).

The slowest mode may be useful in distorted environments and/or with high (capacitive) loads on the SICI interface.

Please take care to wait between SICI frames to allow the sensor to decode and process the data. Minimum wait time between cycles for read/write and test commands (except EEPROM): $25 \mu\text{s}$ (EEPROM commands may take longer).



Data Link Layer

Sequence of Commands:

Algorithm freeze

SICI in	SICI out	Command	Note
AABF _h	don't care	Algorithm freeze	Necessary; stops any other activities not to get in conflict while programming the EEPROM

Refresh EEPROM

SICI in	SICI out	Command	Note
8018 _h	don't care	EEPROM refresh	To be sure the correct EEPROM content is applied

Read EEPROM Register (optional)

Read EEPROM register required to define, if any changes are necessary.

Read command:

Bit:	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Content:	1	0	register address					0	0	0	0	0	0	0	0	0

Please insert for “register address” the register you like to read out. E.g. for changing the low pass filter cut-off frequency, read EEPROM register 0x00. Here, bit [13:8] has to set to ‘000000’. Therewith, the actual content will be read out.

Note: With the 1st read command, the response will not have the content of this register. Every answer is delayed by one command (n-1). Either, a dummy command has to be send (e.g. the same command again), or the next register can be addressed to read out.



Write EEPROM Register

Define the new content of the register.

Send the write command:

Bit:	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Content:	1	0	register address					0	0	0	0	0	0	0	0	1

Again, the “register address” has to set the right address, e.g. ‘000000’ to address EEPROM register 0x00.

The next command must be the data content of this register, e.g. for 18kHz cut-off frequency of the low pass filter (EEPROM register 0x00 influence the cut-off frequency):

Bit:	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Content:	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	1

Provide Programming Voltage

Now, the CS pin (pin 5) must be provided with the 20.5 V programming voltage.

Attention: If the sensor is already mounted on PCB, make sure you have additional hardware implemented to protect the controller for any overvoltage levels!

1st Programming Command

The next step will program all changes where the content has afterwards the value ‘0’.

Therefore, following command has to send:

Bit:	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Content:	1	0	0	0	0	1	0	0	0	0	0	1	1	0	1	0

Bit [10:8] influence the time of the internal programming pulse; typ. this setting is an adequate one.

Note: Keep the programming voltage level at pin CS!

Note: Observe the DIO pin: It will be on “high” during the programming (busy) and will be set to “low” when the programming is finalized. Afterwards further commands can be set.

Refresh EEPROM

SICI in	SICI out	Command	Note
8018 _h	don't care	EEPROM refresh	To be sure the correct EEPROM content is applied

Write EEPROM Register again

With the first command, just the ‘0’ value has been programmed. To program also the ‘1’ content, the register has to be written again with the final data.

Therefore, send the write command again:

Bit:	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Content:	1	0	register address					0	0	0	0	0	0	0	0	1

Afterwards, the next command with the correct content has to be sent. E.g. like following to modify the low pass filter cut-off frequency:

Bit:	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Content:	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	1

2nd Programming Command

The second programming command will write all '1'.

Following command has to send:

Bit:	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Content:	1	0	0	0	0	1	0	0	0	0	0	1	1	0	1	1

Note: Observe the DIO pin: It will be on "high" during the programming (busy) and will be set to "low" when the programming is finalized. Afterwards further commands can be set.

Turn off the Programming Voltage

Now, the programming process itself is finalized. The 20.5 V programming voltage has to be turned off.

Verify Programming Quality

The programming of the EEPROM is based on an iteration process of programming pulses. After every pulse the sensor checks automatically the margin level and if necessary the pulses are repeated as long as the margin level is correct. The maximum no. of pulses is 127. It is strongly recommended to avoid the maximum no. of pulse iterations (a sufficient margin level cannot be guaranteed). The no. of needed iterations can be find out by reading the content of register 29_h.

Bit:	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Content:	1	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0

Bits [14:8] of the response give the no. of needed programming pulses. In case this no. is very low, the length of a programming pulse shall be decreased by decreasing the value [10:8] of every programming command (bits have gray background in the 1st & 2nd programming command description above, example is given for the value 4_b). In case the no. is very high or even maximum of 127, the value shall be increased.

Reset

To be sure the sensor is working proper again after programming; a reset has to be performed. Best way to do this is the power-down off VDD.

However, also a software reset is possible. Therefore, please send following command (7FFF_h):

Bit:	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Content:	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1



Edition 2015-08-15
Published by
Infineon Technologies AG
81726 Munich, Germany
© 2015 Infineon Technologies AG
All Rights Reserved.

Legal Disclaimer

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics. With respect to any examples or hints given herein, any typical values stated herein and/or any information regarding the application of the device, Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind, including without limitation, warranties of non-infringement of intellectual property rights of any third party.

Information

For further information on technology, delivery terms and conditions and prices, please contact the nearest Infineon Technologies Office (www.infineon.com).

Warnings

Due to technical requirements, components may contain dangerous substances. For information on the types in question, please contact the nearest Infineon Technologies Office.

Infineon Technologies components may be used in life-support devices or systems only with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support device or system or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.