TMC428 – Application Note

Half Stepping using L9935 Driver

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Introduction

The build-in microstep sequencers of the TMC428 provide microstepping with different resolutions. Some stepper motor drivers just support half stepping, which may be sufficient for some applications. This application note describes how to configure the TMC428 to drive L9935 stepper motor drivers in current compensated half step mode.

The performance of half stepping vs. microstepping can be simply evaluated with the TMC428-Evaluation-Kit, which is available from TRINAMIC (please contact ***info@trinamic.com*** for details).

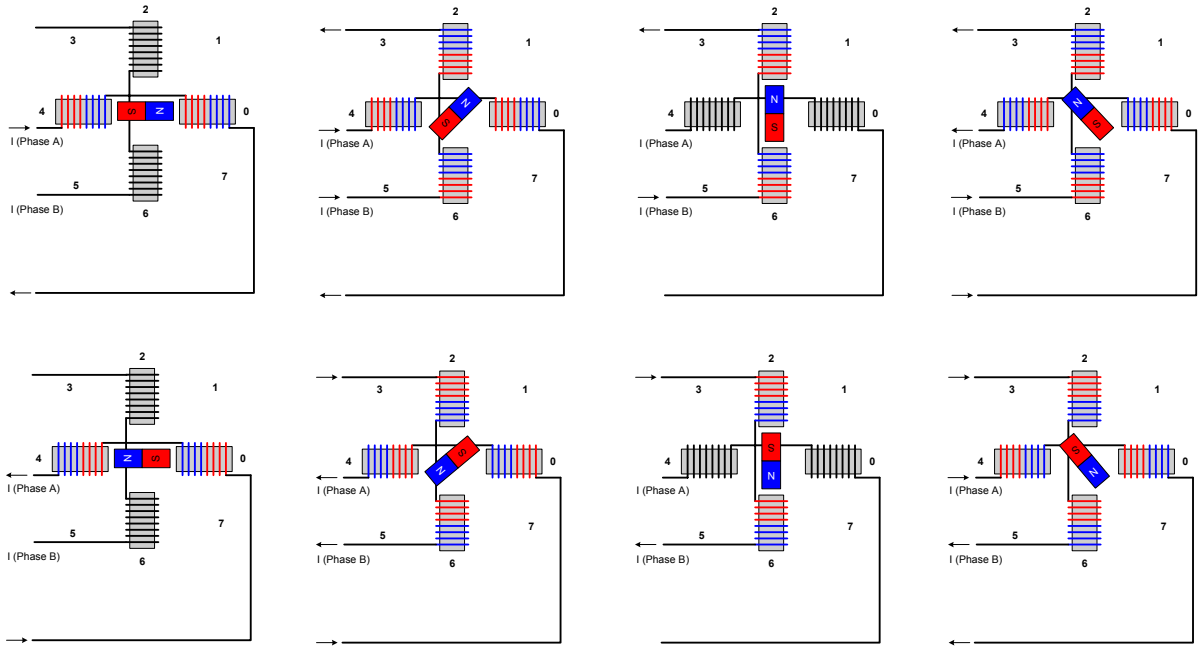


Figure 1 - Half Stepping Scheme

Interface Configuration

In half stepping with a two-phase stepper there are two different kinds of positions. Full step positions (1, 3, 5, 7 Figure 1), where both phases are switched on, and half step positions (0, 2, 4, 6 Figure 1), where only one phase is switched on. To have a constant thermal dissipation loss, at full step positions the currents for each phase has to be reduced by a factor of square root of two. This current compensated half stepping can be realized as described in the following.

The L9935 datagram bits, the TMC428 primary signal mnemotics and TMC428 primary signal codes are

	D7	***D6***	***D5***	***D4***	***D3***	***D2***	***D1***	***D0***
L9935	1	1	current scale phase B		phase B	current scale phase A		phase A
428 signal	***one***	***one***	***DAC_B_5***	***DAC_B_4***	***PH_B***	***DAC_A_5***	***DAC_A_4***	***PH_A***
428 code	***$11***	***$11***	***$0D***	***$0C***	***$0E***	***$05***	***$04***	***$06***

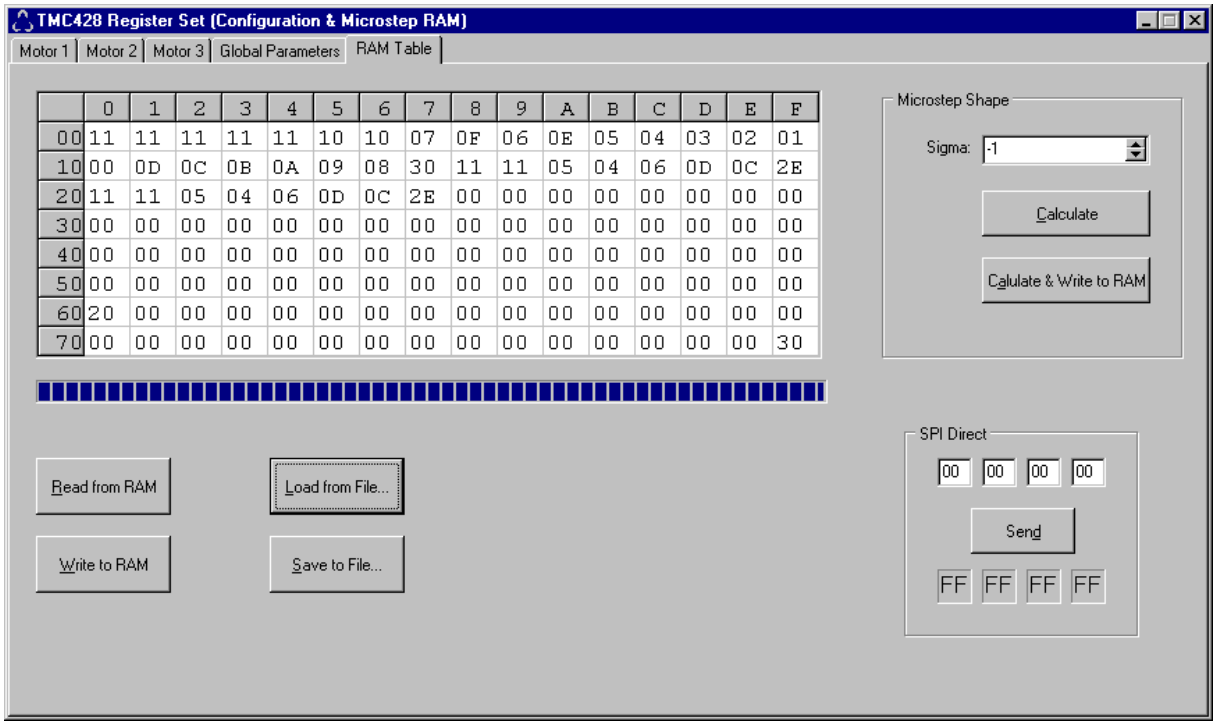
with

D2	***D1***	***D0***	
current scale phase B		***polarity of current of phase B***	***current of phase B***
1	1	0	0 mA
1	0	0	60 mA
0	1	0	550 mA
0	0	0	900 mA
1	1	1	0 mA
1	0	1	-60 mA
0	1	1	-550 mA
0	0	1	-900 mA

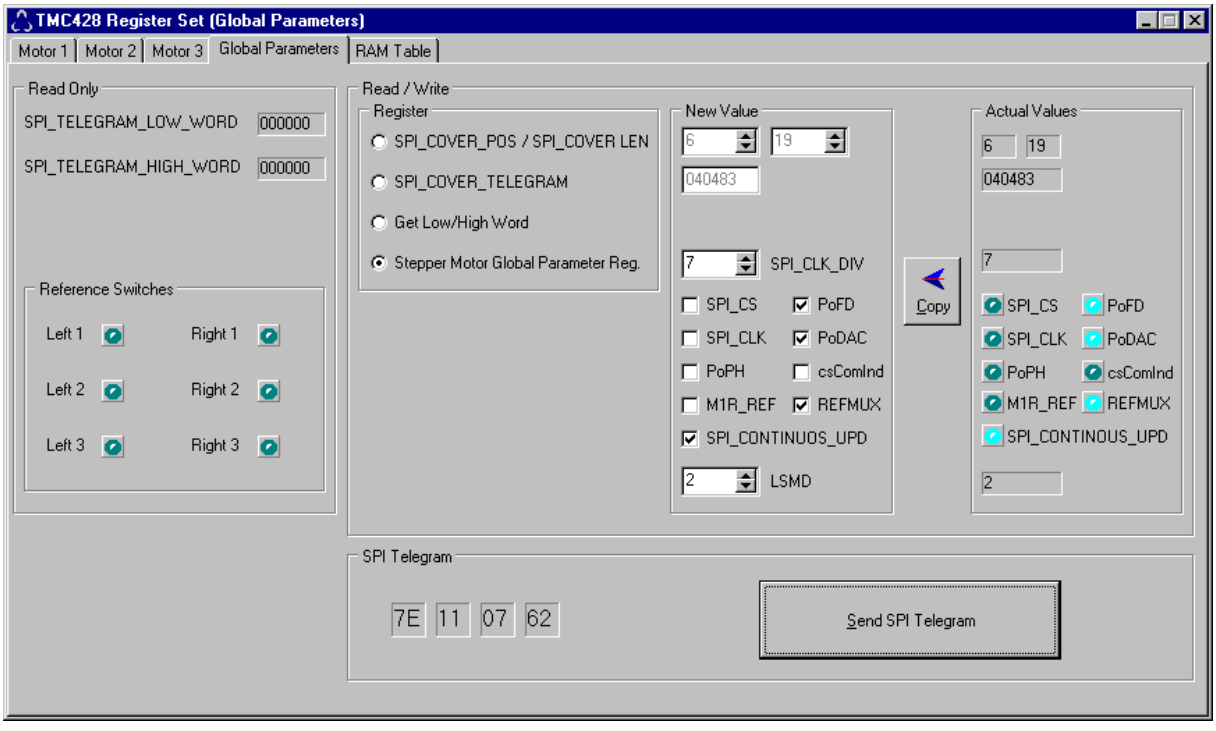
D5	***D4***	***D3***	
current scale phase B		***polarity of current of phase B***	***current of phase B***
1	1	0	0 mA
1	0	0	60 mA
0	1	0	550 mA
0	0	0	900 mA
1	1	1	0 mA
1	0	1	-60 mA
0	1	1	-550 mA
0	0	1	-900 mA

The microstep sequencer associated to each stepper motor individually reads DAC data words out of the microstep look-up table (LUT) for each microstep. The microstep resolution register (***usrs***) setting determines the distance between two successive microsteps (see TMC428 data sheet for details). During power-on, all positional counters are initialized by 0. Setting the microstep resolution register (named ***usrs***) to 1 selects half stepping mode for the microstep sequencer of the associated stepper motor. The microstep LUT is provided to hold 64 values of a quarter sine wave. These 64 values are indexed by the microstep sequencer using addresses ranging from 0 to 63. A quarter sine wave stored in the microstep LUT is automatically expanded to full period sine wave. If half stepping is chosen after power-on reset before any step has been done, the microstep sequencer for each half step reads the DAC values from the following addresses 0, 32, 63, 32, 0, 32, 63, 32, … for phase B and 63, 32, 0, 32, 63, 32, 0, 32, … for phase A.

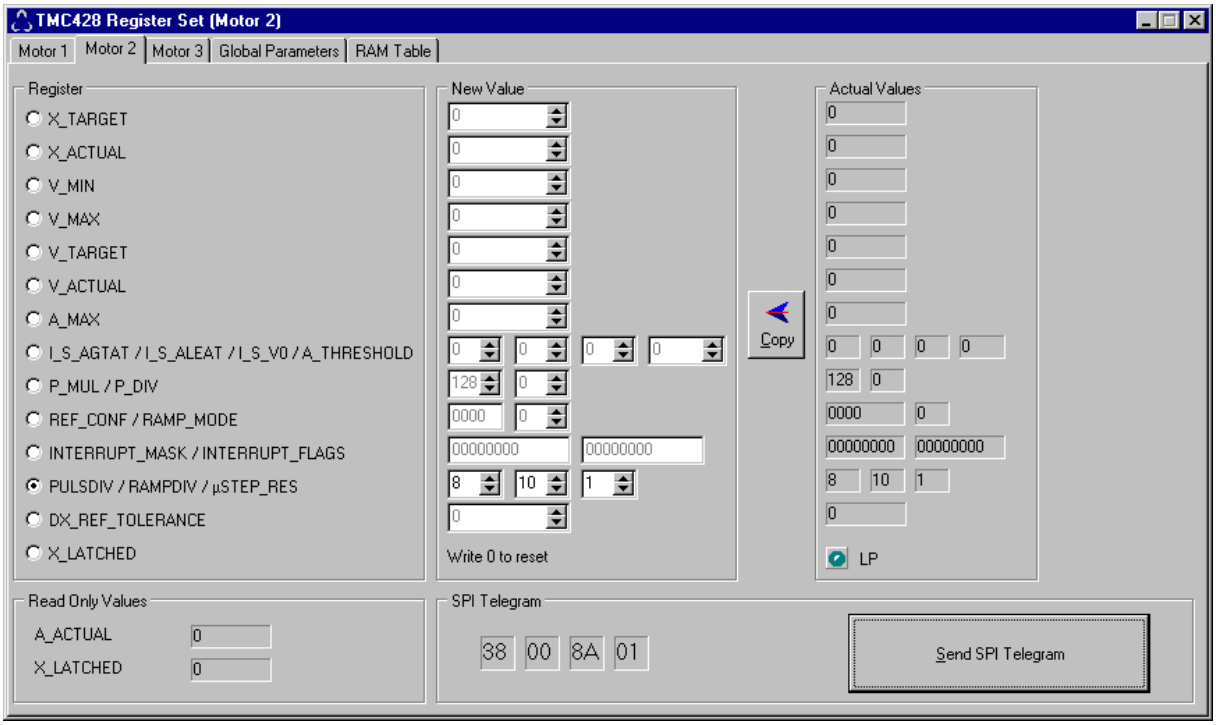
So, to realize current compensated half stepping using the L9935 one has to write DAC values into the TMC428 configuration RAM representing the current for the current compensated half stepping scheme. These DAC values (the two most significant bits, representing coil currents 0mA, 60mA, 550 mA, 900 mA) have to be written into the configuration RAM at 0, 32, 63. This can be easily done with the TMC428-Evaluation-Kit software:



A configuration file is available for this (please contact ***info@trinamic.com*** for request). Additionally, the PoDAC configuration bit has to be switched on:



Before starting the motor, one has to set ***usrs*** to 1, and switch off current scaling that is provided for microstepping. Current scaling is possible also with half stepping using the L9935, but with restrictions. The settings are as shown:



Now the stepper motor is driven by the L9935 with current compensated half stepping. Writing a value of 6 into the ***i_s_v0*** register, automatic current scaling down to 550 mA is done for the L9935 if the associated stepper motor is at rest.

Restrictions using Half Stepping with L9935

No step must be done with the L9935 after power-on of the TMC428 before setting the usrs register to 1.

For low resistance coils driven by the L9935, the half stepping scheme only works correctly within the motor supply voltage range of 8V to 18V.

Microstepping with the A9372 on the TMC428-Evaluation-Kit is not possible together with the current compensated half stepping configuration described above for the L9935.

Please refer to www.trinamic.com ***for updated data sheets and application notes.***

The TMCtechLIB CD-ROM including data sheets, application notes, schematics of evaluation boards, software of evaluation boards, source code examples, parameter calculation spreadsheets, tools, and more is available from TRINAMIC Motion Control GmbH & Co. KG by request to info@trinamic.com

Literature

- TMC428 – Data Sheet, TRINAMIC Motion Control GmbH & Co. KG,
  (on-line ***http://www.trinamic.com/***)

- L9935 – Data Sheet, ST-Microelectronics,
  (on-line ***http://www.st.com/***)

Revision History

Version	*Date*	*Comment*
1.00	March 19, 2002	First complete version published in printed form
1.00	October 1st, 2004	Changes concerning new company TRINAMIC Motion Control GmbH & Co. KG

Life support policy

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