Memorandum
**To:** Charlie Refvem
From: Ruodolf Rumbaoa
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For the term project our driver must be able to interface with the TMC4210 and TMC2208 ICs to function properly with the stepper motor. Our drivers will need to have the functionality of enabling the TMC2208, setting velocity and acceleration on the TMC4210, setting a target position of the stepper through the TMC4210, and setting or reading the actual position of the stepper through TMC4210. These methods are laid out in the following class diagram.
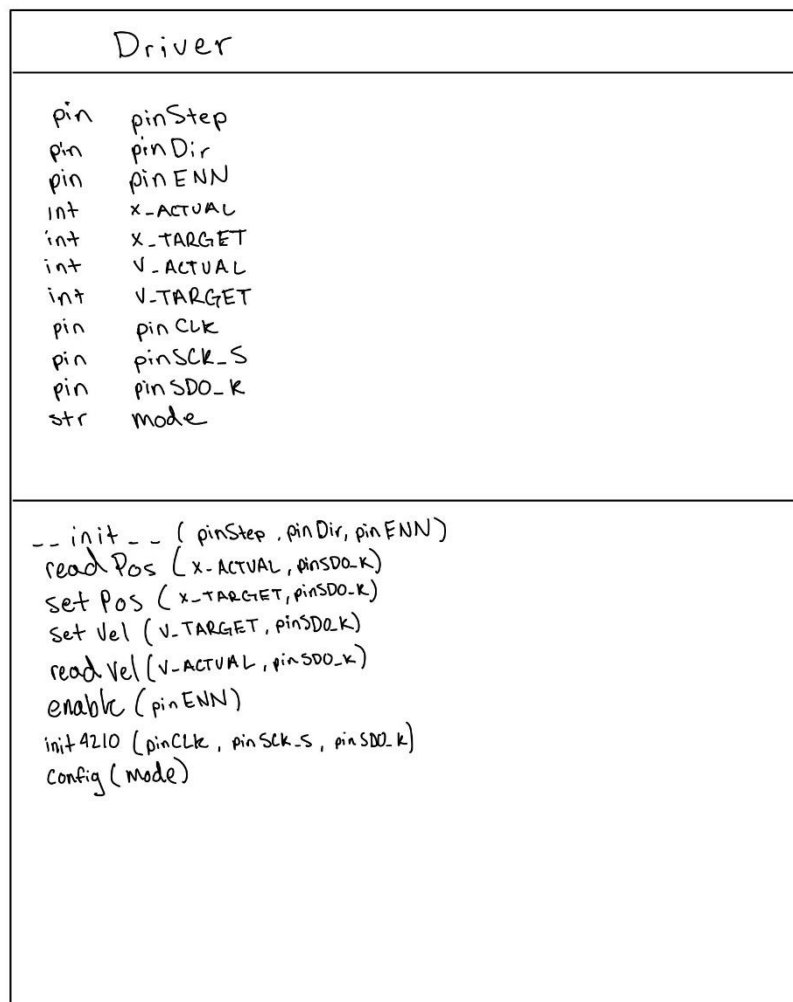
Figure 1. Driver class Diagram

To perform these methods, we must use the register map to either read or write to the corresponding register. To enable the TMC2208, we plan on connecting the EN1 and EN2 pins for the two TMC2208 drives to PC0 and PC1 on the Nucleo-L476RG, so that we can toggle them. These are read as active low, so we have to toggle the pin low to enable the TMC2208. To initialize the TMC4210 we write to the IF_CONFIGURATION_4210 address. Setting velocity will be done by writing to V_TARGET. Setting

acceleration will be done by writing to A_MAX. To set a target position we will write to X_TARGET. Finally, to read the actual position of the stepper, we read from X_ACTUAL. We may also make use of limit switches to indicate the position of the stepper but have not figured out how to do that yet.

TMC4210 REGISTER MAPPING

32 BIT DATAGRAM SENT FROM µC TO THE TMC4210 VIA PIN SDI_C

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

ADDRESS		RW	DATA
SMDA	IDX		**STEPPER MOTOR REGISTER SET (SMDA=00)**
0 0	0 0 0 0		X_TARGET
	0 0 0 1		X_ACTUAL
	0 0 1 0		V_MIN
	0 0 1 1		V_MAX
	0 1 0 0		V_TARGET
	0 1 0 1		V_ACTUAL
	0 1 1 0		A_MAX
	0 1 1 1		A_ACTUAL
	1 0 0 1	RW=0 : WRITE access / RW=1 : READ access	1 PMUL PDIV
	1 0 1 0		lp REF_CONF R_M
	1 0 1 1		INTERRUPT_MASK INTERRUPF_FLAGS
	1 1 0 0		PULSE_DIV RAMP_DIV 0
	1 1 0 1		DX_REF_TOLERANCE
	1 1 1 0		X_LATCHED
	1 1 1 1		USTEP_COUNT_4210
	JDX		**GLOBAL PARAMETER REGISTERS (SMDA=11)**
1 1	0 1 0 0		IF_CONFIGURATION_4210
	0 1 0 1		POS_COMP_4210
	0 1 1 0		POS_COMP_INT_4210 M I
	1 0 0 0		**POWER-DOWN**
	1 0 0 1		TYPE_VERSION (= $429101 for TMC4210, read-only)
	1 1 1 0		- - gp_in - r_l r_r
	1 1 1 1		motlr 0 0 0 0 0 0 STPDIV_4210 0 0 0 0 0 0 00

SMDA	Stepper motor driver address	r_l, r_r, gp_in	Left switch / right switch / general purpose input (read out)
R_M	RAMP_MODE mask	I	Interrupt
	Unused bits		

Figure 2. Register map for the TMC4210

The following table will include our initial plan for pin connections for the drivers with the Nucleo-L476RG. Most of the pins will be standard GPIOs while the MOSI, MISO, and SCK will be configured to a more dedicated pin.

Table 1. Preliminary pin configuration

MCU Pin	Function
PB_6	CLK
PC2	CS1
PC3	CS2
PA_5	SCK
PA_6	MOSI
PA_7	MISO
PC0	EN1
PB4	INDEX1
PC1	EN2
PB5	INDEX2
GND	GND
3V3	+3.3V