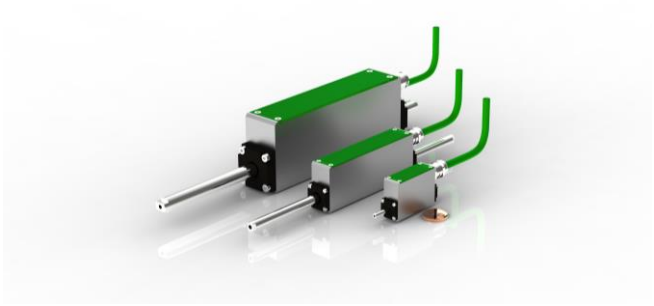
Tubular Linear motor parametrization with TKSED PC Software



Revision History

Date	Revision	Description
13.06.2019	0	Document creation

INDEX

1 Introduction

This document explains how to configure and parametrize the linear motor using TKSED PC software in combination with TBS1 24VDC Low voltage servo drives and MBD 3x400VAC servo drives.
TKSED software can be downloaded from Dowload section of www.nilab.at.
The configuration steps here reported are related to the TKSED version 0.010.0.2.
TKSED PC software is running on Microsoft Windows PC with communication cable USB to servo drive RS232 communication port. Please, download the installation manual for additional information about how to connect the drive to controller and PC for commissioning.

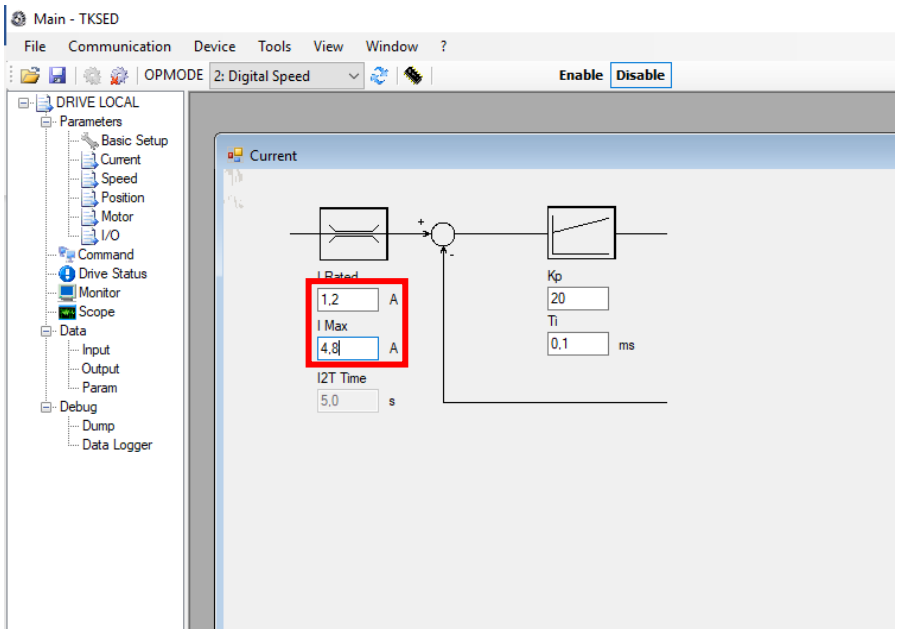
All steps explained in the Section 2 of this guide is made before shipping the product to the customer. In particular, the drive is supplied with encoder calibration and phase angle stored inside the memory of the servo drive. Normally, the customer could be made fine tuning considering section 3 of this guide.

For any additional information, please contact our technical support by email or by phone:
+43 720 513 258.

2 Motor configuration

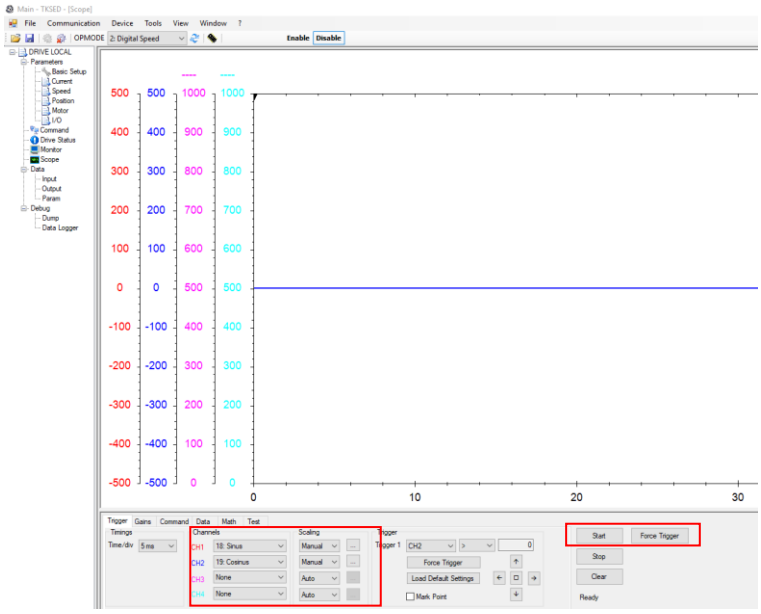
2.1 *STEP 1 – Current loop configuration*

Please, donwload the datasheet of the motor. Then set the correct value for I rated to Nominal current of the motor and the Peak value (typically 4 x Irated)

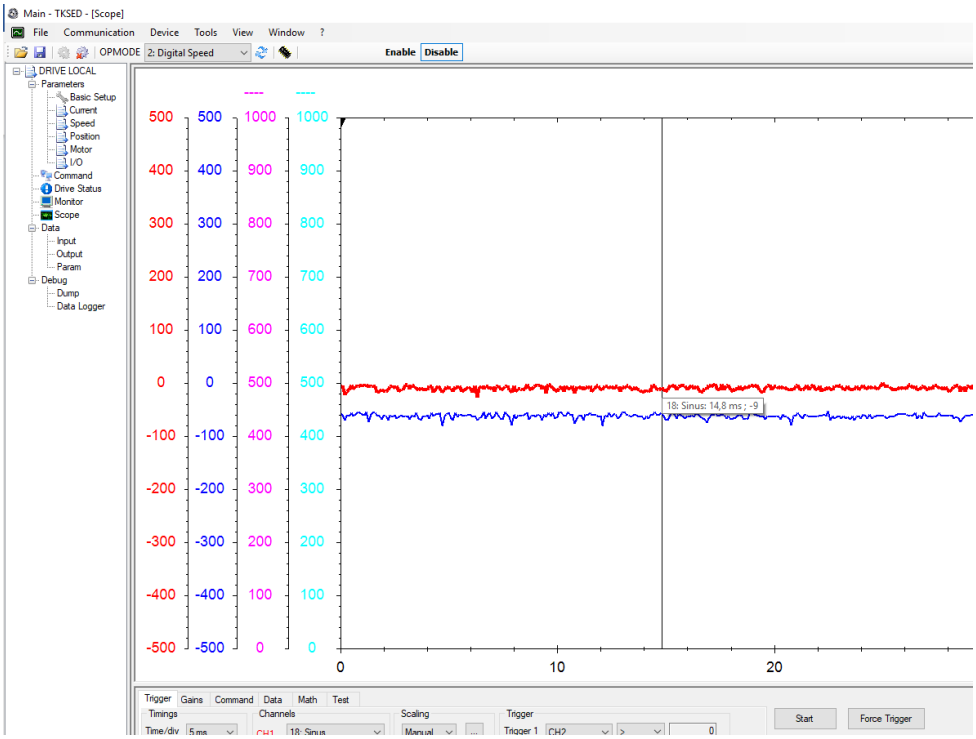


2.2 *STEP 2 – Calibrate the encoder offset and gain*

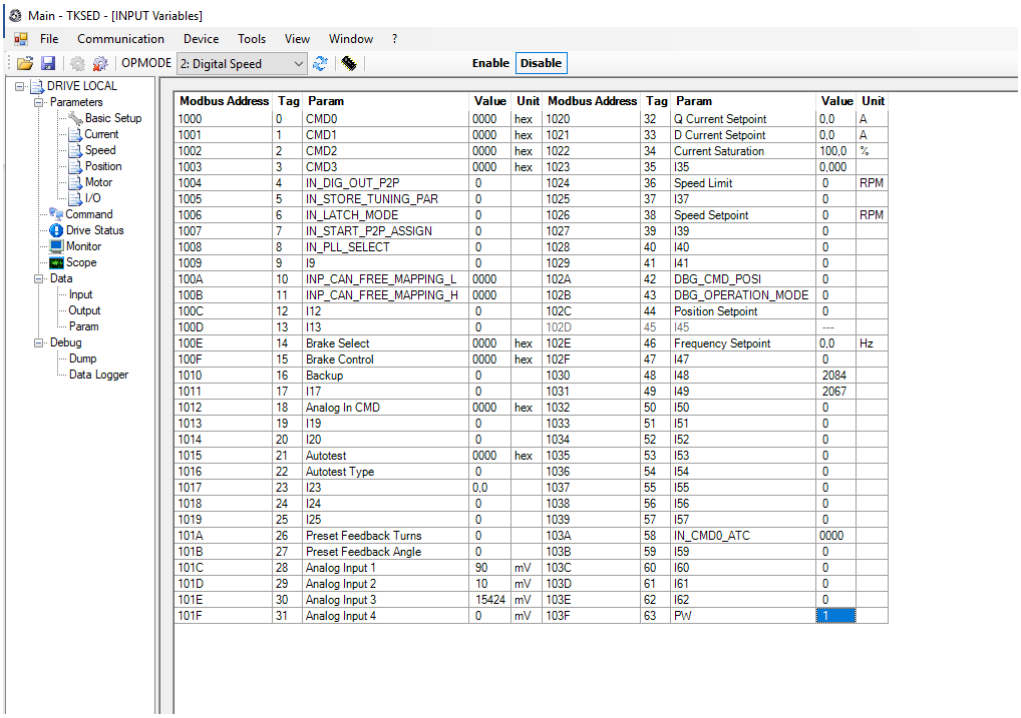
First of all remove the shaft from the motor. Then open the scope tool. Set the CH1 and CH2 to 18:Sinus and 19:Cosinus signal with scaling manual with limit -500 and +500. Then press the button start and subsequently the button force trigger.



Then using the mouse cursor click on the Sine and Cosine curve to see the offset value. (in this example Sinus -9 counts and Cosinus -58 counts

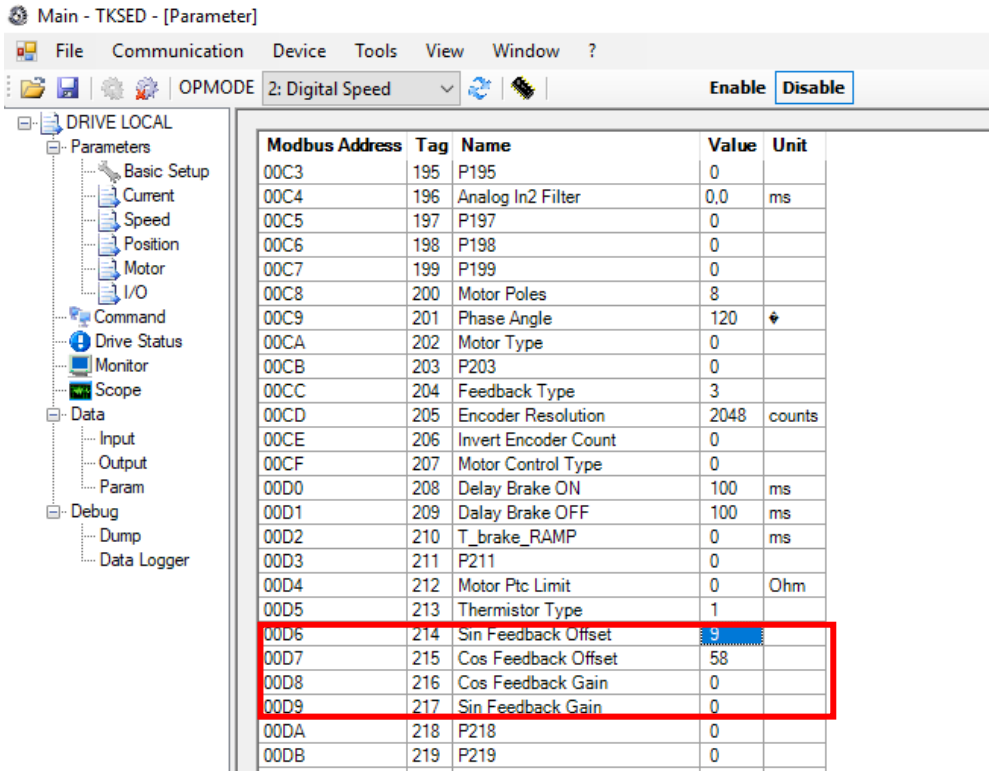


Then go to Data – Input window and Set PW param to 11 (encoder calibration enabled)



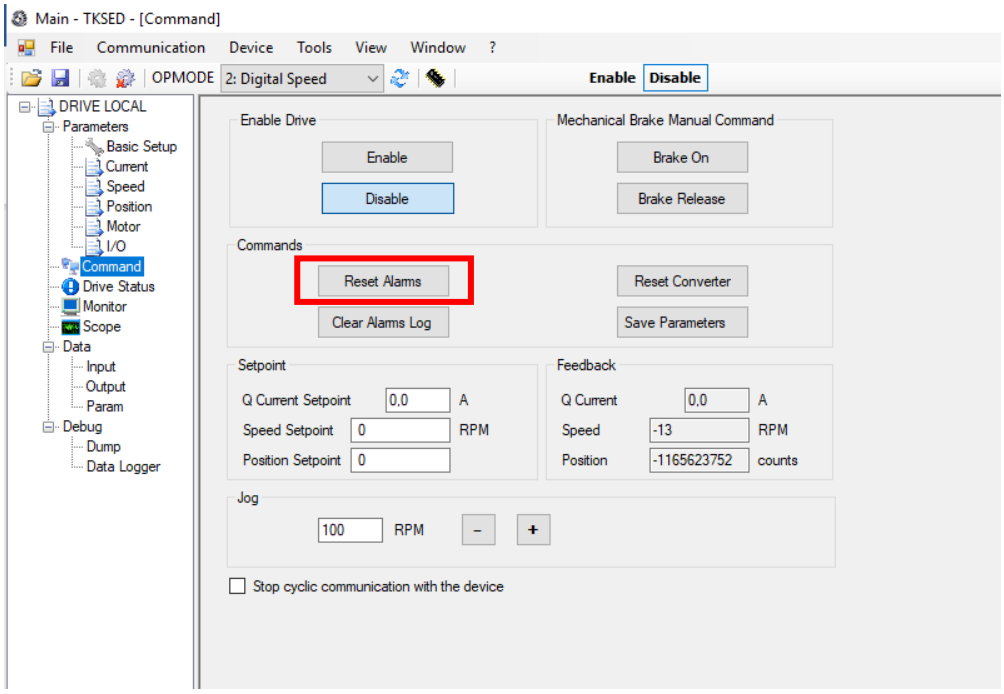
Modbus Address	Tag	Param	Value	Unit	Modbus Address	Tag	Param	Value	Unit
1000	0	CMD0	0000	hex	1020	32	Q Current Setpoint	0,0	A
1001	1	CMD1	0000	hex	1021	33	D Current Setpoint	0,0	A
1002	2	CMD2	0000	hex	1022	34	Current Saturation	100,0	%
1003	3	CMD3	0000	hex	1023	35	I35	0,000	
1004	4	IN_DIG_OUT_P2P	0		1024	36	Speed Limit	0	RPM
1005	5	IN_STORE_TUNING_PAR	0		1025	37	I37	0	
1006	6	IN_LATCH_MODE	0		1026	38	Speed Setpoint	0	RPM
1007	7	IN_START_P2P_ASSIGN	0		1027	39	I39	0	
1008	8	IN_PLL_SELECT	0		1028	40	I40	0	
1009	9	I9	0		1029	41	I41	0	
100A	10	INP_CAN_FREE_MAPPING_L	0000		102A	42	DBG_CMD_POSI	0	
100B	11	INP_CAN_FREE_MAPPING_H	0000		102B	43	DBG_OPERATION_MODE	0	
100C	12	I12	0		102C	44	Position Setpoint	0	
100D	13	I13	0		102D	45	I45	---	
100E	14	Brake Select	0000	hex	102E	46	Frequency Setpoint	0,0	Hz
100F	15	Brake Control	0000	hex	102F	47	I47	0	
1010	16	Backup	0		1030	48	I48	2084	
1011	17	I17	0		1031	49	I49	2067	
1012	18	Analog In CMD	0000	hex	1032	50	I50	0	
1013	19	I19	0		1033	51	I51	0	
1014	20	I20	0		1034	52	I52	0	
1015	21	Autotest	0000	hex	1035	53	I53	0	
1016	22	Autotest Type	0		1036	54	I54	0	
1017	23	I23	0,0		1037	55	I55	0	
1018	24	I24	0		1038	56	I56	0	
1019	25	I25	0		1039	57	I57	0	
101A	26	Preset Feedback Turns	0		103A	58	IN_CMD0_ATC	0000	
101B	27	Preset Feedback Angle	0		103B	59	I59	0	
101C	28	Analog Input 1	90	mV	103C	60	I60	0	
101D	29	Analog Input 2	10	mV	103D	61	I61	0	
101E	30	Analog Input 3	15424	mV	103E	62	I62	0	
101F	31	Analog Input 4	0	mV	103F	63	PW	1	

Then go to Data – Param windows and set the right offset in the 214 and 215 address.



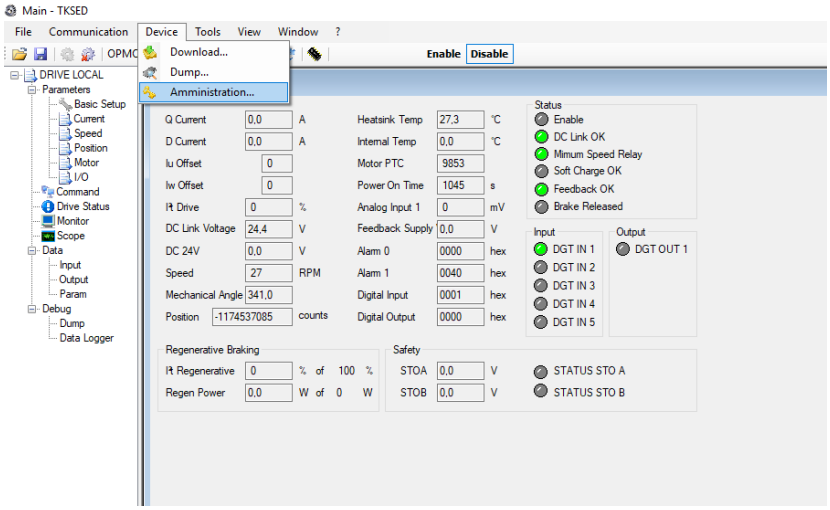
Modbus Address	Tag	Name	Value	Unit
00C3	195	P195	0	
00C4	196	Analog In2 Filter	0,0	ms
00C5	197	P197	0	
00C6	198	P198	0	
00C7	199	P199	0	
00C8	200	Motor Poles	8	
00C9	201	Phase Angle	120	
00CA	202	Motor Type	0	
00CB	203	P203	0	
00CC	204	Feedback Type	3	
00CD	205	Encoder Resolution	2048	counts
00CE	206	Invert Encoder Count	0	
00CF	207	Motor Control Type	0	
00D0	208	Delay Brake ON	100	ms
00D1	209	Dalay Brake OFF	100	ms
00D2	210	T_brake_RAMP	0	ms
00D3	211	P211	0	
00D4	212	Motor Ptc Limit	0	Ohm
00D5	213	Thermistor Type	1	
00D6	214	Sin Feedback Offset	9	
00D7	215	Cos Feedback Offset	58	
00D8	216	Cos Feedback Gain	0	
00D9	217	Sin Feedback Gain	0	
00DA	218	P218	0	
00DB	219	P219	0	

The insert in the motor the shaft and reset the Alarm in Command window with Reset Alarm button

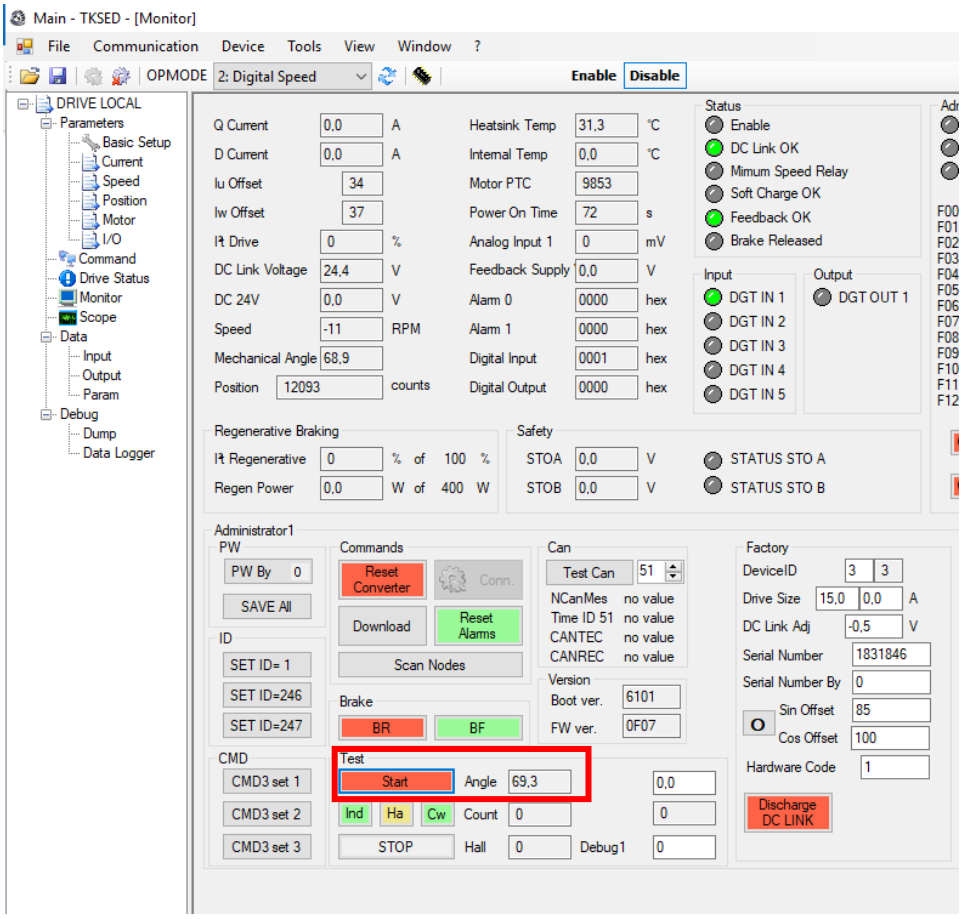


2.3 STEP 3 – Commutation phase calculation

Please, enter in Amministration mode with password **2fpcbl**

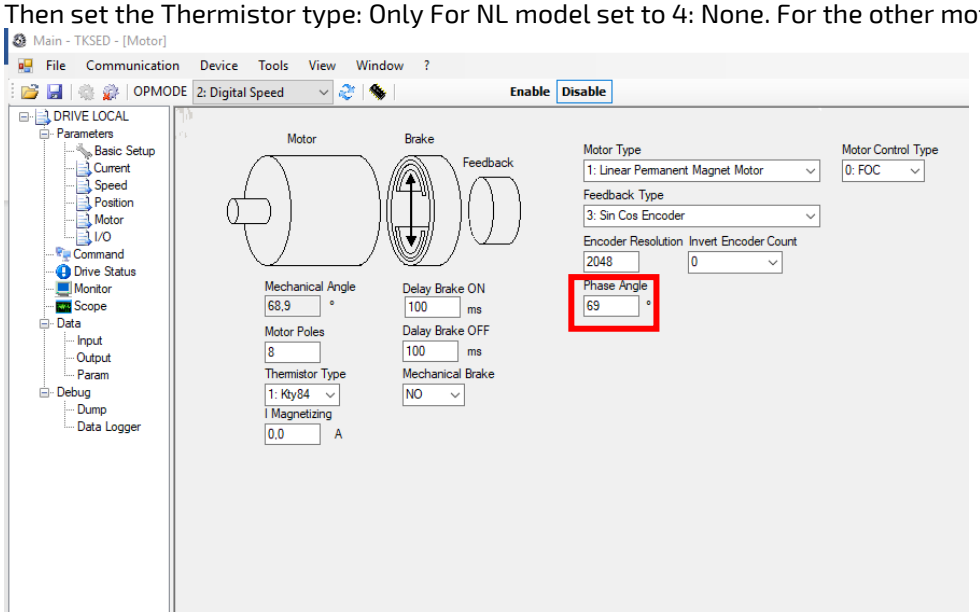


Then press Start button to calculate the phase. The motor moves in a U phase position and TKSED calculate the commutation phase (with NL080Q motor = 69,3). **Pay attention any motor size have different Angle value.**



2.4 STEP 4 - Motor configuration

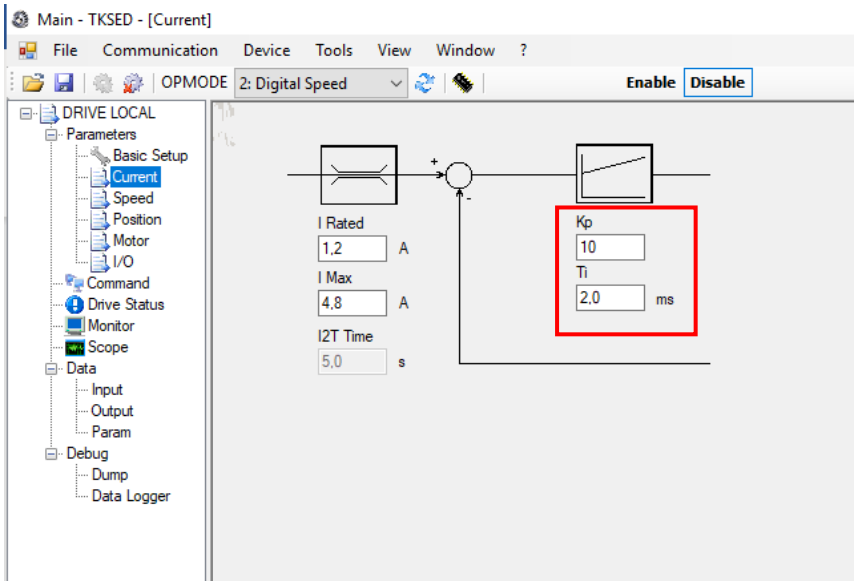
Set the calculated value in Step 3 in the Motor window.
Motor type to 1: Linear permanent Magnet Motor
Motor control type to 0: FOC
Feedback type: Sin Cos Encoder
Encoder resolution: 2048
Then set the Thermistor type: Only For NL model set to 4: None. For the other motor model set to 1:Kty84



3 Motor tuning

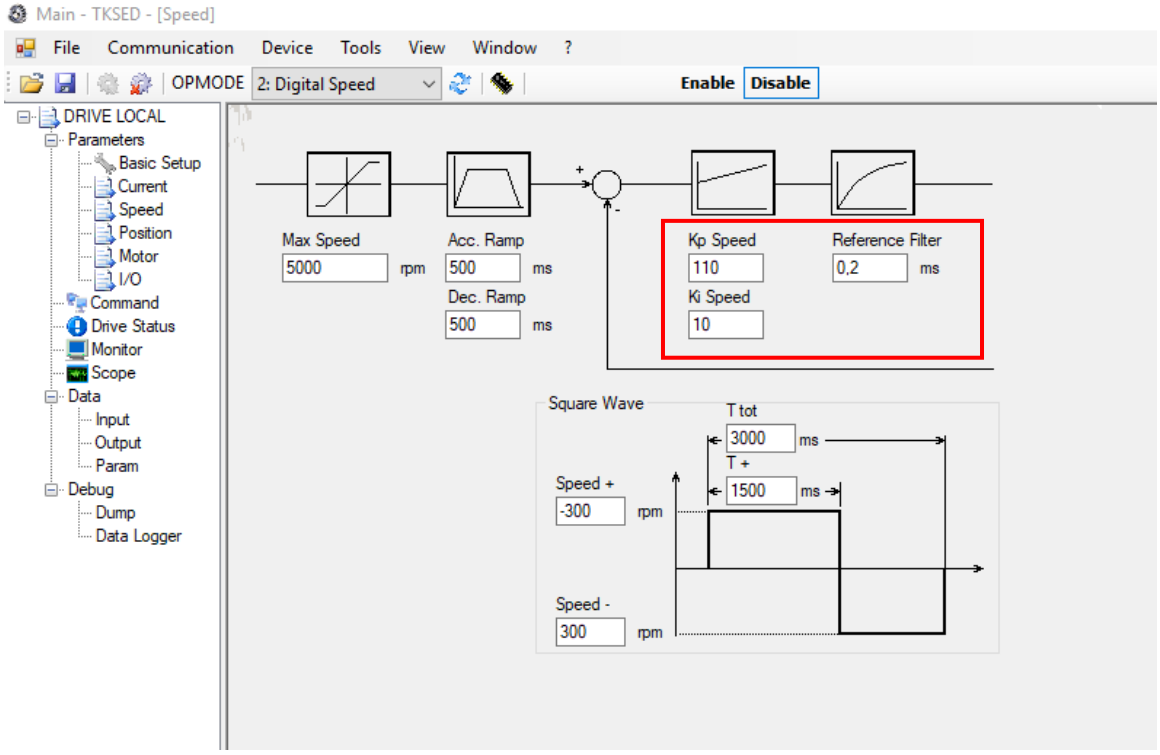
3.1 STEP 1- Current loop

First of all set a starting value on the current loop. Kp=10 and Ti=2msec.

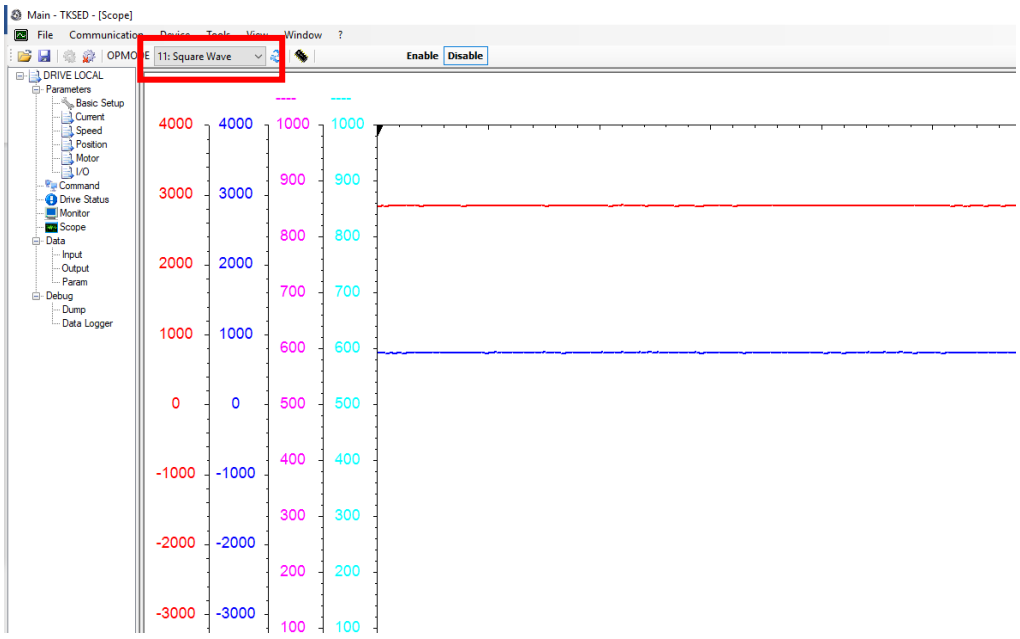


3.2 STEP 2 – Speed loop and current loop tuning

First step is setting the default value on the speed loop.
Kp Speed to 110, Ki Speed to 10 and Reference filter to 0.2msec



The open the scope tool and select in the OPMODE the mode 11: Square Wave

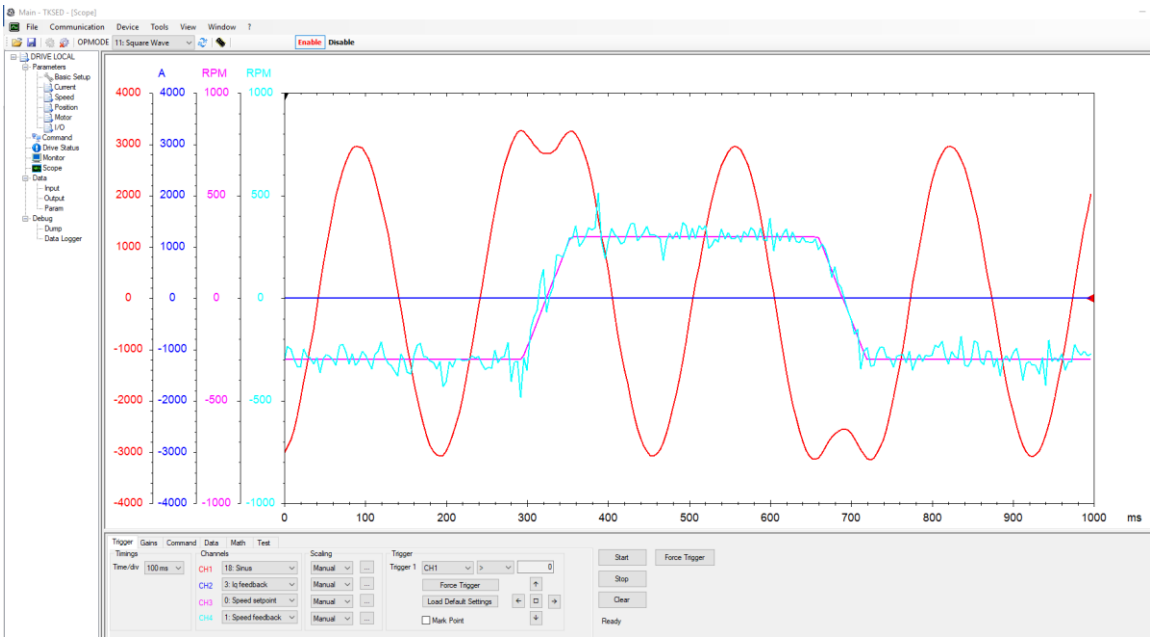


Then prepare the scope for the right acquisition.

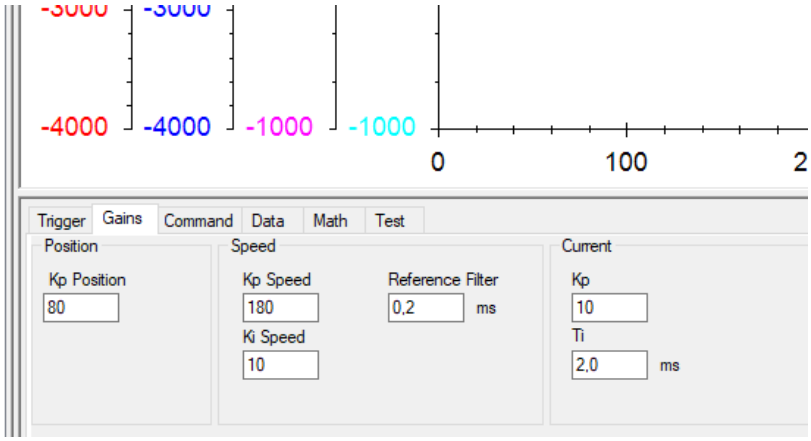
Setting the channel of the scope:

Time/div set to 100msec.
CH1 : 18: Sinus with Manual scale min = -4000 and max=4000 counts
CH2 : 3: Iq feedback with Manual scale min = -1 and max=+1 amps
CH3: 0: Speed setpoint with Manual scale min = -1000 and max=1000 counts
CH4: 0: Speed feedback with Manual scale min = -1000 and max=1000 counts
Trigger 1 CH1 condition > value 0

Then move the shaft of the motor in the middle of the stroke and press Enable button on the top.
The motor starts to move, then press Start button to collect the info into the scope diagram.

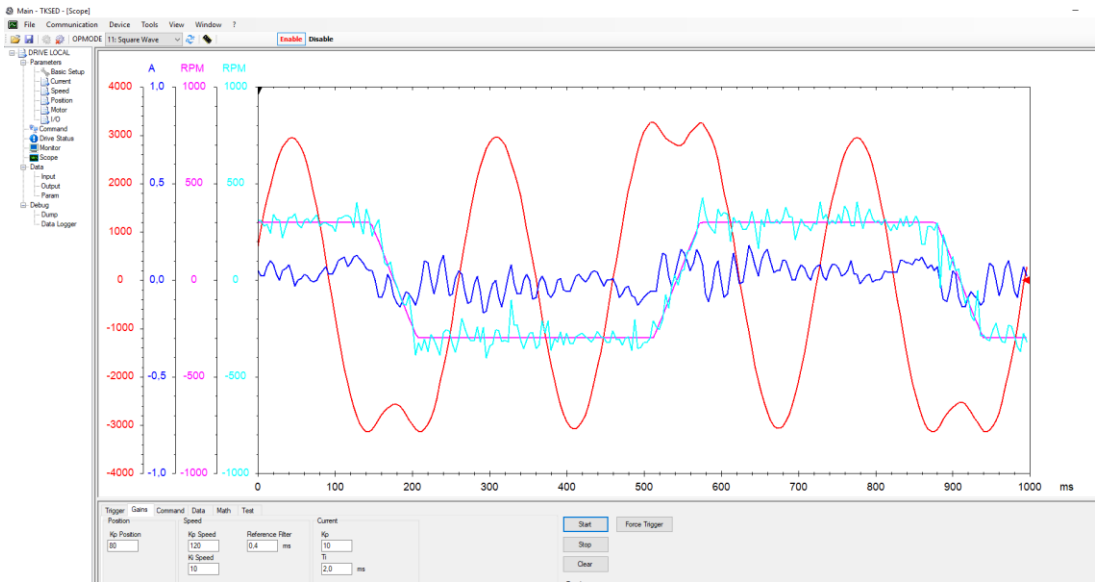


Then click on the Gains folder below to open the calibration data.

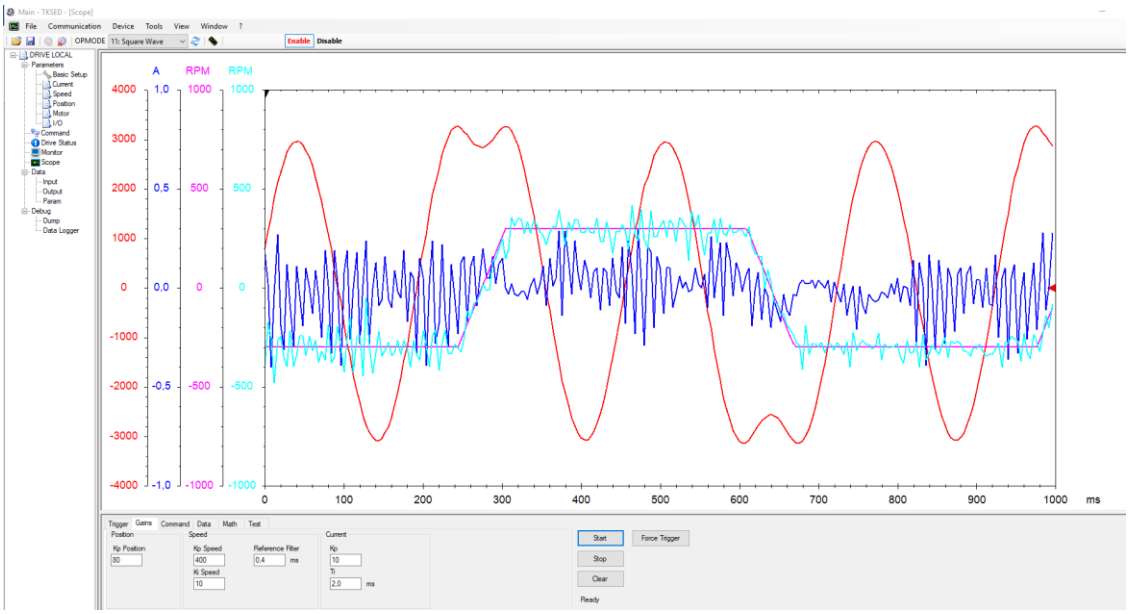


Increasing the Kp speed you will increase the rigidity and increase the noise. Descresing Kp you can reduce the noise but you decrease the rigidity.
If you would like to reduce the position deviation when you increase the Kp Speed you have to increase accordirgly the Ki Speed too.
So, a starting value for the two loop are:

Kp Position=80
Kp Speed=120, Ki Speed=10 Reference Filter =0,2mse
Kp Current=10, Ti=2msec
You can see the limit in increasing the Kp Speed loop when the current start to oscillate.
For exampe with Kp Speed=120 we have this behaviour:



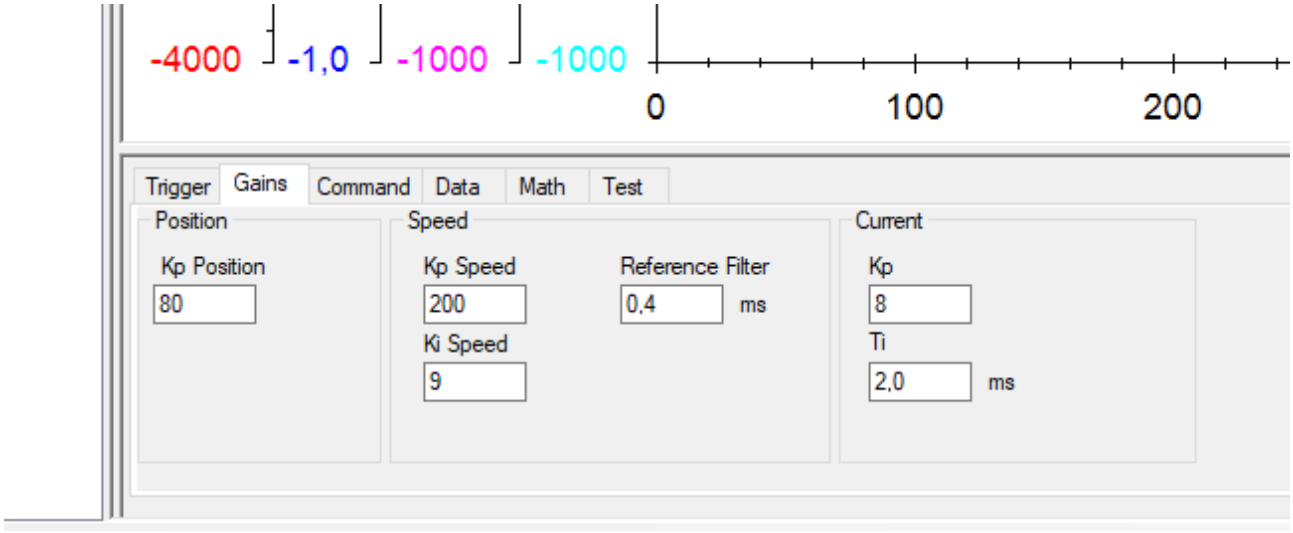
If we set the Kp Spped to 400 noise increase the current start to oscillate like this:



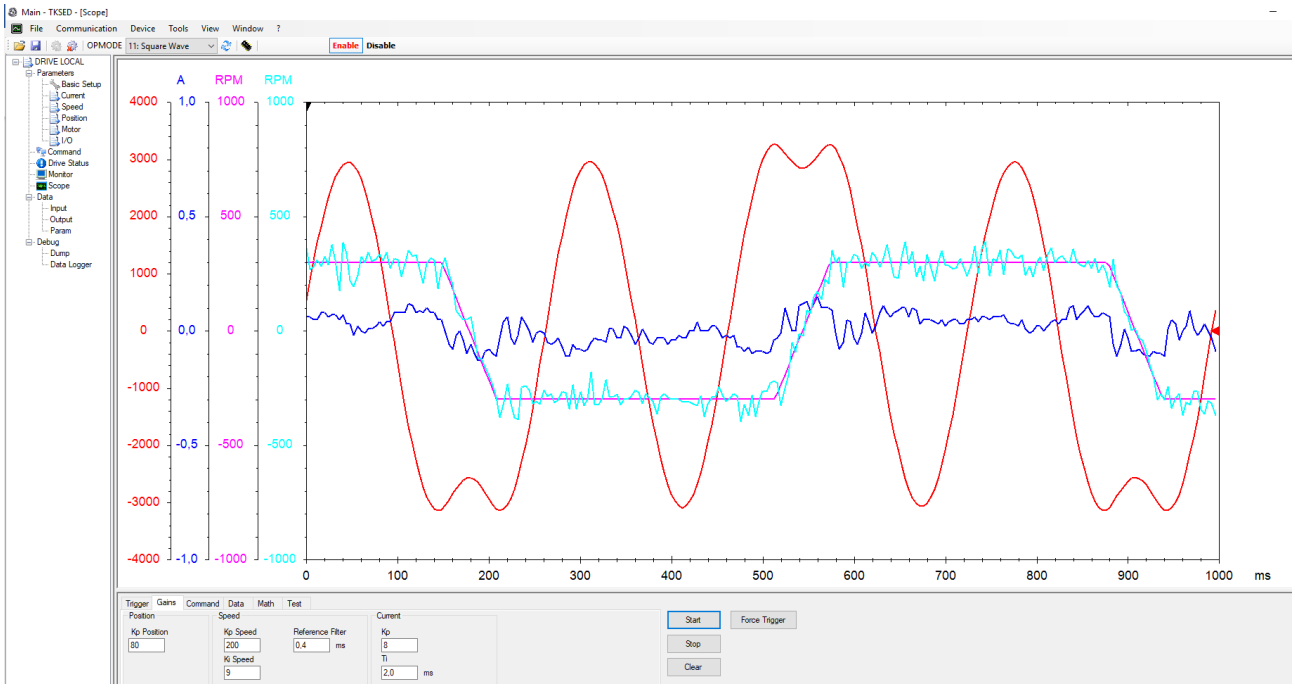
So, the optimale vale for Kp Speed is half the value found when the current start to oscillate. In this example Kp speed will be set to the maximum value of **200.**

Then you can increase the Ki Speed in the same way to found when the current start to oscillate and set to the half of the founded value. In our example set to founded value was 18 and the we set the Ki Speed to **9.**

Finally we can increase the Kp current in the same way to find when the current start to oscillate. In this example we found 17 and then we set the Kp Current to **8**.



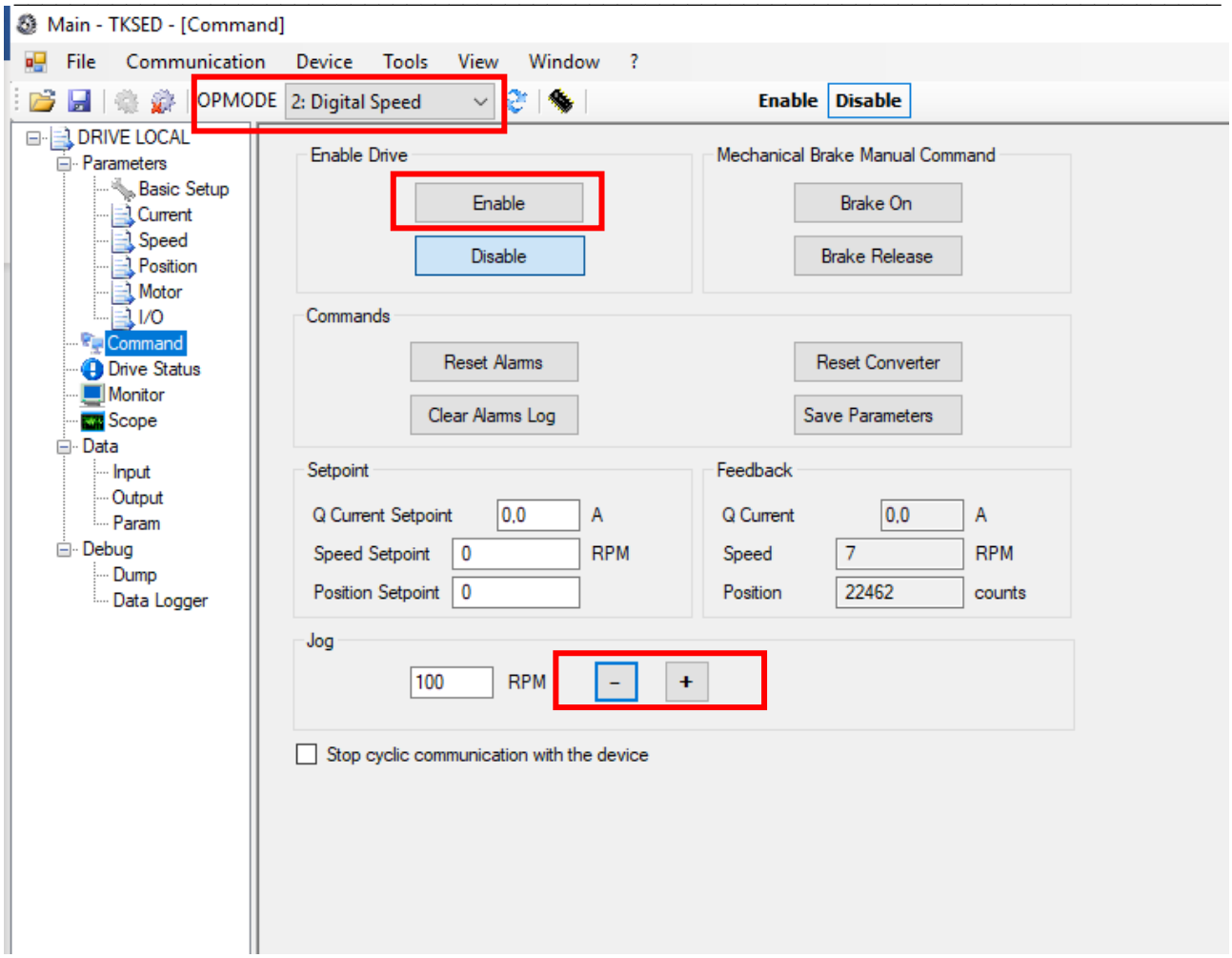
So, the final acquisition with the scope is the following image.



So, press Disable button to disable the motor.

3.3 STEP 3 – Digital speed test and rigidity test

Please, select the OPMODE to 2: Digital Speed and Enable the motor



Try to interact with motor by hand to evaluate the rigidity and then move the motor with + an – button in jog mode to see if the motion is smooth or not.