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 - Please do not put us on hold. Others will hear the hold music.
 - Do not use a speaker phone. Background noise can be heard.
 - We welcome comments and questions.
You can type questions into the “Chat” window. Please send to ‘All Panelists’
 - Questions not answered during the Café can be e-mailed to training@yaskawa.com or can be entered into the survey sent to you at the end of the class.



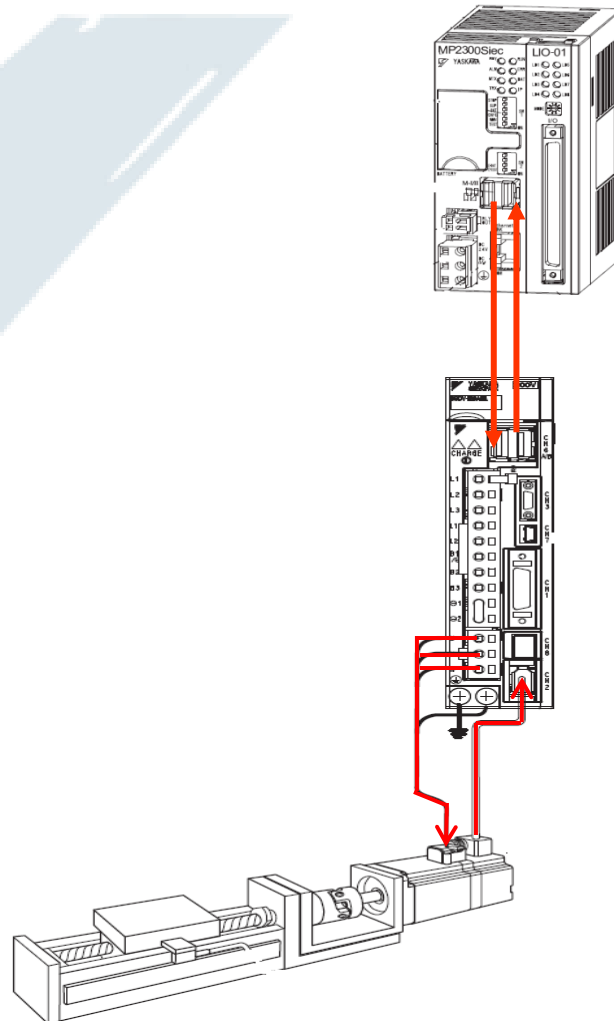
MPiec: Controller Parameters that Enhance Application Performance

Hosted by:

Nishant Unnikrishnan
Applications Engineer
Yaskawa America Inc



Keys to Performance



Performance Filters

Ensure precise command to servopack

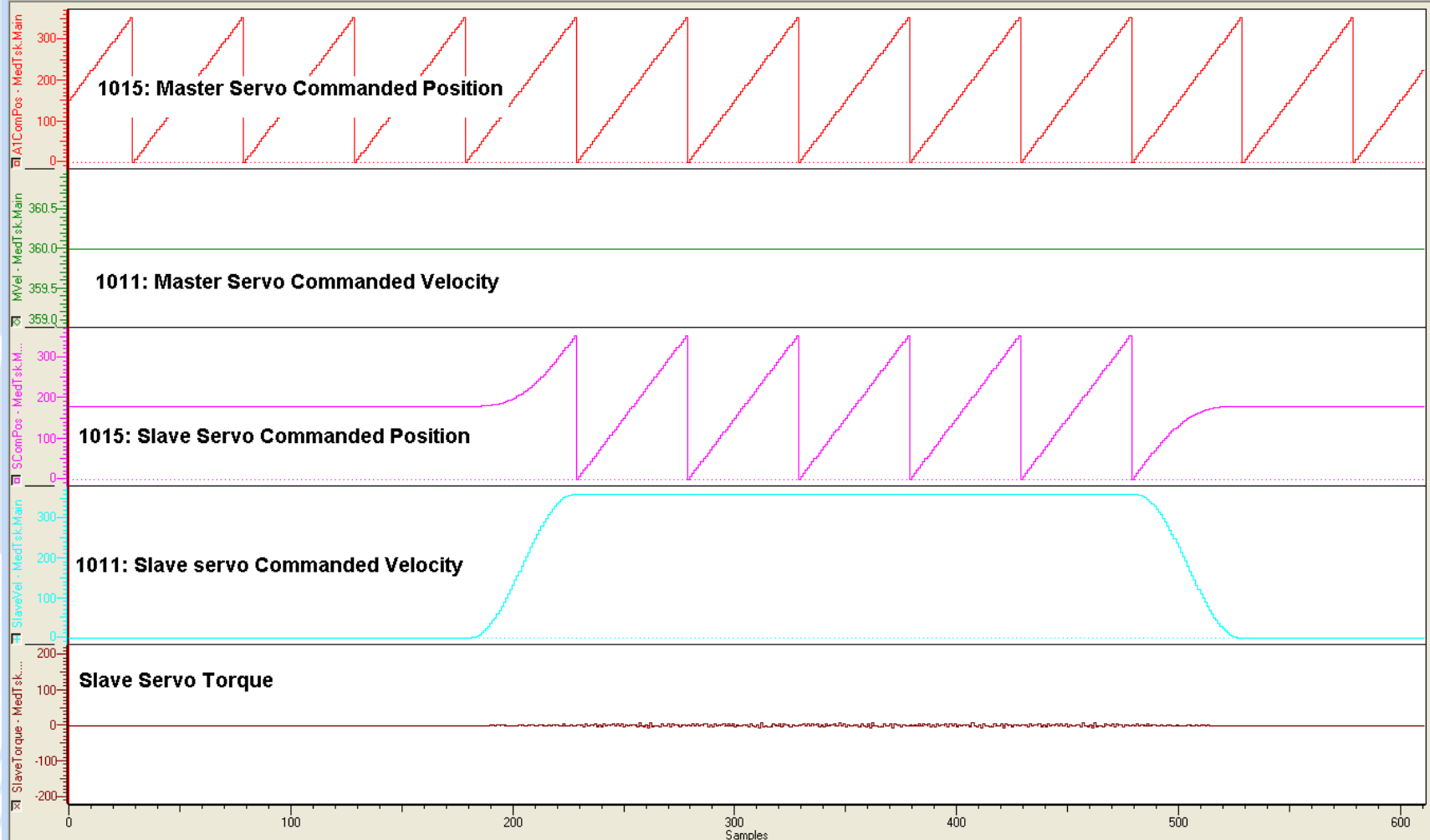
Tuning

Ensure appropriate response from motor

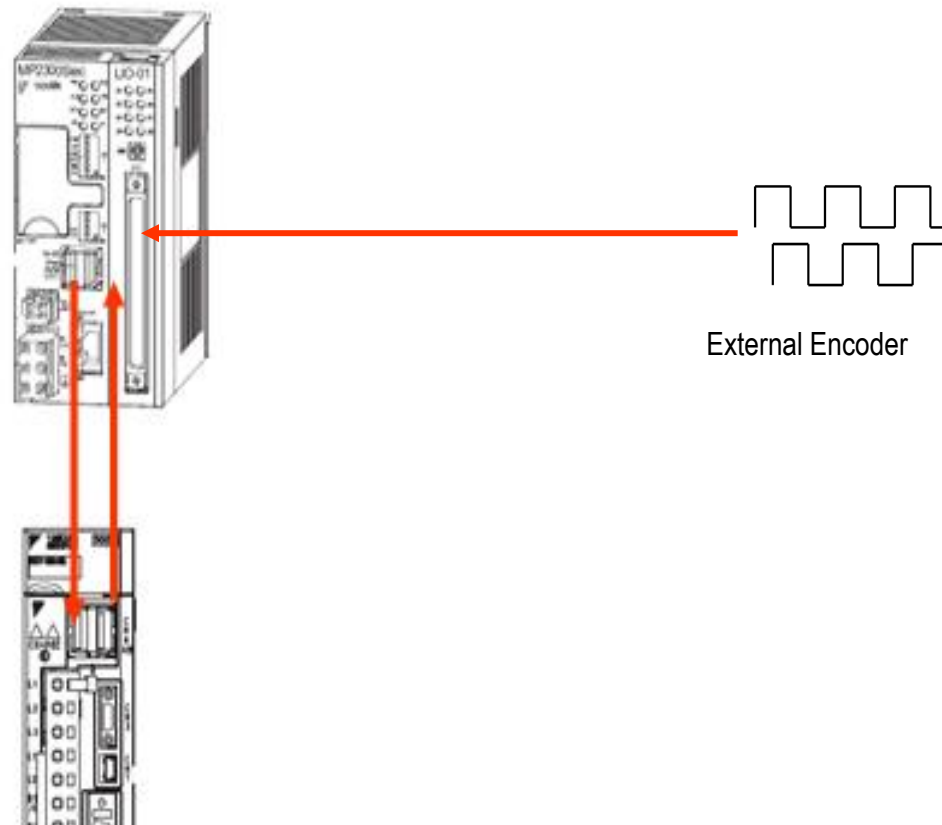
Keys to Performance

	Synchronized motion (Gear, Cam)	Un-synchronized motion (Discrete)
1	Filtered master data	Moving average filter
2	Communication delay compensation	-
3	Feedforward component	Feedforward component
4	Servopack sub-interpolation	Servopack sub-interpolation

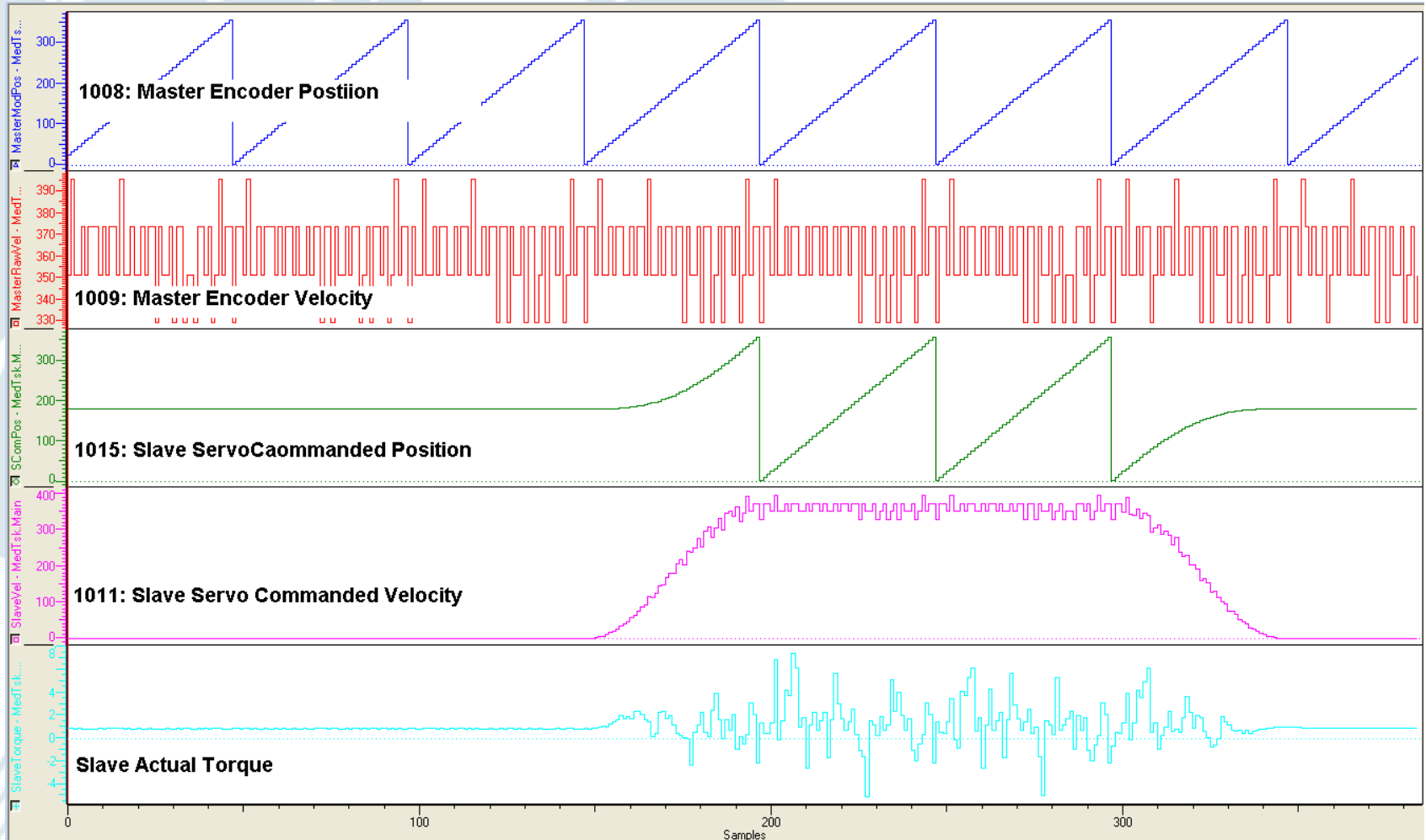
Expected Cam Motion



Synchronized Motion

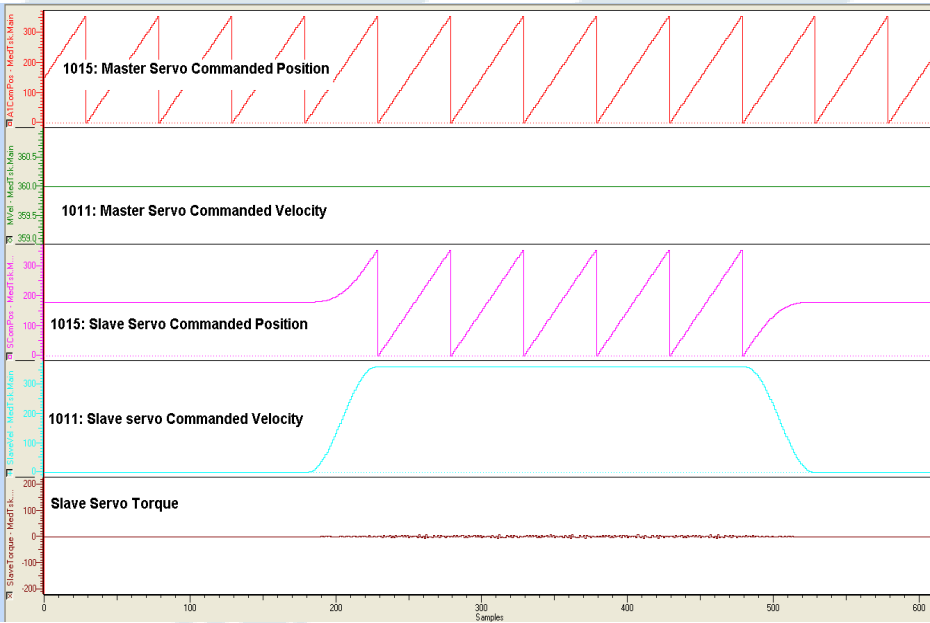


Actual Cam Motion

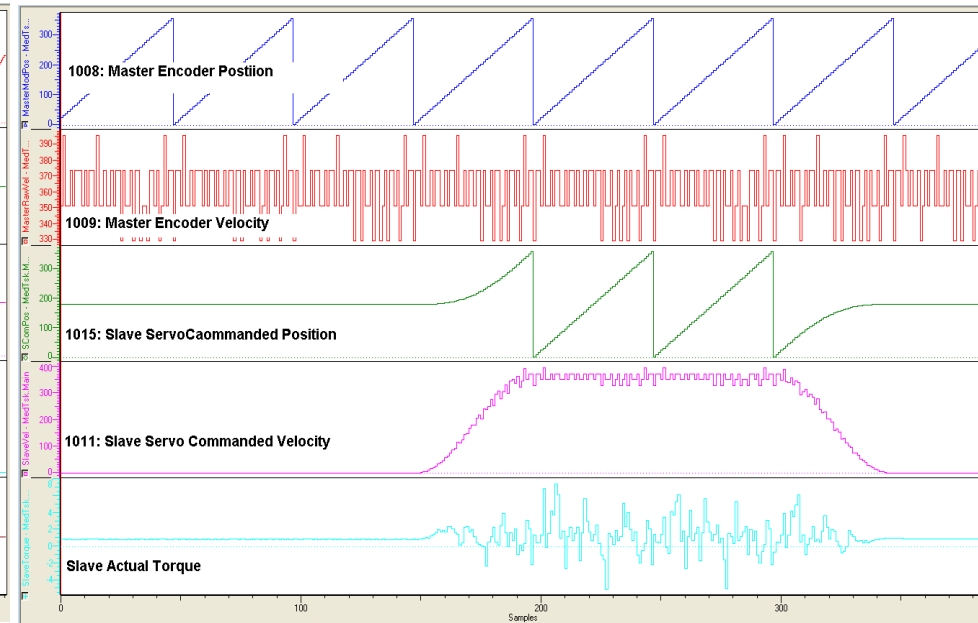


Cam Motion

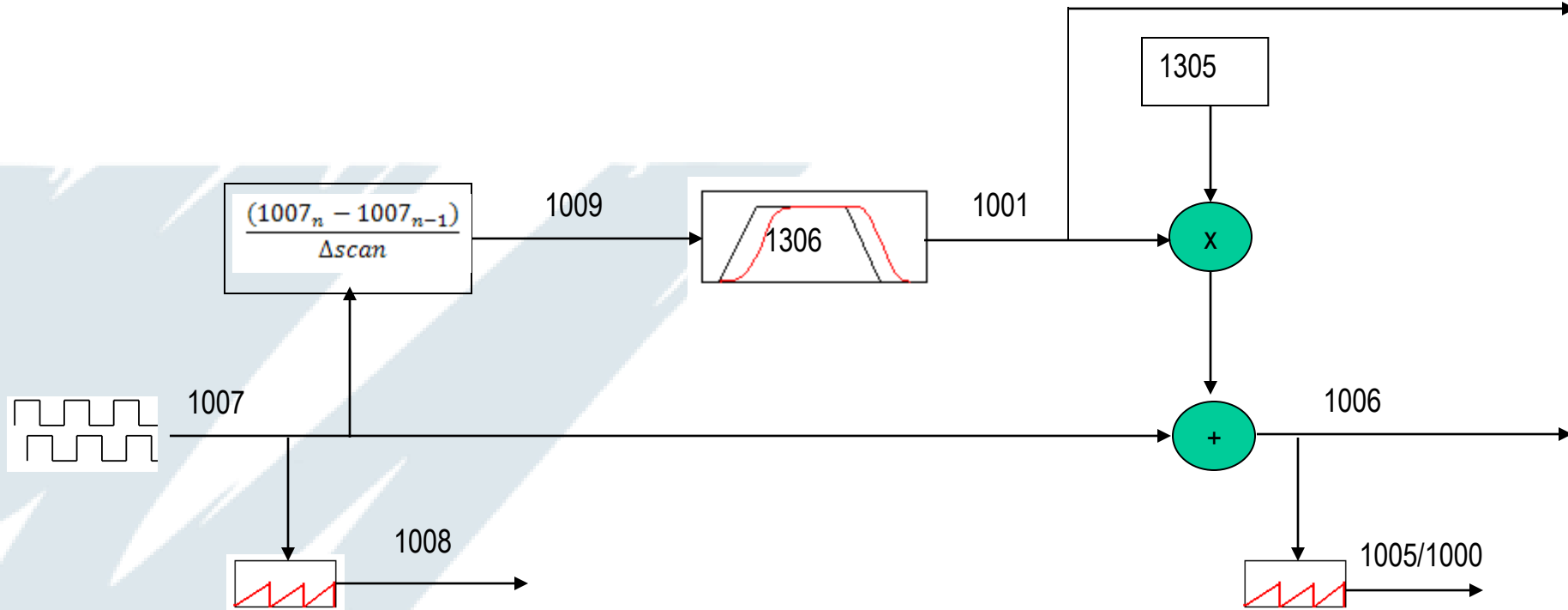
Servo Master



External encoder master

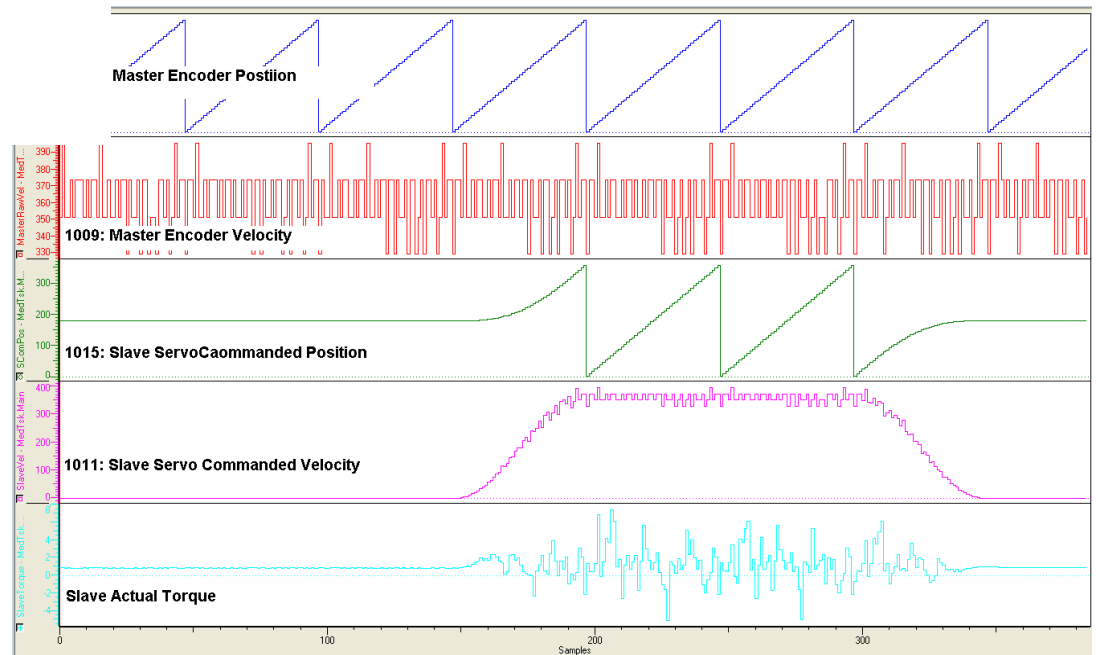
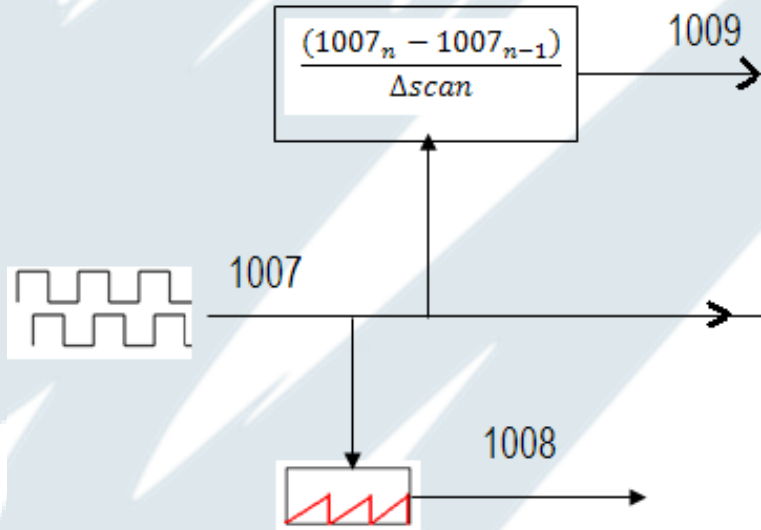


External Encoder Filters

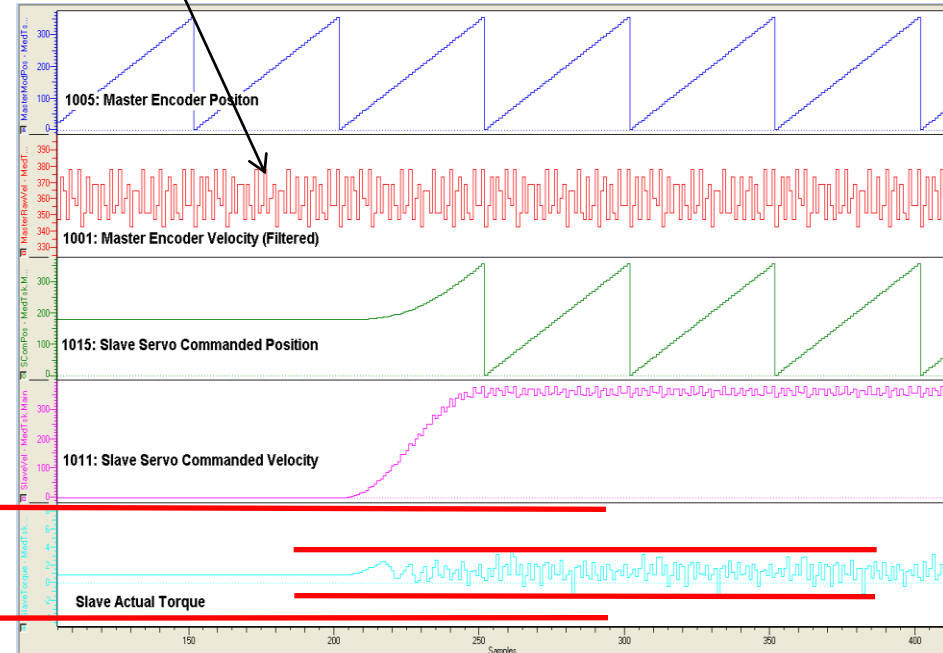
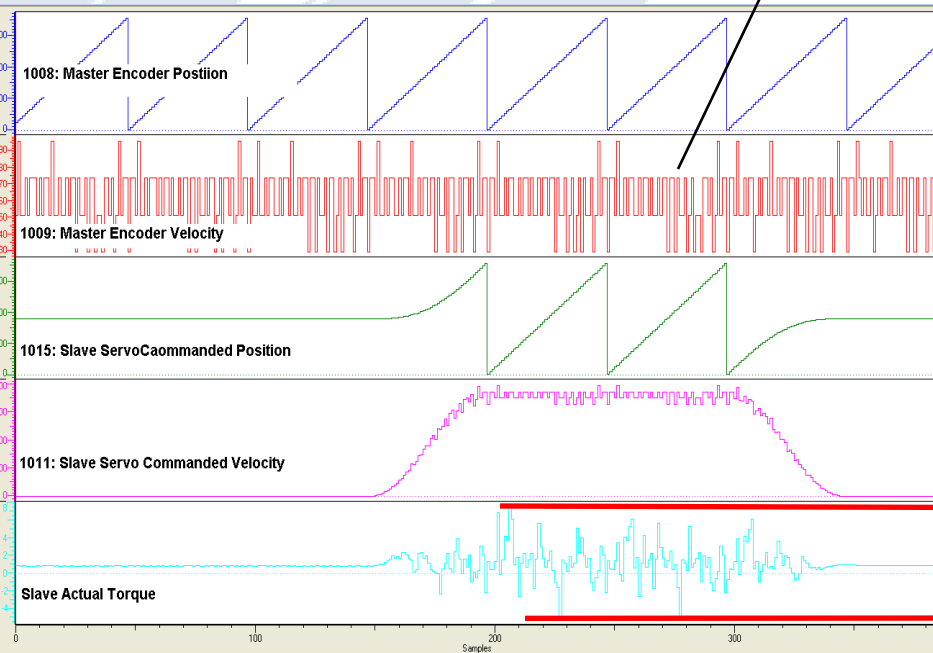
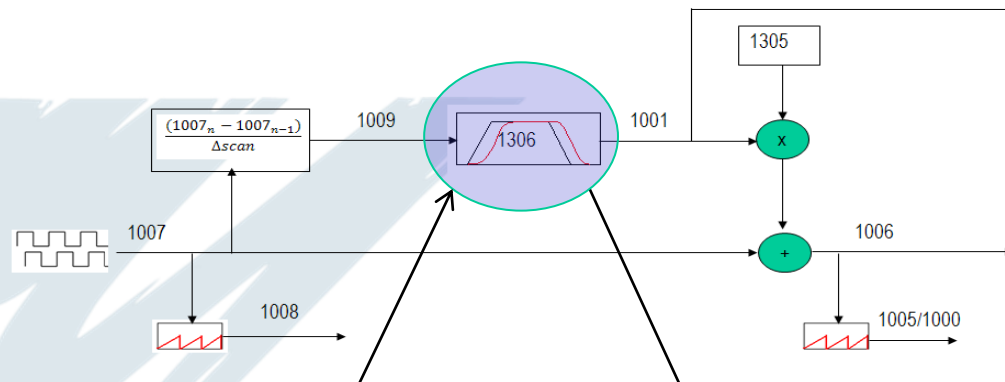


Controller Parameter	Description	DataType	Default	Units
1001	Actual Velocity (Post S-curve filter)	LREAL		User units/s
1005	Actual Position Cyclic	LREAL		User units
1006	Actual Position Non Cyclic	LREAL		User units
1008	Raw Encoder Position Cyclic	LREAL		User units
1007	Raw Encoder Position Non Cyclic	LREAL		User units
1009	Actual Velocity (Pre S-curve filter)	LREAL		User units/s
1305	External Encoder Scan Compensation	LREAL	2 MLINK scans	s
1306	Velocity Filter (Moving average)	LREAL	0.0	s

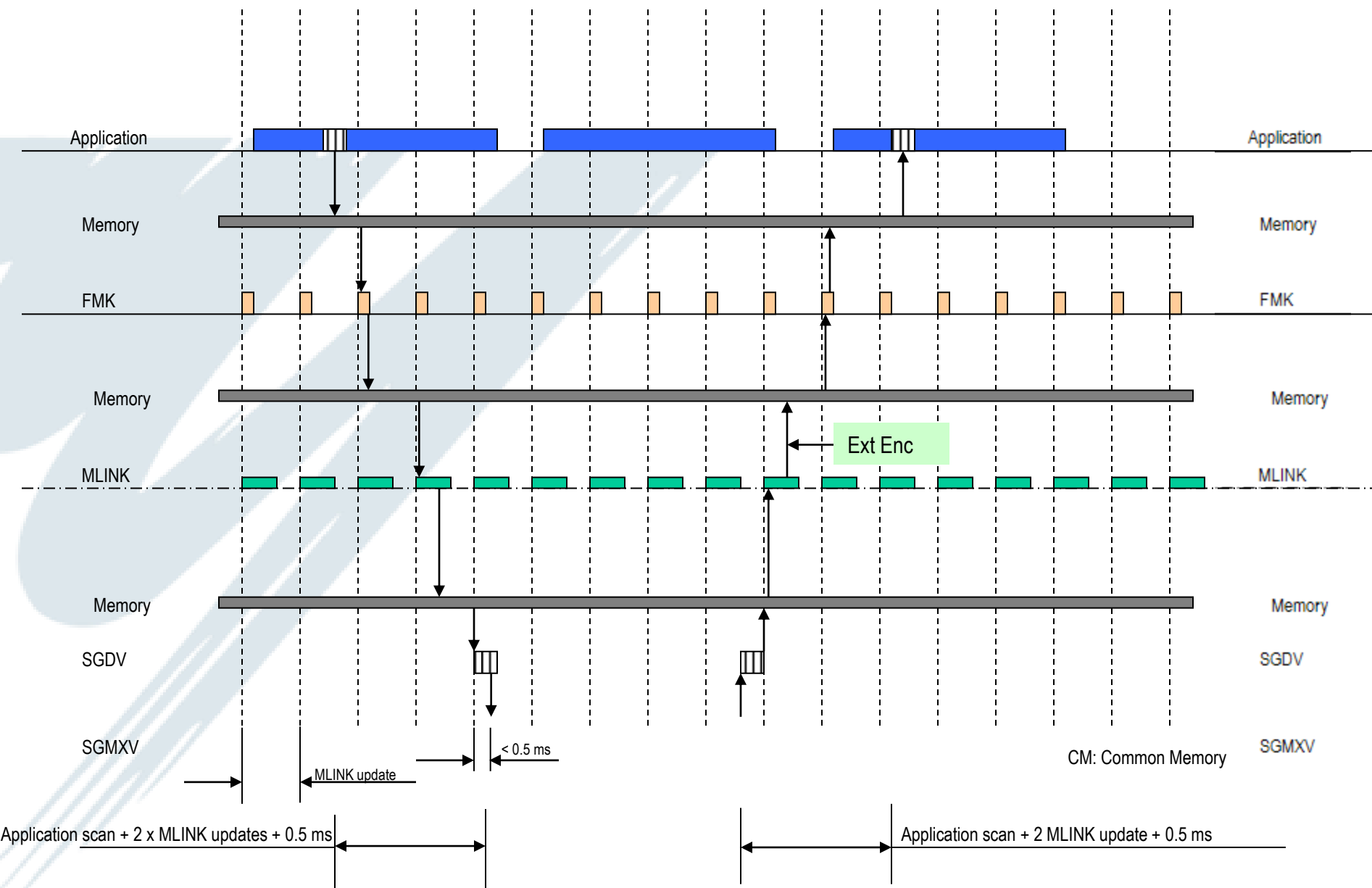
Actual Cam Motion



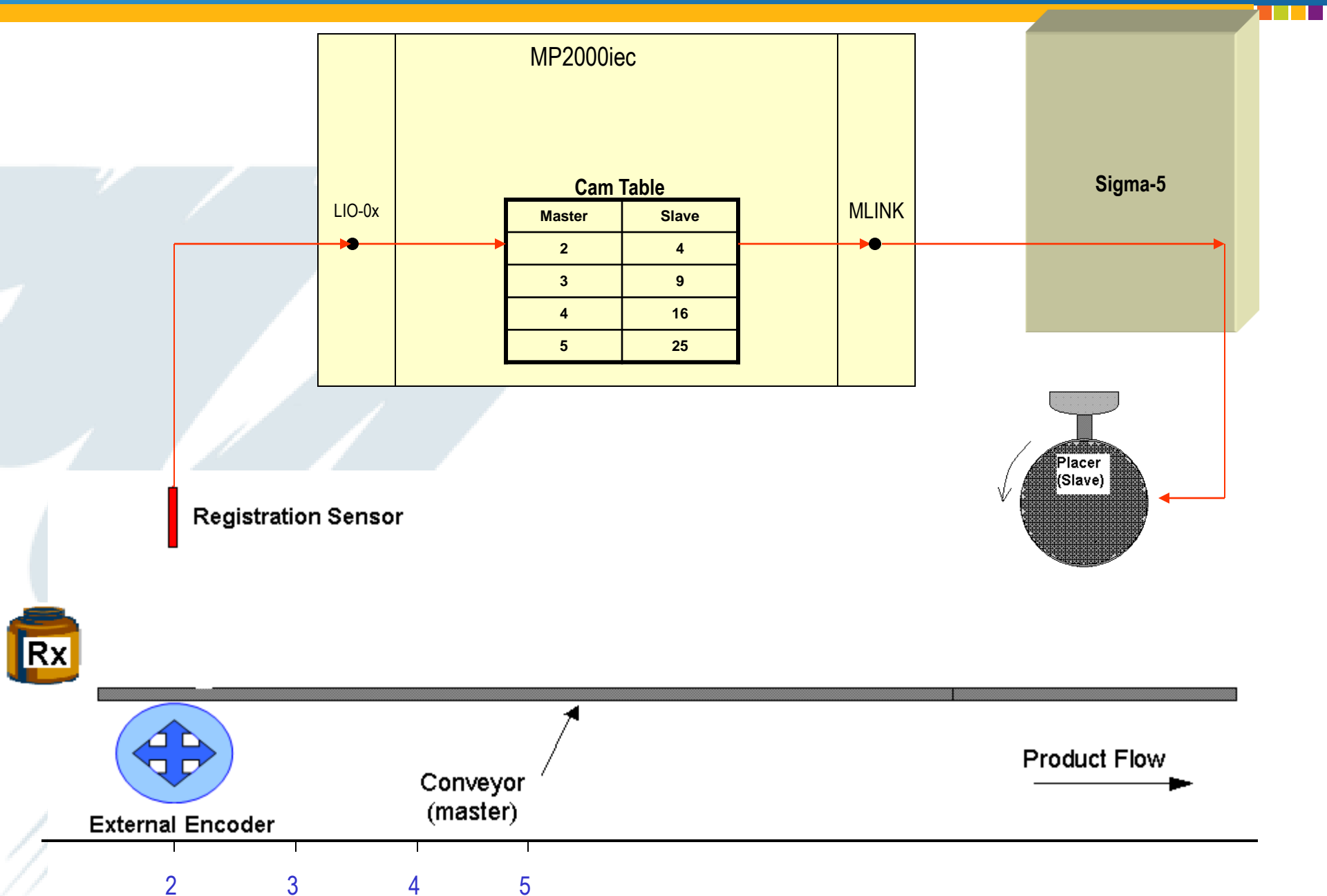
Actual Cam Motion



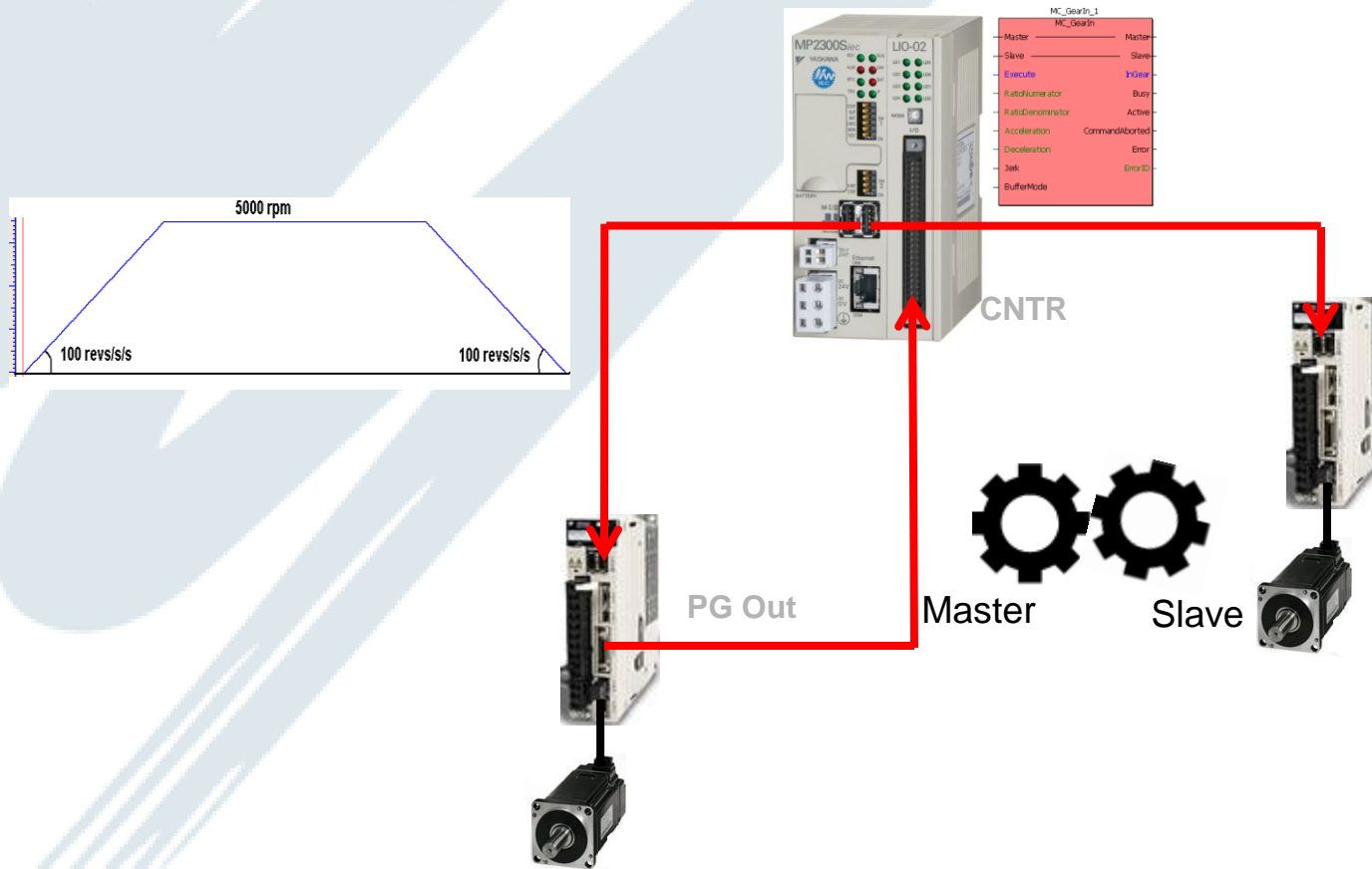
Communication delays



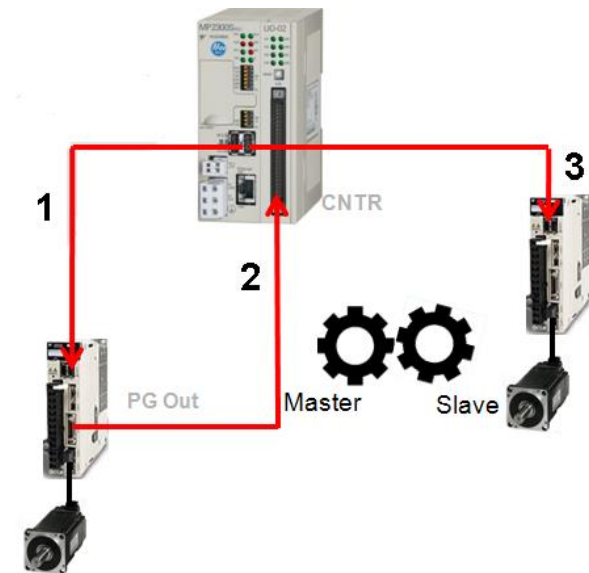
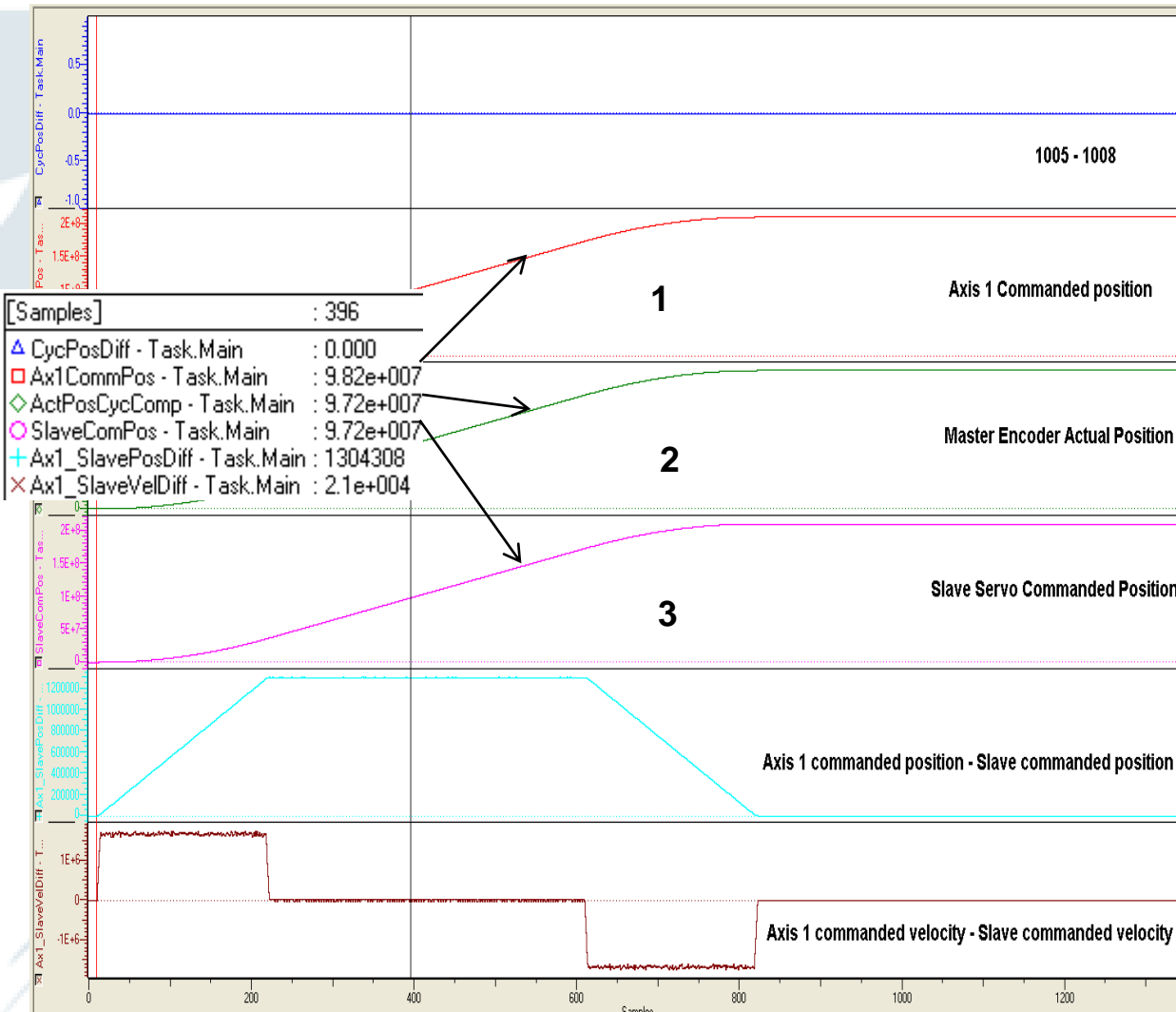
Need for Scan Compensation



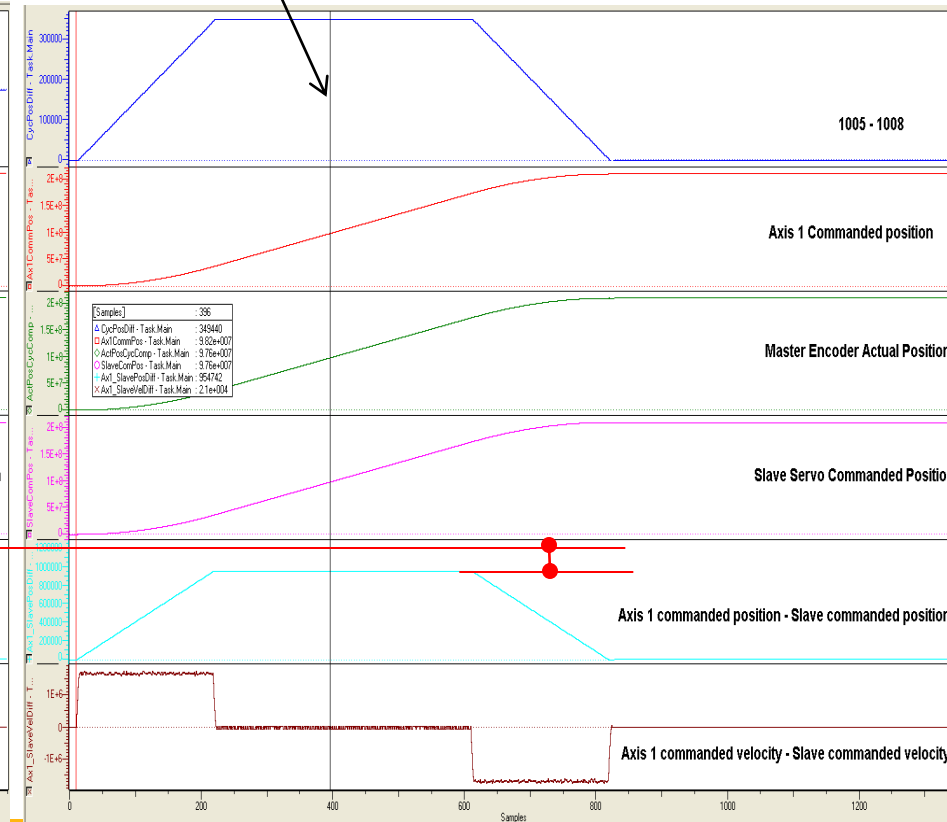
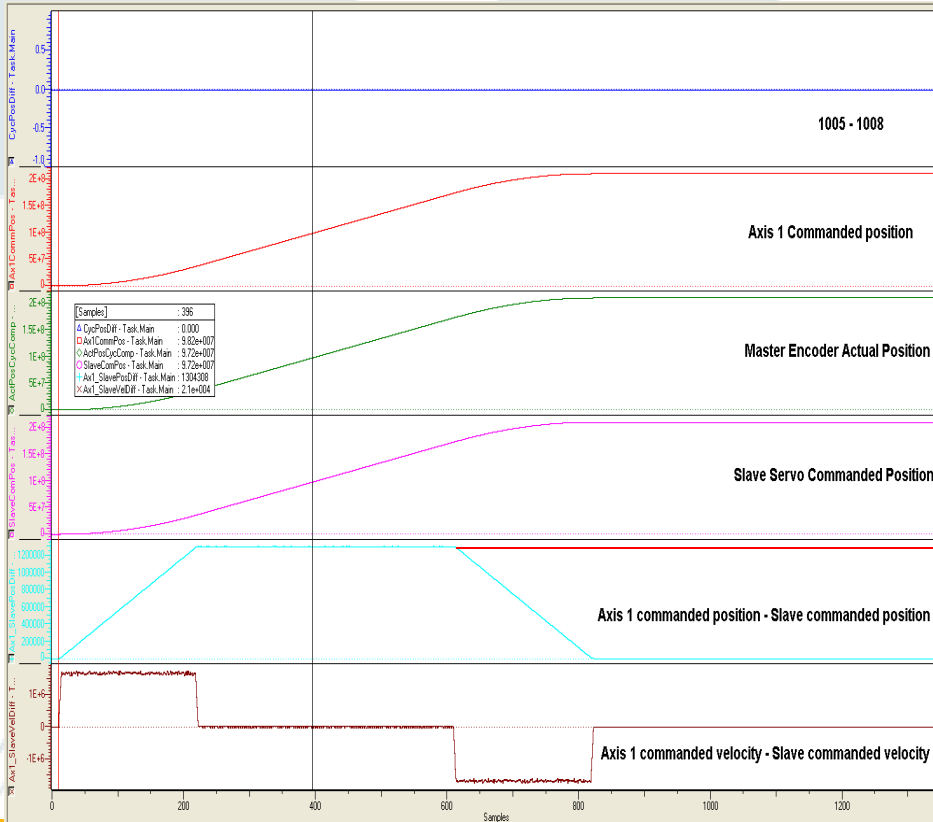
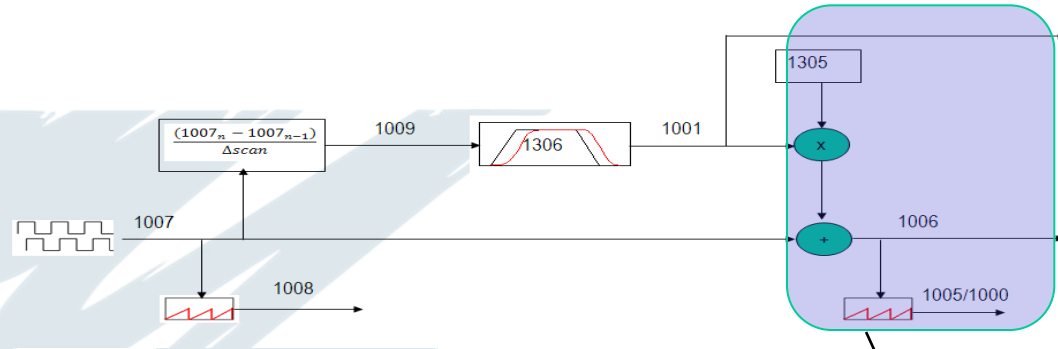
Synchronization test stand



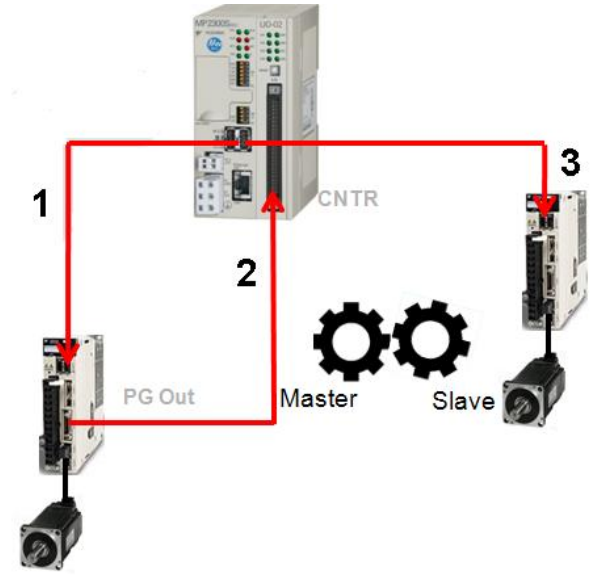
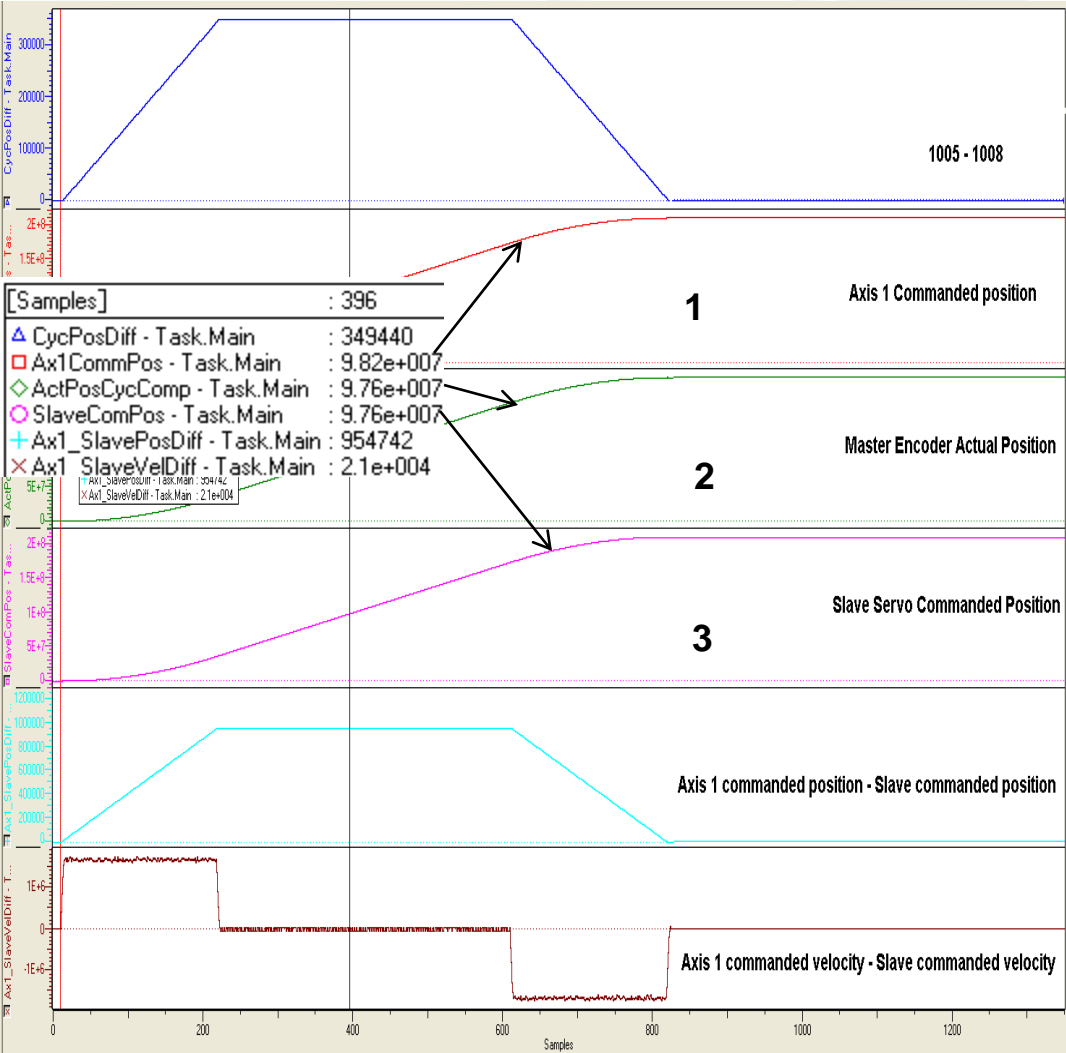
Communication delays



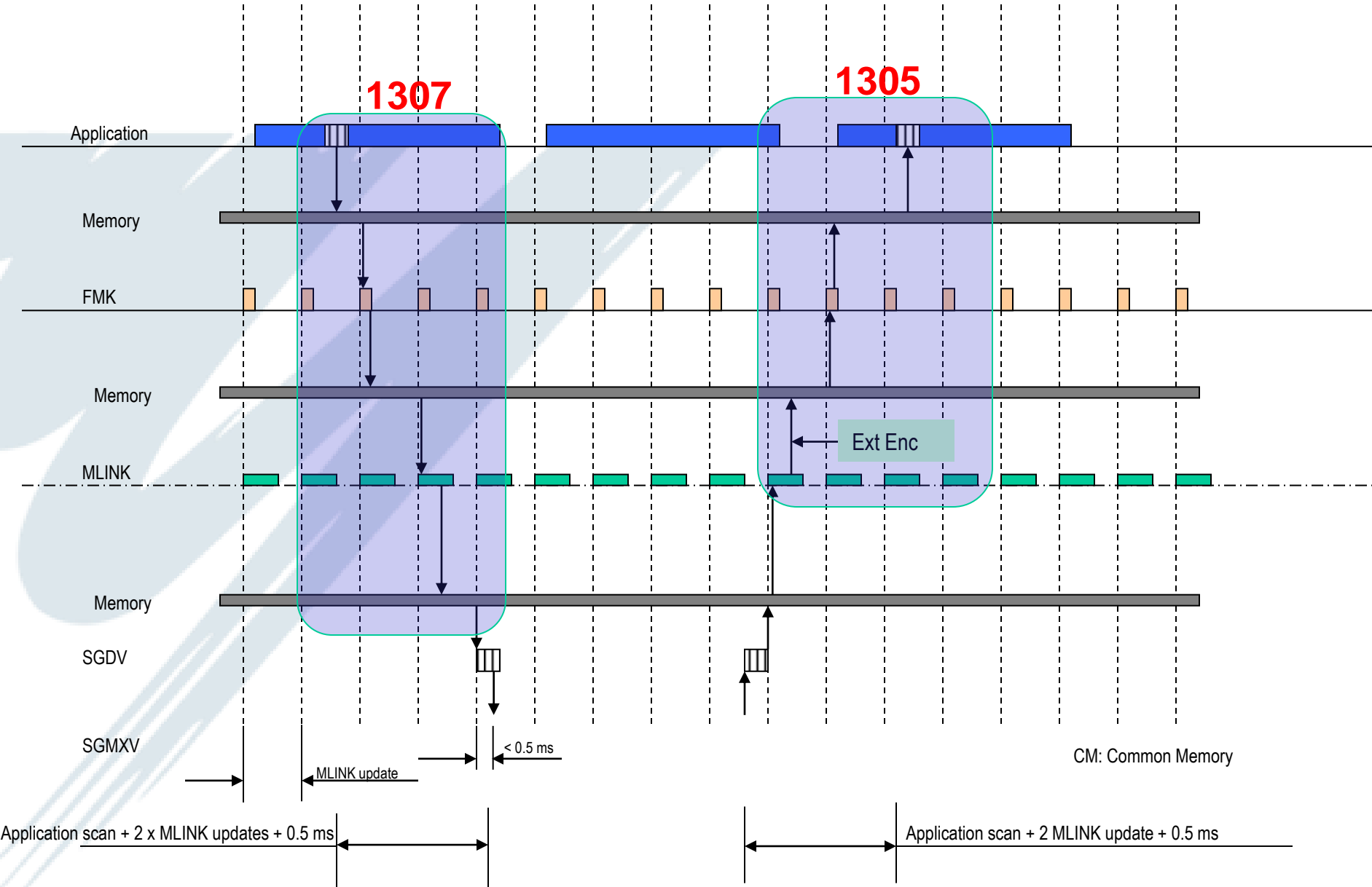
Communication delays : 1305



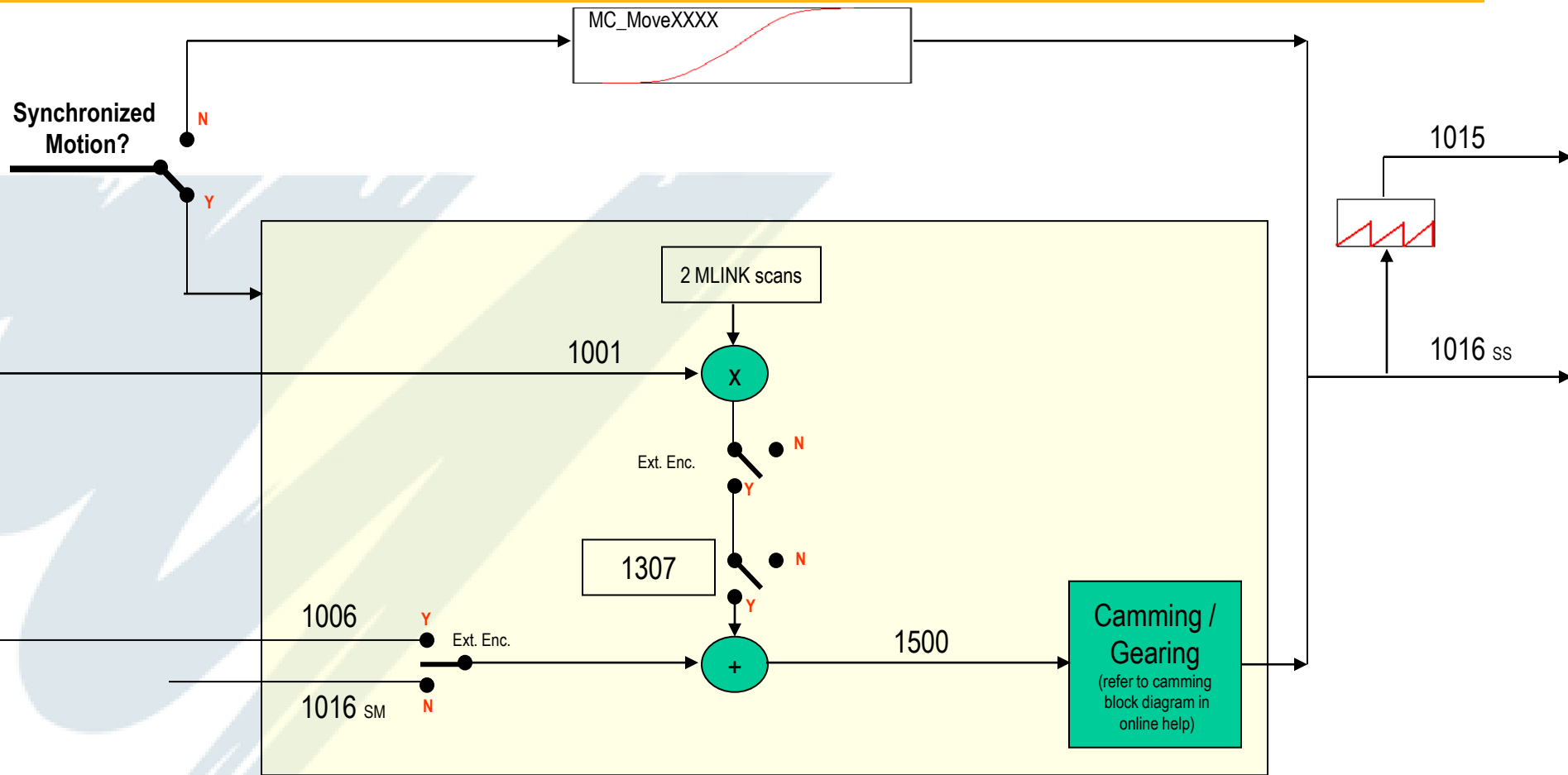
Communication delays: 1305



Communication delays

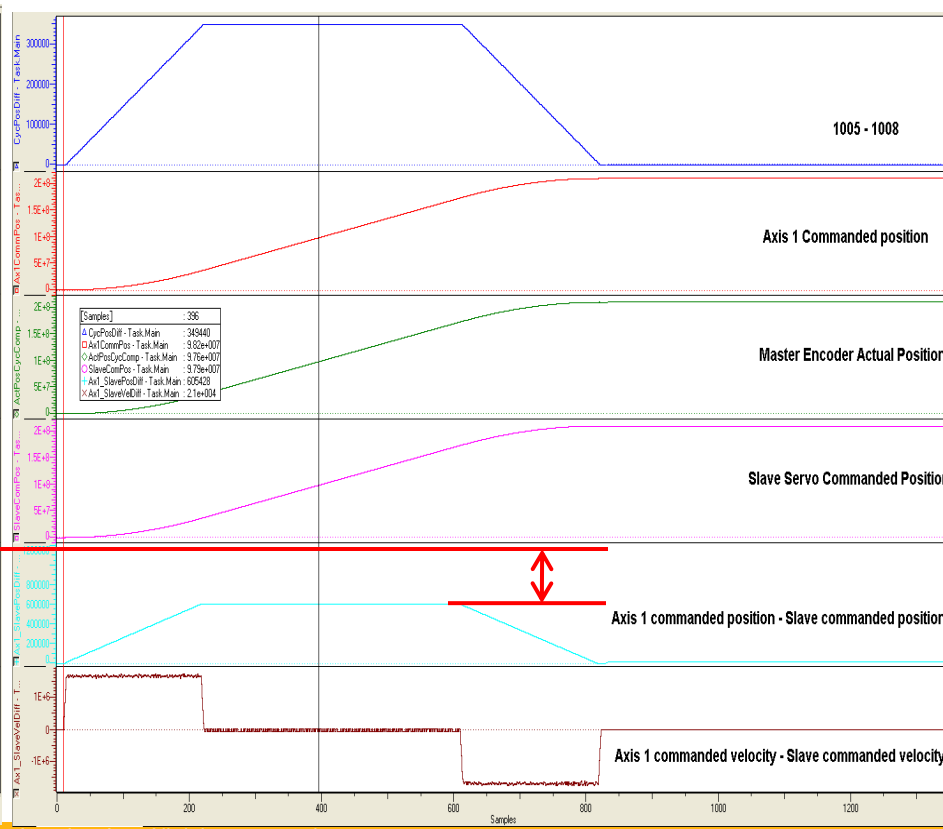
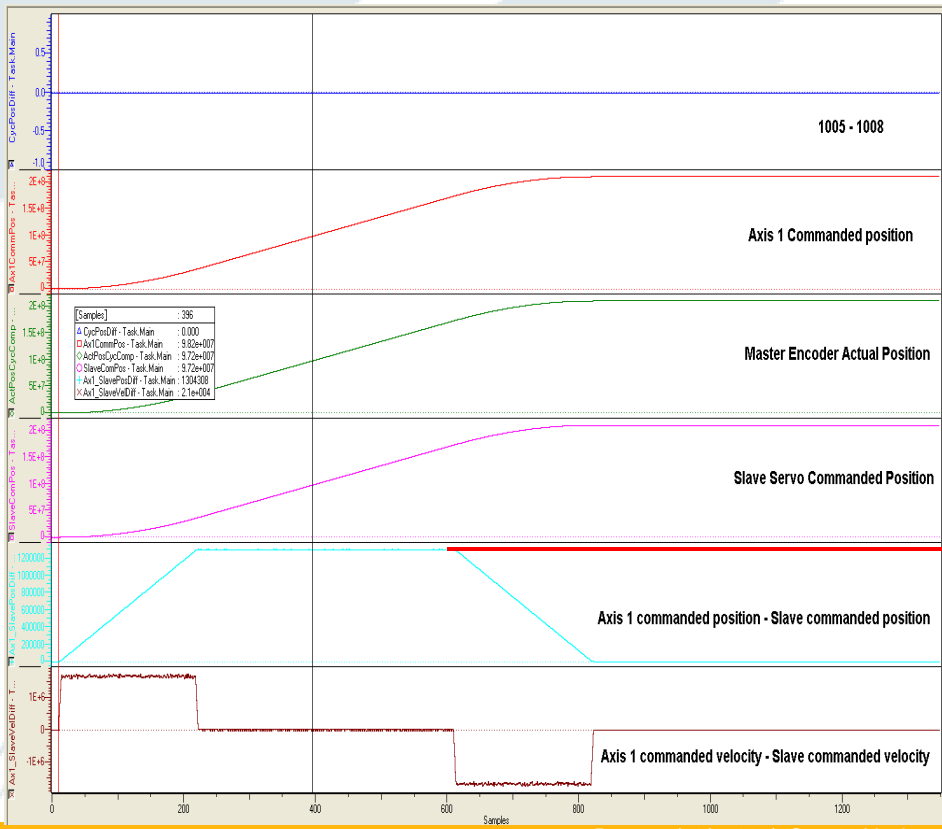
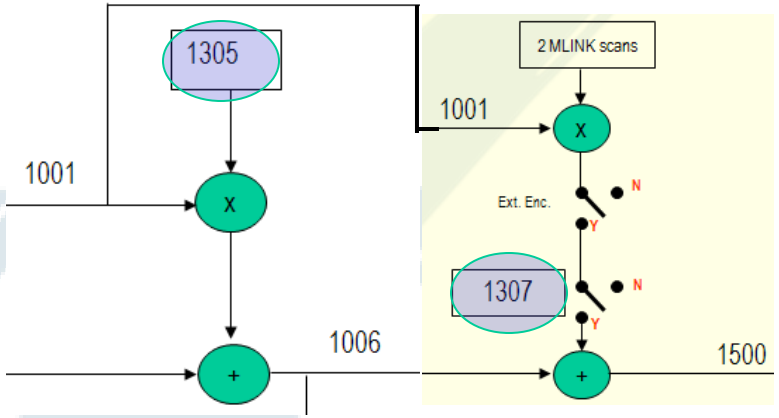


Scan Compensation

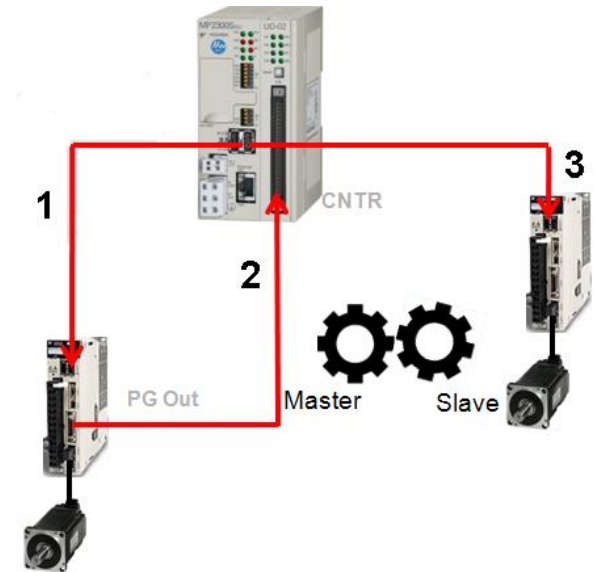
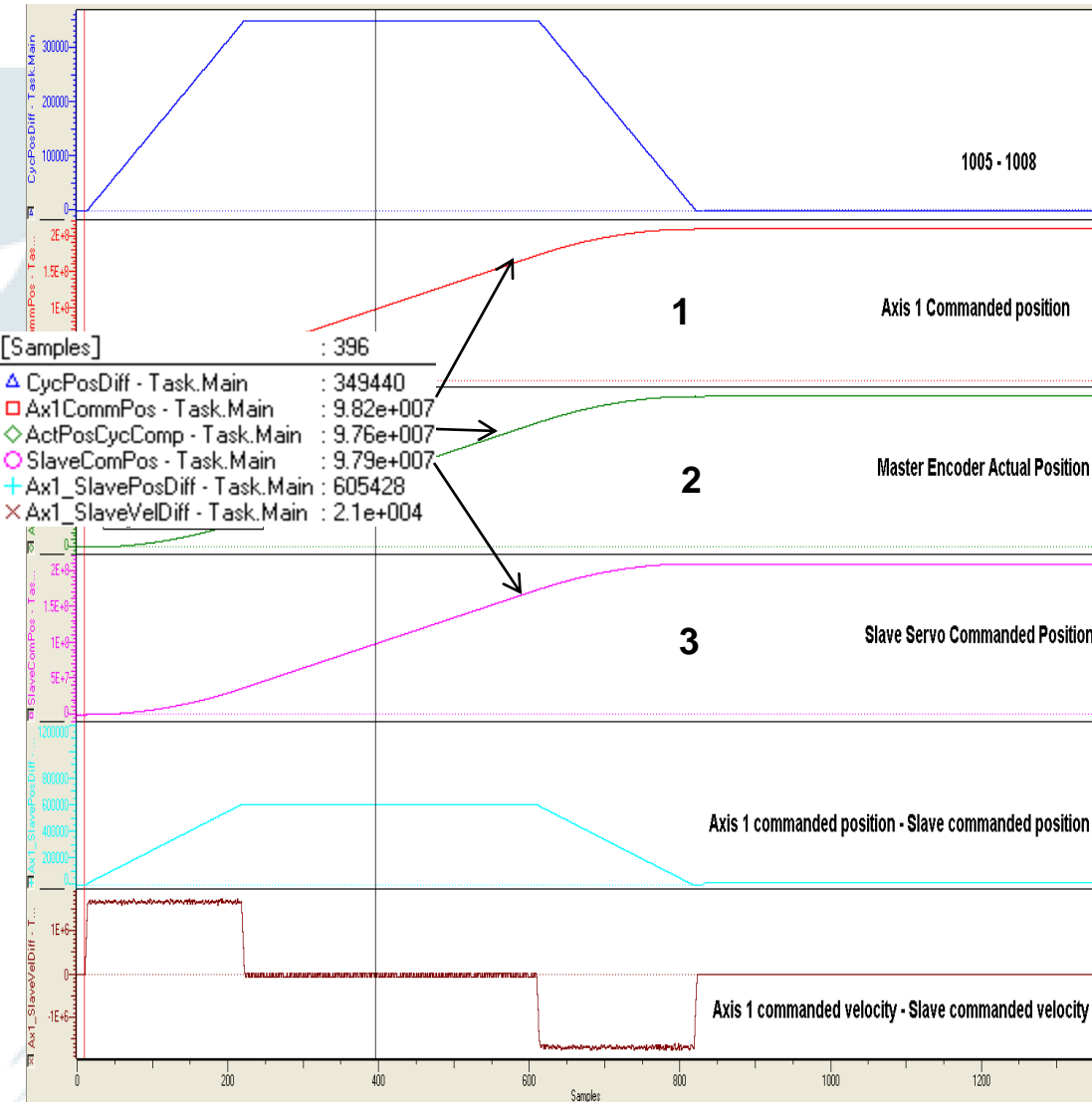


Controller Parameter	Description	Data Type	Default	Units
1001	Actual Velocity (Post S-curve filter)	LREAL		User units/s
1006	Actual Position Non Cyclic	LREAL		User units
1015	Commanded Position Cyclic	LREAL		User units
1016 SM	Commanded Position Non Cyclic (Servo Master)	LREAL		User units
1016 SS	Commanded Position Non Cyclic (Servo Slave)	LREAL		User units
1307	Mechatrolink Compensation	BOOL	TRUE	
1500	Cam Master Position	LREAL		User units

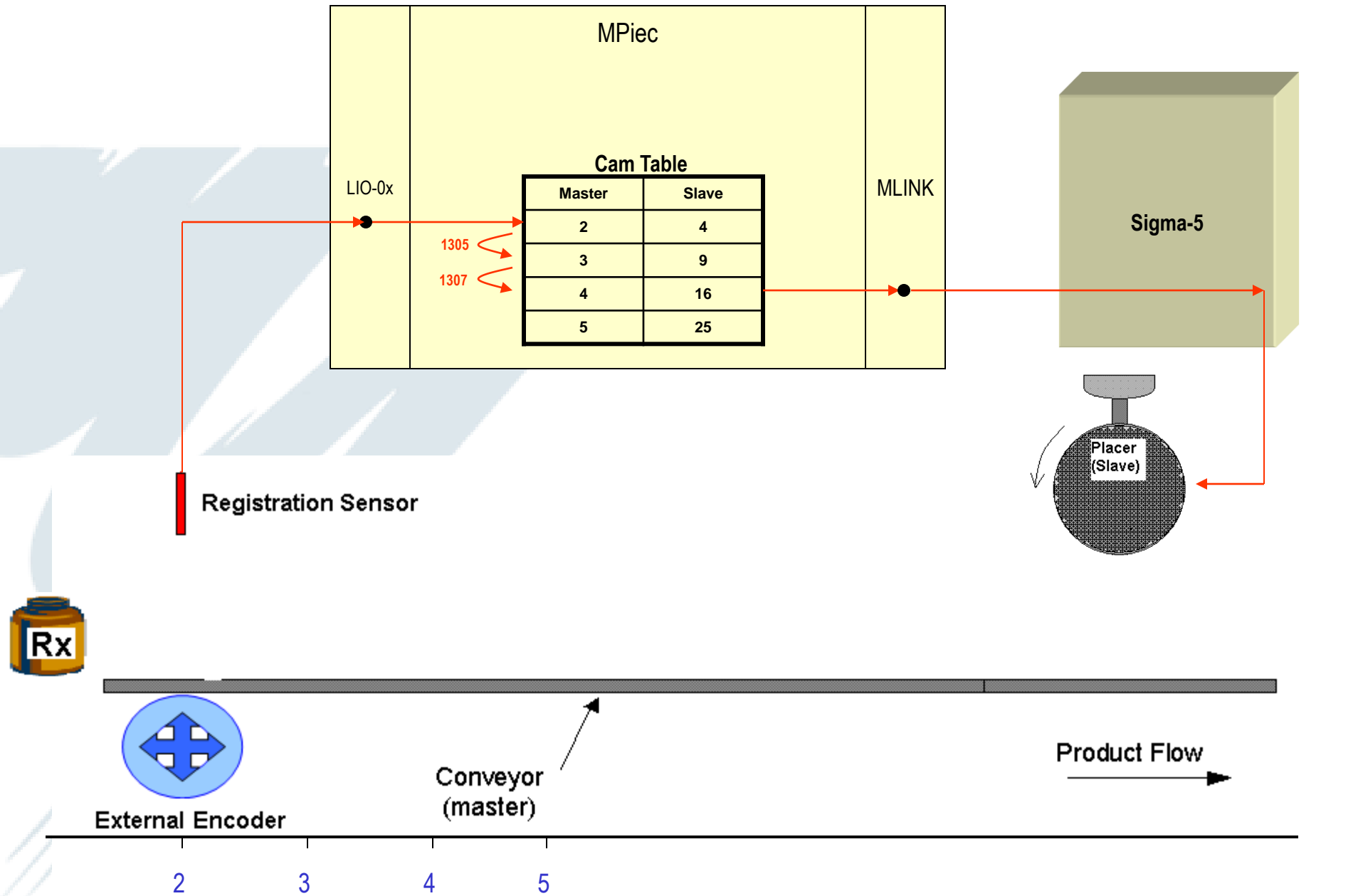
Communication delays



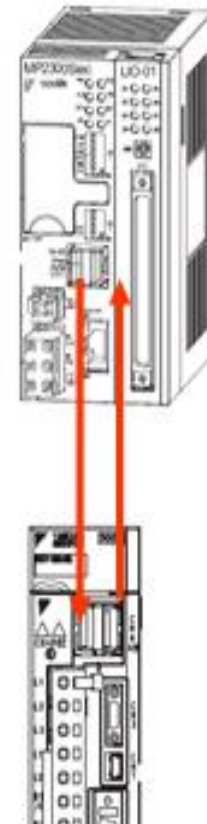
Communication delays



Scan Compensation

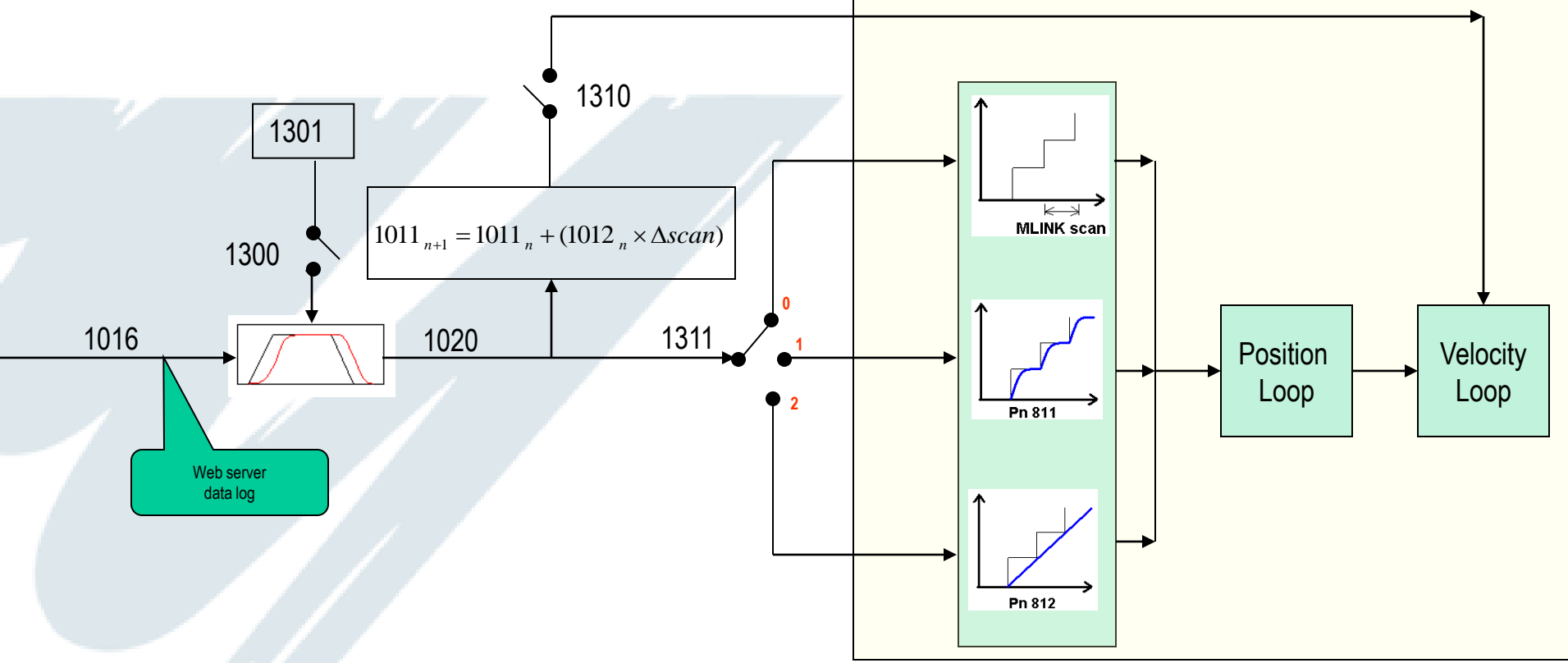


Filters for Synchronized and Unsynchronized motion



MP2300siec/ MP2310iec

Sigma-5 - MECHATROLINK

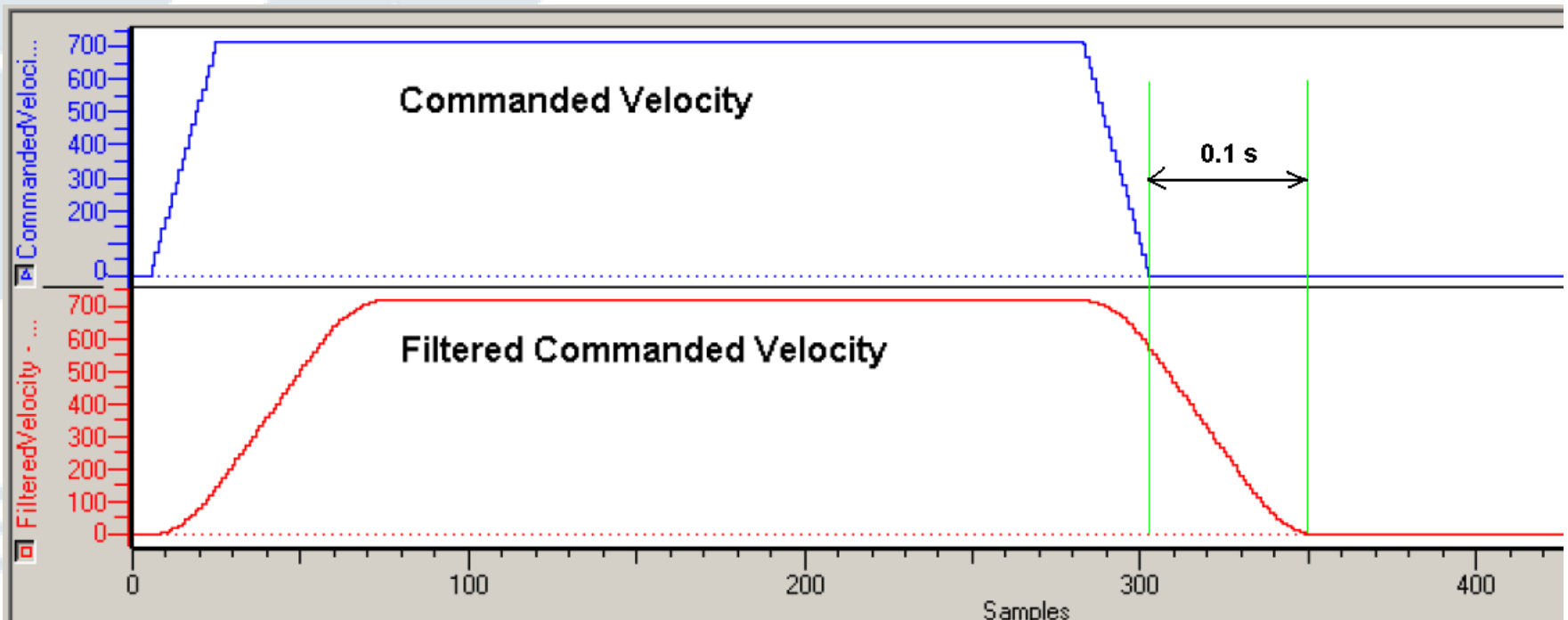


Controller Parameter	Description	Data Type	Default	Units
1011	Commanded Velocity	LREAL		User units/s
1012	Commanded Acceleration	LREAL		User units/s/s
1016	Commanded Position Non Cyclic	LREAL		User units
1020	Commanded Position Non Cyclic (Post S curve filter)	LREAL		User units
1300	Moving Average Filter Switch	BOOL	FALSE	
1301	Moving average Filter Time Constant	LREAL	0.1	s
1310	Controller side Velocity Feed Forward Switch	BOOL	1	
1311	Optional ACCFIL switch	LREAL	0	

Motion Filter: 1300

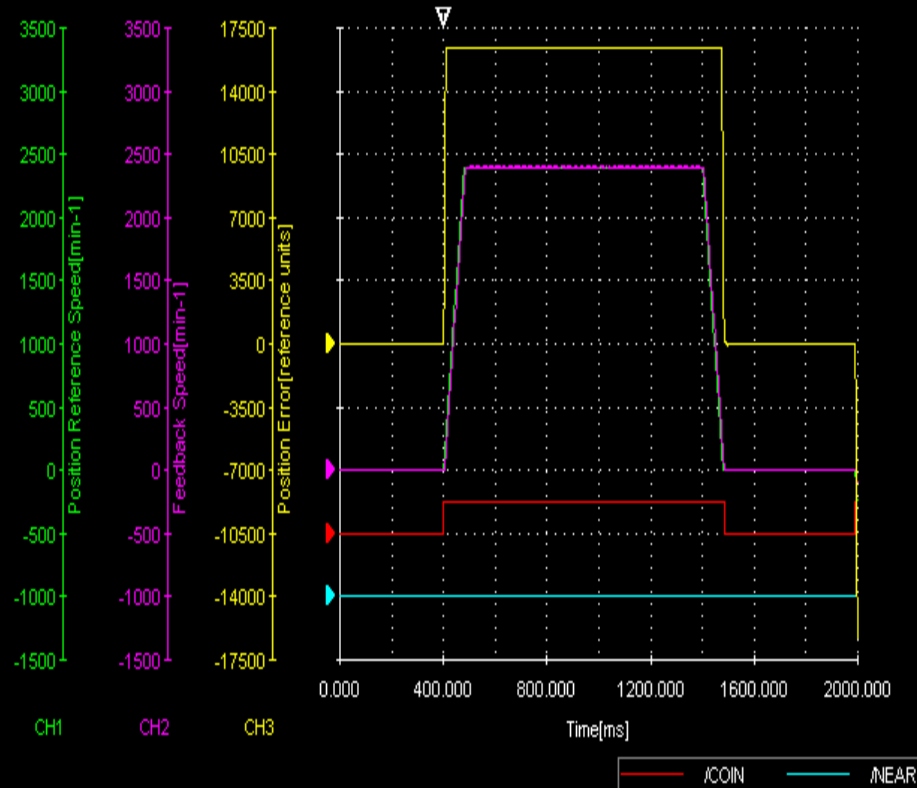
Parameter #	Parameters	Current Value	Units	Min	Max	Default Value
1007	Load Type	Rotary		0	1	Linear
1031	Logical Axis Number	1		1	512	
1300	Moving Average Filter 1 Enable	False				False
1301	Moving Average Filter 1 Time Constant	0.1	s	0	1	0.1

← Set to TRUE

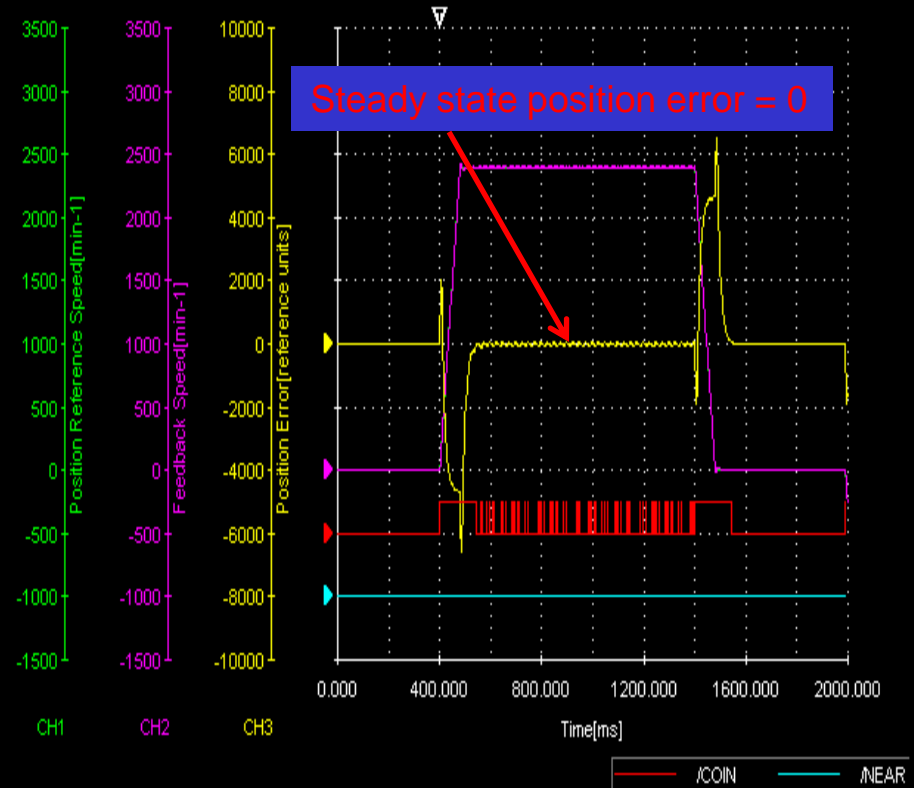


Velocity Feedforward: 1310

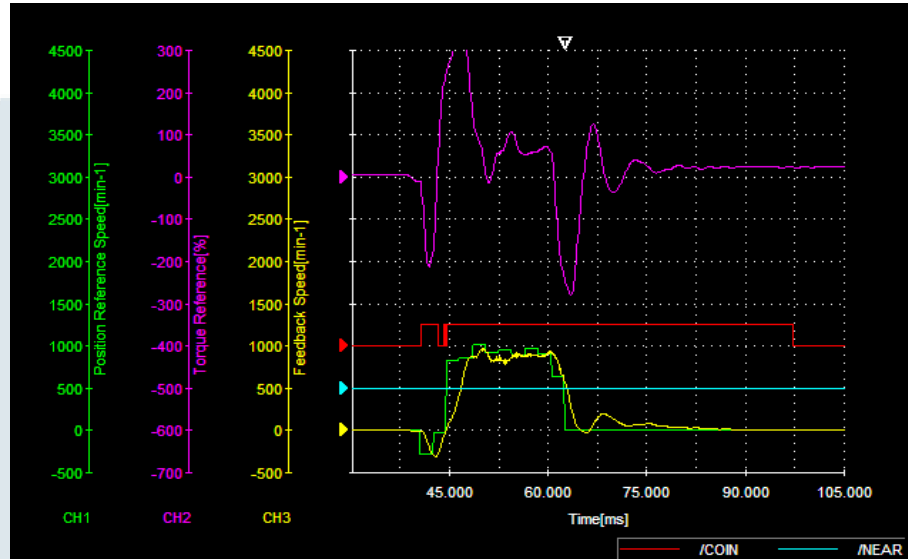
Controller parameter 1310 = 0



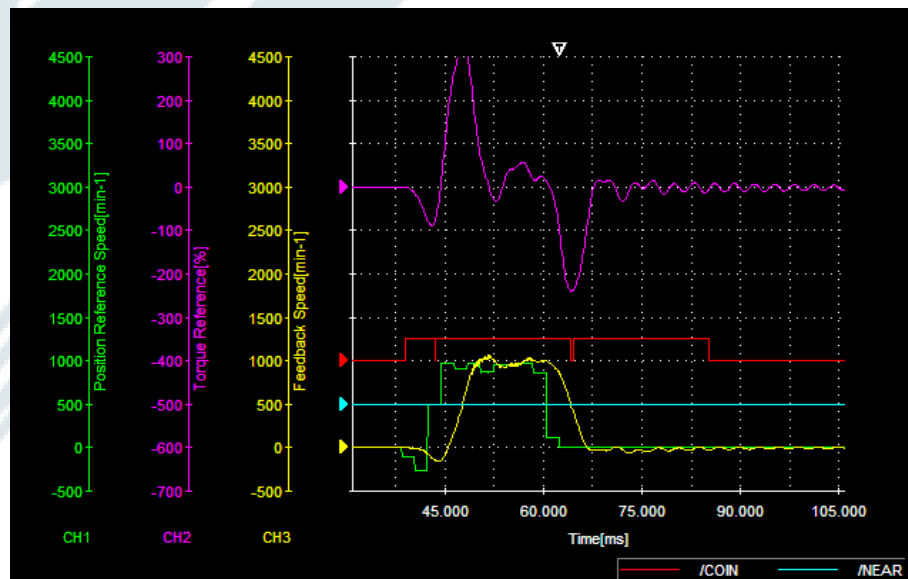
Controller parameter 1310 = 1



Velocity Feedforward: 1310 vs Pn109



1310 = 1
Pn109 = 0

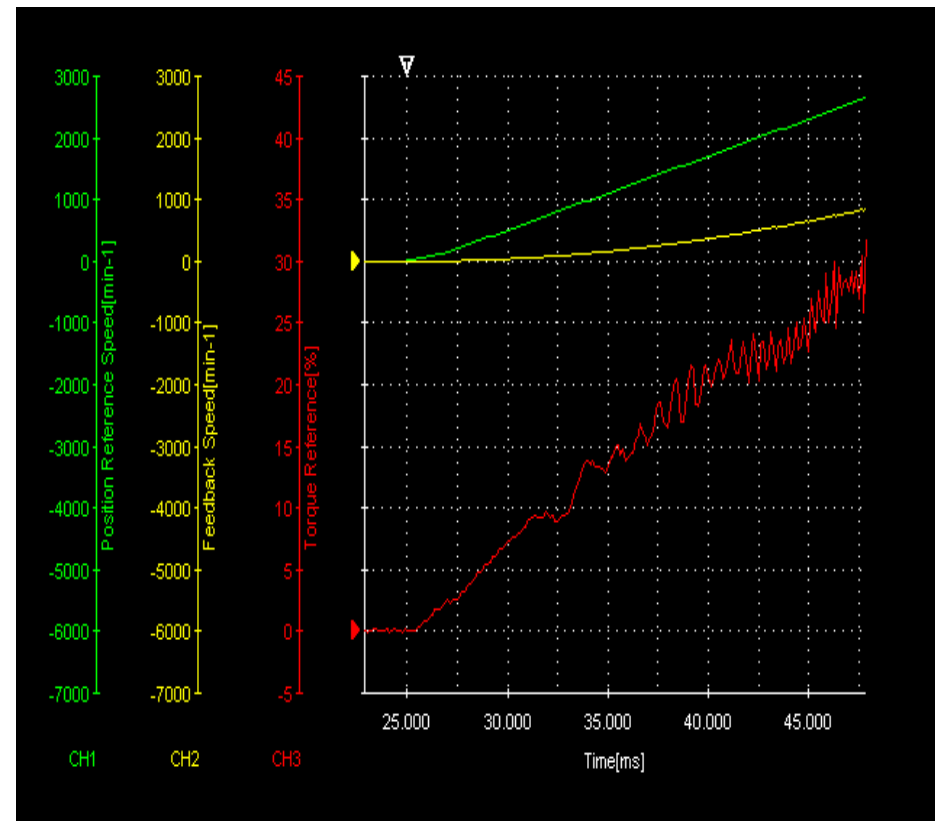
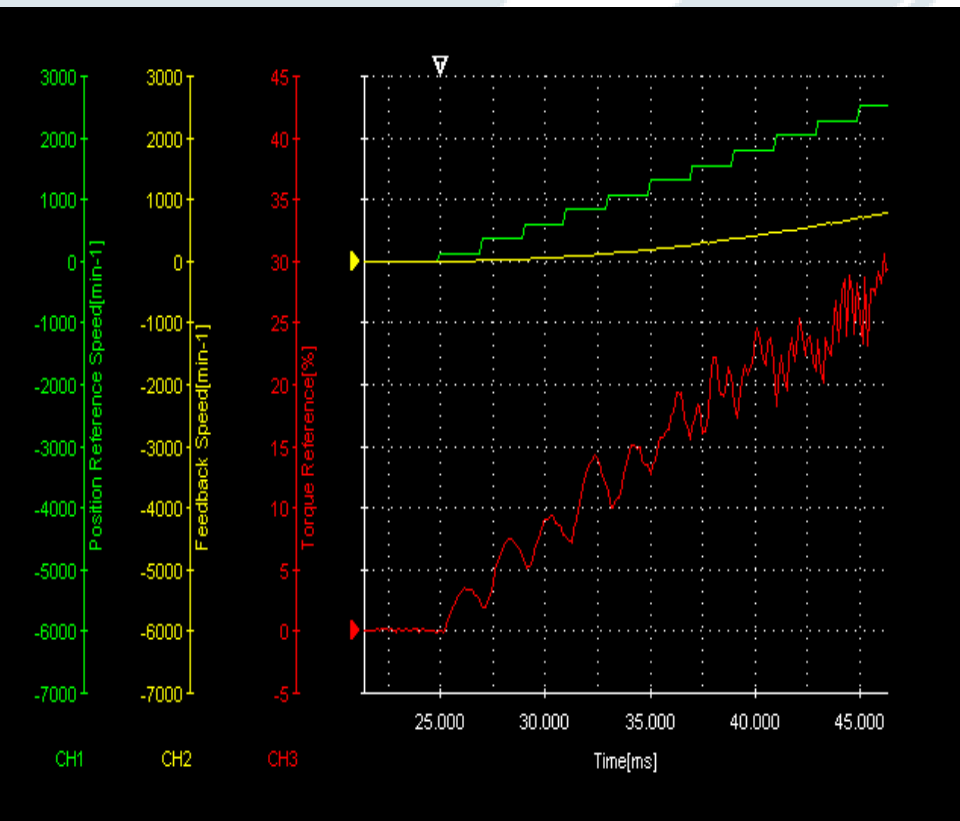


1310 = 0
Pn109 = 100

Servopack Sub-interpolation: 1311

Controller parameter 1311 = 0
Pn 812 = 0 ms

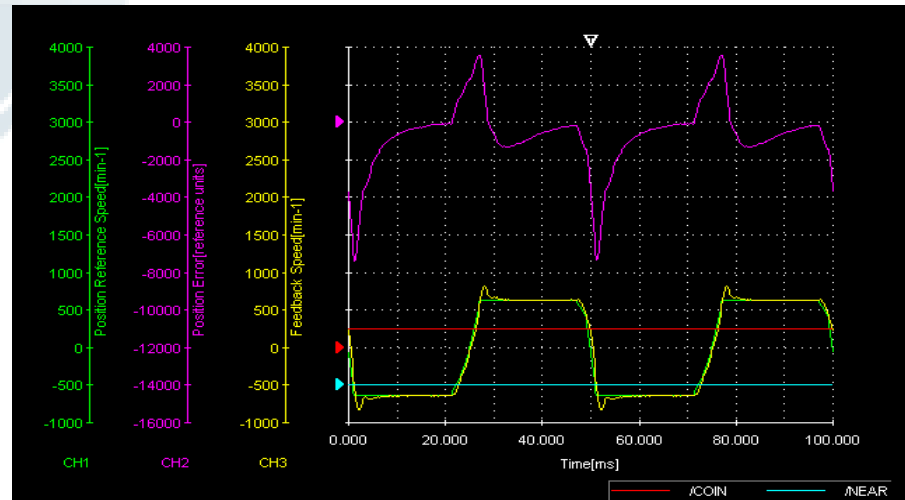
Controller parameter 1311 = 2
Pn 812 = 2 ms



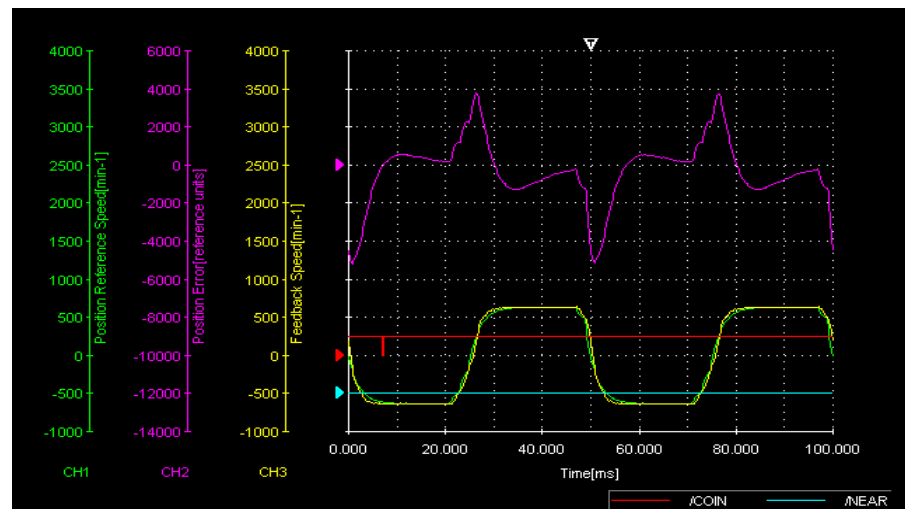
Controller sends commands every MECHATROLINK update (2 ms)

Servopack Sub-interpolation: 1311

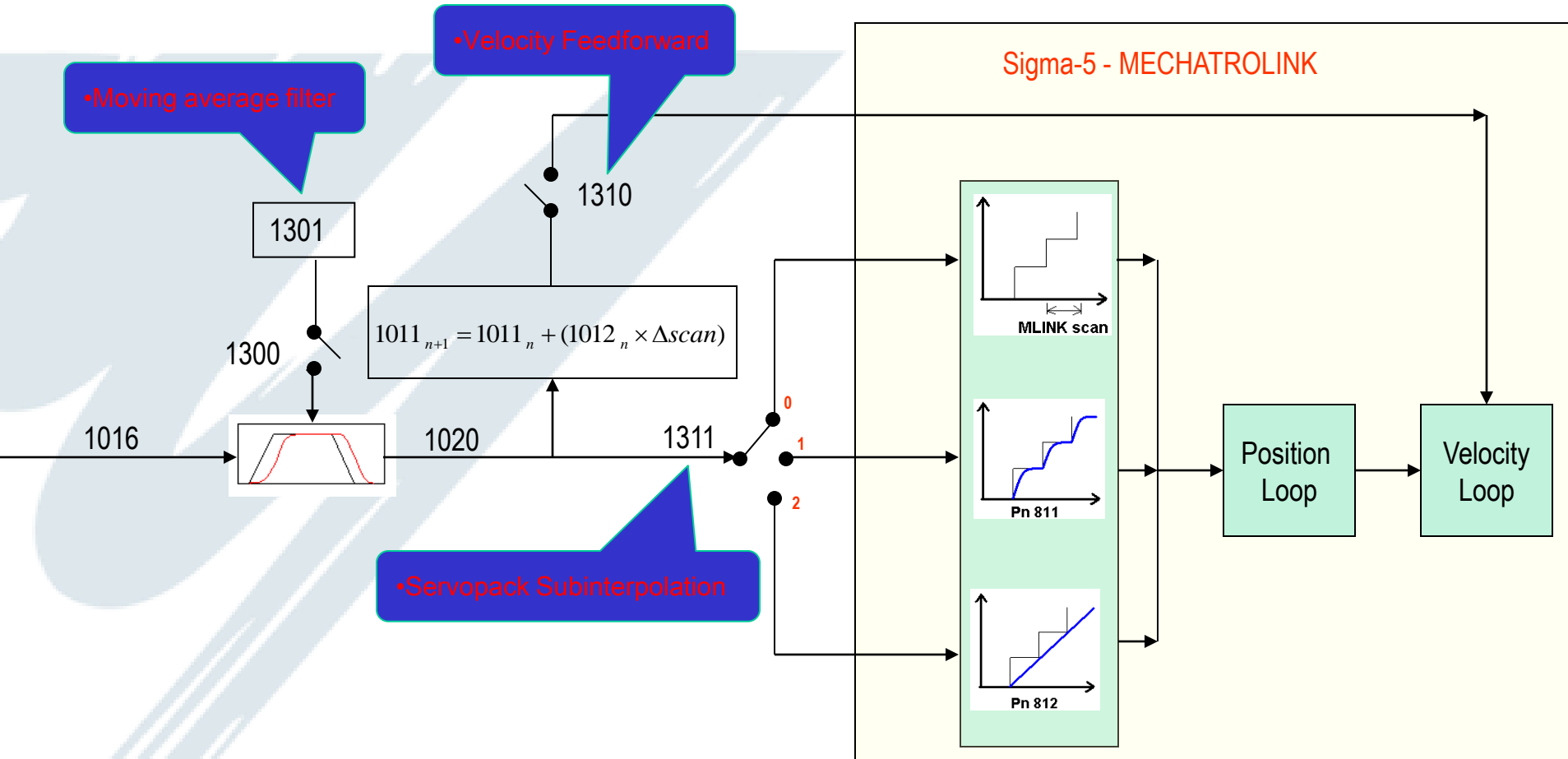
Pn 1311 = 2
Pn812 = 2ms



Pn 1311 = 1
Pn811 = 2ms

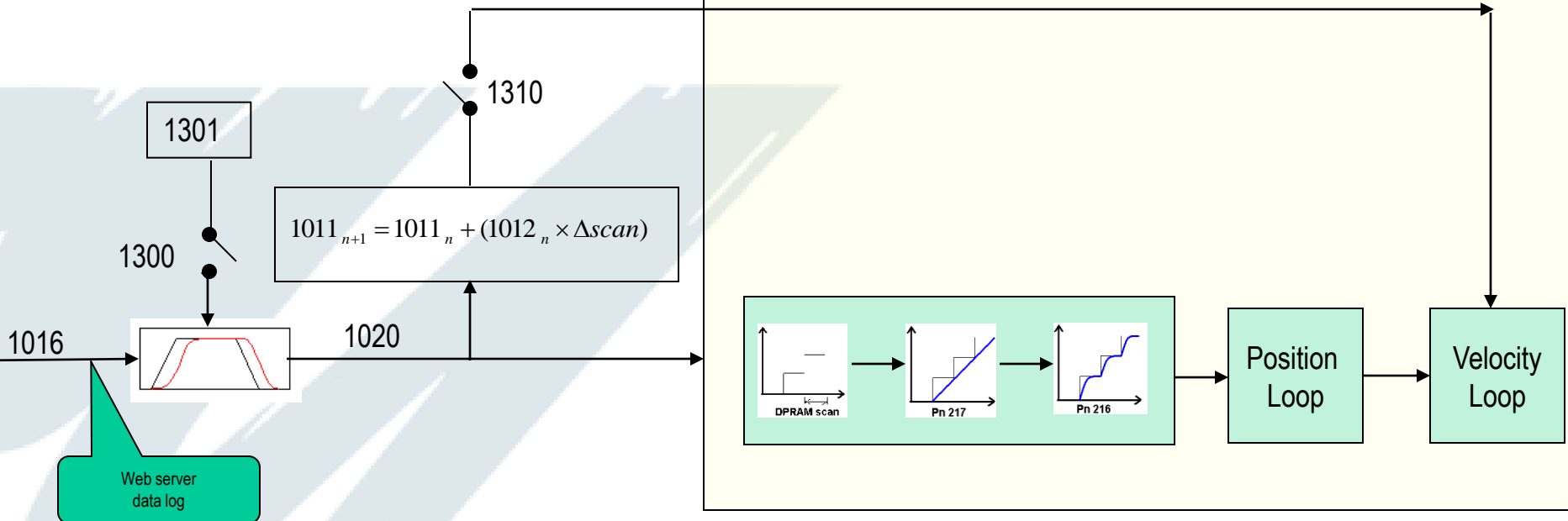


MP2300siec/ MP2310iec



MP2600iec

Sigma-5 – Option Style



Controller Parameter	Description	Data Type	Default	Units
1011	Commanded Velocity	LREAL		User units/s
1012	Commanded Acceleration	LREAL		User units/s/s
1016	Commanded Position Non Cyclic	LREAL		User units
1020	Commanded Position Non Cyclic (Post S curve filter)	LREAL		User units
1300	Moving Average Filter Switch	BOOL	FALSE	
1301	Moving average Filter Time Constant	LREAL	0.1	s
1310	Controller side Velocity Feed Forward Switch	BOOL	1	

Summary

	Synchronized motion (Gear, Cam)	Un-synchronized motion (Discrete move)
1	Filtered master data (1306)	Moving average filter (1300)
2	Communication delay compensation (1305, 1307)	-
3	Feedforward component (1310) *	Feedforward component (1310) *
4	Servopack sub-interpolation (1311)	Servopack sub-interpolation (1311)

* Consider Pn109 for motion profiles with high acceleration profiles

Customer 1

Application: Camming

MECHATROLINK: 4 ms

- *RMS torque : 96% (Calculated RMS torque 66%)*
- *A860: Encoder overheating alarm (Started designing heat sink)*
- *Rough sounding*

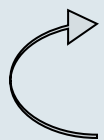


Pn 812 = 4 ms

- **RMS torque : 67%**
- **Smooth sounding**

MP2600iec: High Speed Indexer

Sequence

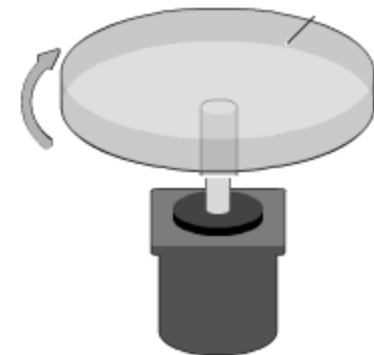
- 
- *Get digital input*
 - *Command motion (max 180 degrees)*
 - *Settle to 0.36 degrees*

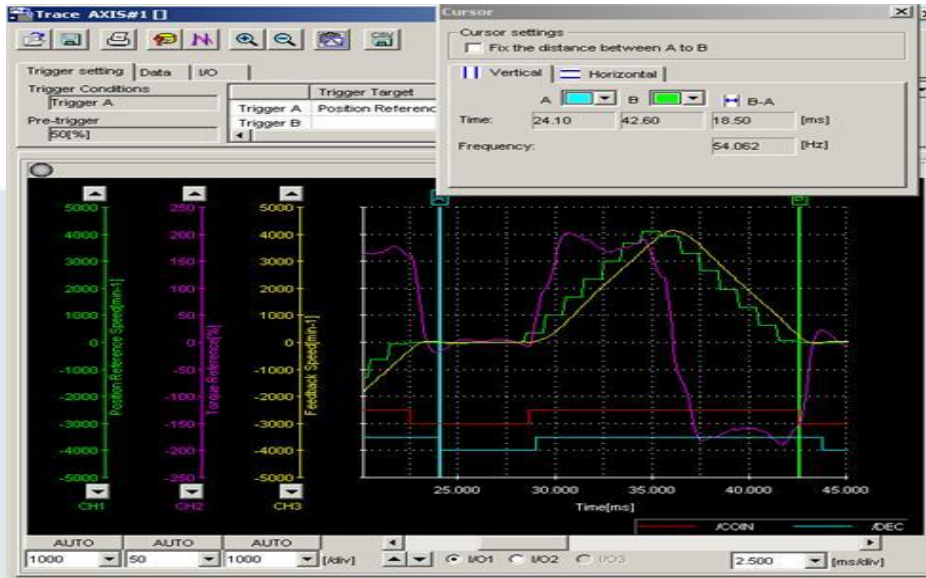


Within 20 ms

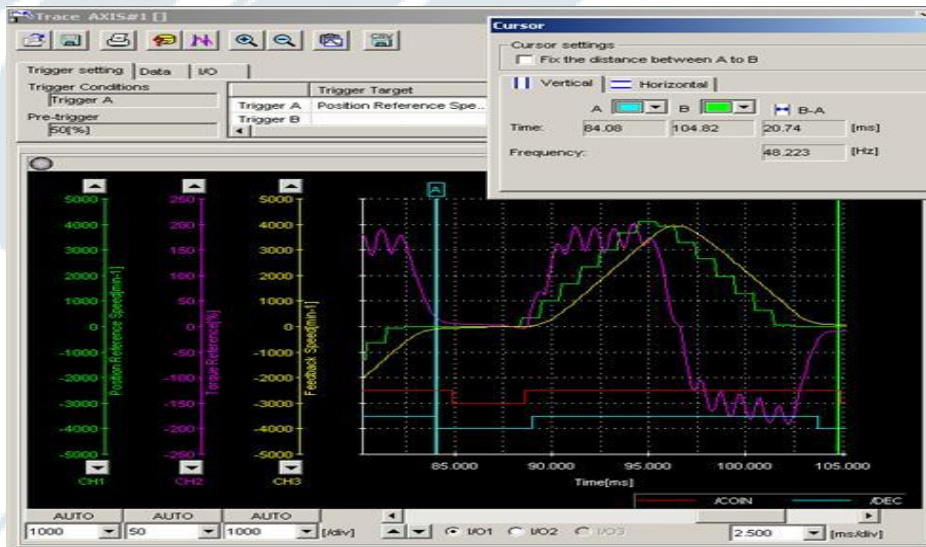
Challenges

- *Fast reaction to IO and fast motion command*
- *Smooth torque profile. Motor getting hot.*
- *Tuning to obtain fast settling*





Pn217 = 10 (moving average filter)
 Move time = 18.5 ms



Pn216 = 10 (Exponential filter)
 Move time = 20.74 ms

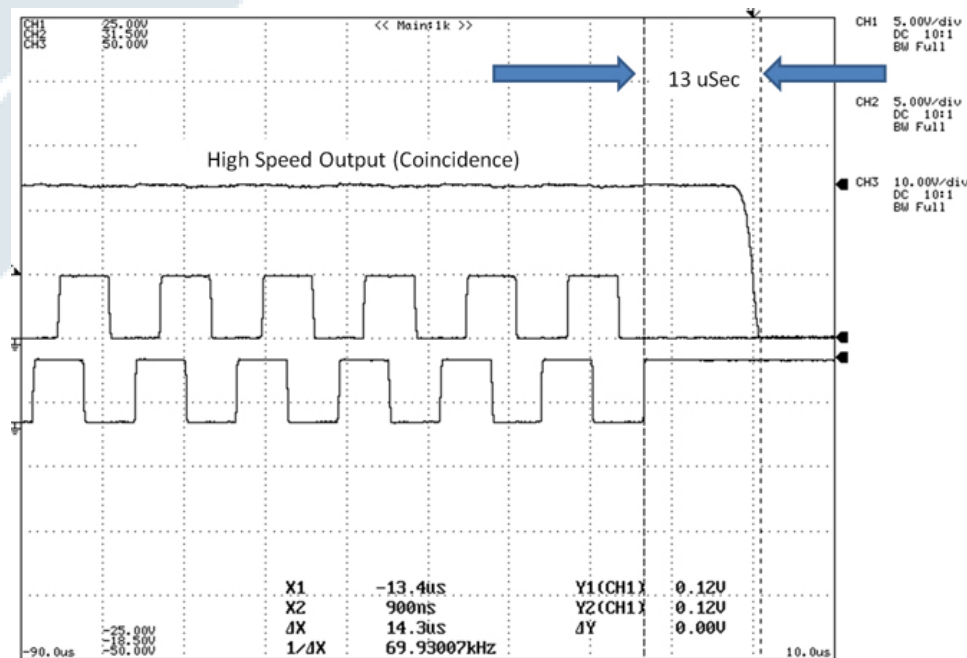
Servopack sub-interpolation was critical in bringing down RMS torque and in preventing encoder over heating

Additional Parameters

- *High Speed Output (1050)*
- *Option Monitor Read (1032)*

High Speed Output (based on External Encoder Position)

HighSpeedOutputEnable	1050	BOOL	R/W	FALSE	Set TRUE to arm or toggle to re-arm the external encoder high speed output.
HighSpeedOutputPosition	1052	LREAL	R/W	0.0	Set this value before the high speed output function is enabled.
HighSpeedOutputPositionNonCyclic	1053	LREAL	R/W	0.0	This is the user unit equivalent of the raw 32 bit encoder value set in the hardware for high speed output compare.
HighSpeedOutputStatus	1051	BOOL	R	N/A	Status bit indicates when the hardware sets the high speed output and remains set until the function is disabled.

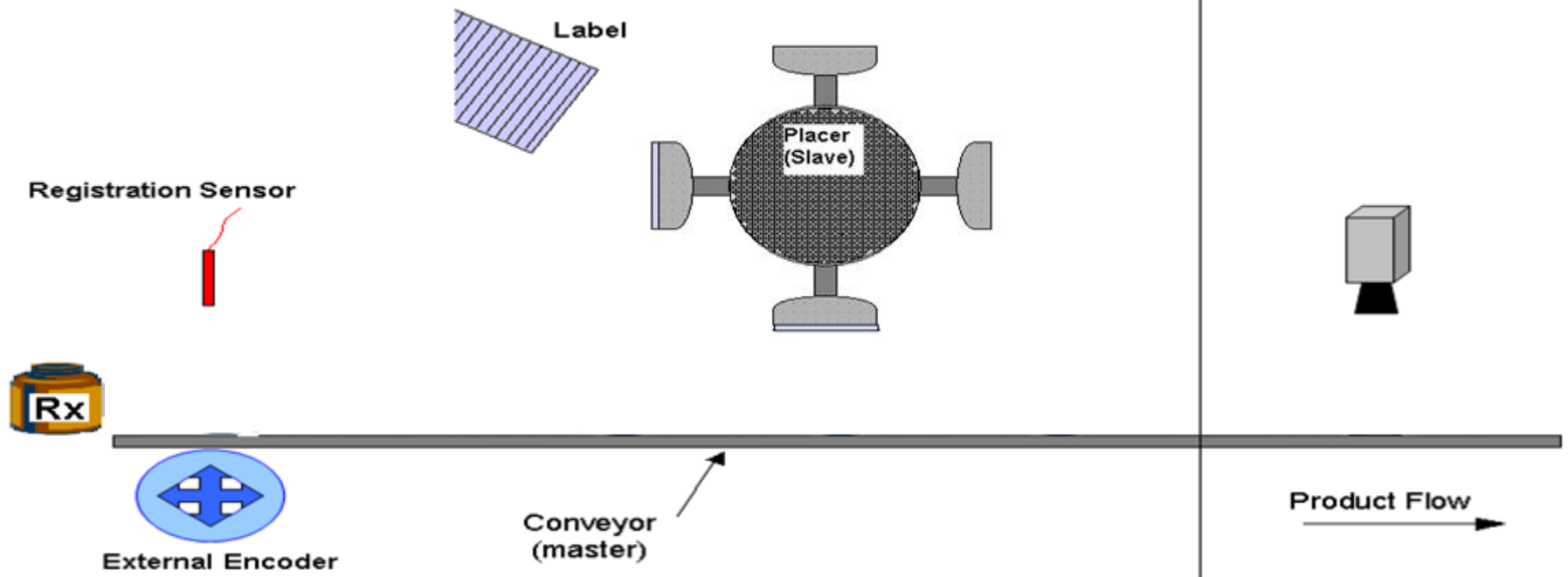


Digital output can be triggered within 13 us of an external encoder reaching a specified position

High speed output application

LABELING STATION

INSPECTION & VALIDATION



1) Product registration

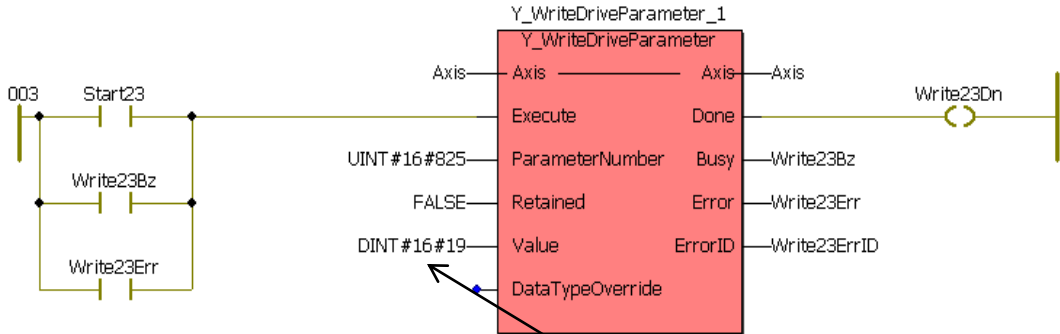
< 60 us on LIO

2) Labeling using cam

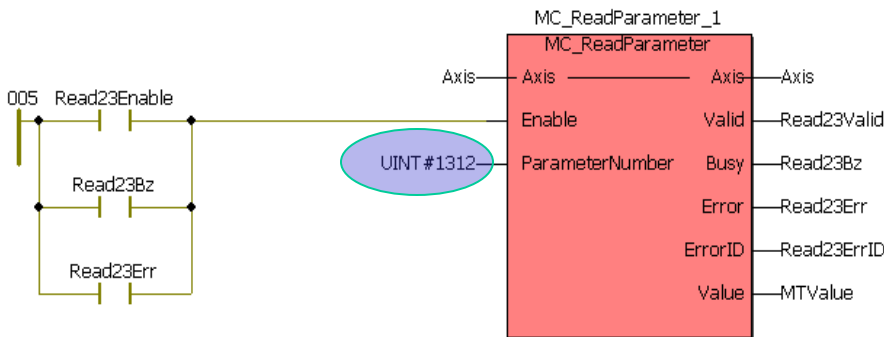
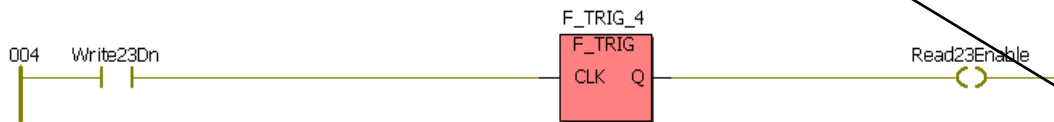
3) Inspection triggered using high speed digital output

output within 13 us on LIO

Option Monitor Read (1312)



Wait one scan after the parameter is written before valid data is read back



Option Monitor 1 Selection		-	-
0000H	Motor movement speed [1000000H/overspeed detection position]		
0001H	Speed reference [1000000H/overspeed detection position]		
0002H	Torque [1000000H/max. torque]		
0003H	Position error (lower 32 bits) [reference unit]		
0004H	Position error (upper 32 bits) [reference unit]		
0005H	System reserved		
0006H	System reserved		
000AH	Encoder count (lower 32 bits) [reference unit]		
000BH	Encoder count (upper 32 bits) [reference unit]		
000CH	FPG count (lower 32 bits) [reference unit]		
000DH	FPG count (upper 32 bits) [reference unit]		
0010H	Un000: Motor rotating speed [min ⁻¹]		
0011H	Un001: Speed reference [min ⁻¹]		
0012H	Un002: Torque reference [%]		
0013H	Un003: Rotational angle 1 [encoder pulses from the phase-C origin]		
0014H	Un004: Rotational angle 2 [deg]		
0015H	Un005: Input signal monitor		
0016H	Un006: Output signal monitor		
0017H	Un007: Input position reference speed [min ⁻¹]		
0018H	Un008: Position error [reference unit]		
0019H	Un009: Accumulated load ratio [%]		
001AH	Un00A: Regenerative load ratio [%]		
001BH	Un00B: DB resistance consumption power [%]		
001CH	Un00C: Input reference counter [reference unit]		
001DH	Un00D: Feedback pulse counter [encoder pulse]		
001EH	Un00E: Fully-closed loop feedback pulse counter [external encoder resolution]		
001FH	System reserved		
0023H	Primary multi-turn data [Rev]		
0024H	Primary incremental data [pulse]		
0080H	Previous value of latched feedback position (LPOS) [encoder pulse]		

Pn825

2

0000

Immediately