

APPLICATION NOTE: Determining Signal Delay between Analog Data Channels and WFT

APN-1017

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SUMMARY

The signal input to a Titan Digital Pod (internal or external versions) will be slightly delayed with respect to the analog input. This delay is the result of differences in processing time and filtering between the Digital and Analog sections. This delay will be consistent with the same test configuration and thus can be calculated. By determining the delay values in the system, users will then be able to correctly configure the TCS Exporter for the delay value(s). The method described below uses an impulse to measure and determine the delay for a given test configuration that uses Wheel Force Transducers (WFT's).

SETUP

To measure the delay, begin by instrumenting the wheel with the WFT that you will be using for the test. Connect the WFT output to the Digital Pod input.

Mount an Accelerometer to the wheel on the Z axis. Wire the sensor to channel 1 of the Titan Input Module. Connect the Titan device to a computer or a Titan CPU connected to your network.

MEASURING THE DELAY

Delay values will vary based on the scan rate of the test system; this means that in order to determine delay value for the system, this procedure should be performed using the same scan rate planned for the actual test.

Launch TCS and connect [F1] to the Titan Device. In the 'Configuration' screen, set the Scan Rate to the appropriate rate for the test that you will be running:



Clicking on the 'Digital Pod Configuration' button opens the "Configure Digital Pod" window. Configure the Wheel Force Transducer on the appropriate CAN port.

	🔡 Configure Digital Pod
Enable V Digital Pod Configuration	Configure Digital Pod Manage CAN Channel Definitions CAN Port 1 Source: Disabled CAN Port 2 Source: Wheel Force Configure WFT Baud Rate: 500000 Enable Silent (No Ack) GPS Enable GPS Enable PPS Serial Port 1 Source: Disabled V

Click on the 'Manage CAN Channel Definitions' button. Browse and select the correct DBC file for the WFT, and then click on the 'Load' button to load the file into TCS:

🛃 Ma	nage CAN Chann	els					×
Selec	t CAN List			Select DBC F	ile		
Road	yn_S6MT	•	-	Browse	Files\kistler\Roadyn_	S6MT.dbc Logo	J I
new	list	delete lis					2
					dele	te selected Un	do
	Name	MessagelD	Scalar	Offset	BitLength	StartBit	^
۱.	As4	39	1	0	16	48	
	An4	39	0.1	0	16	32	∎
	Mz4	39	1	0	16	16	T
	My4	39	1	0	16	0	
	Mx4	38	1	0	16	48	Ť
	Fz4	38	4	0	16	32	Ī
	Fy4	38	2.5	0	16	16	
	Fx4	38	4	0	16	0	
	As3	37	1	0	16	48	T
	An3	37	0.1	0	16	32	T
	Mz3	37	1	0	16	16	~
<		i IIII	i)	i	>	

Exit out of the 'Manage CAN Channels' window and return to the 'Configure Digital Pod' window

Click on the 'Configure WFT' button to get the 'Configure CAN Port' screen. Select the appropriate DBC file from the CAN List dropdown (upper right). If the channel names in the DBC file match the field labels in TCS, clicking on the 'Auto Assign Channels' button will automatically map the proper channels to all wheels, eliminating the need to make individual assignments:

😸 Configure CAN Port 2							
				(Auto Assign Channels	CAN List: Roadyn_	S6MT.dbc 💌
Front Left	Use Wheel 🔽	Front Right	Use Wheel 🔽	Rear Left	Use Wheel 🔽	Rear Right	Use Wheel 🔽
Force		Force		Force		Force	
* Fx1 (32)	~	* Fx2 (34)	~	× Fx3 (36)	~	× Fx4 (38)	*
y Fy1 (32)	~	y Fy2 (34)	~	у Fy 3 (36)	~	y Fy4 (38)	*
z Fz1 (32)	~	z Fz2 (34)	~	z Fz3 (36)	~	z Fz4 (38)	*
Moment		Moment		Moment		Moment	
× Mx1 (32)	~	× Mx2 (34)	~	× Mx3 (36)	~	× Mx4 (38)	~
y My1 (33)	~	y My2 (35)	~	у МуЗ (37)	~	У Му 4 (39)	*
z Mz1 (33)	~	z Mz2 (35)	*	z Mz3 (37)	~	z Mz4 (39)	*
angle An1 (33)	~	angle An2 (35)	~	angle An3 (37))	angle An4 (39)	~
angle speed As1 (33)	~	angle speed As2 (35)	~	angle speed As3 (37)	✓	angle speed As4 (39)	~

Click on the close box to enter the channel assignments into TCS.

Switch to the Sensors screen and select an Accelerometer sensor. Configure the Engineering Units for the Accelerometer sensor to Newtons ("N"). The reason for selecting Newtons is so that the Accelerometer will plot on the same display as the WFT. The scaling factor for the sensor should be changed so that the WFT and Accelerometer show the same amplitude for the impulse, this means that the user may have to scale up the Accelerometer by adjusting the Sensitivity parameter. The easiest way to do this is through trial and error.

🛷 Mars Labs TCS 3.1.9 C	urrent test: Kistler_409	Root Path: C:\Documents a	nd Settings\Greg\My Doc	umentsWars Lab	let
Test Device Settings Ut	il Help		Local Inde	x: 0000 Free: 182	2.17 GB Device Index: 0000 Free: 0 KB []
1: Configuration		2: Ru	2: Runtime		3: Export
A: Device Configuration	on	B: Sensors	C: Tags and Ch	annels	D. Recording & Triggers
•• Voltage ••• Acceleration •••• ICP	Name: Dytran Description		Manufacturer Model		
<mark>Dytran</mark> Strain Digital			Serial Number		
Thermocouple Other Displacement	Eng Units N	Custom Duit:	s Calibration Target Thre	eshold 2 🛟	*
Load Pressure	Input Dividers Input Dividers Enabled	Sensitivity 20 Sensi 100 N	tivity (mv) Gauge R	ation unt Value 100000 esistance 350	
		Offset 0	Ma	nual RCal - Target I - Target -4.36736 nual RCal + Target	
	Type: Solid State Excitation Excitation Source Internal Excitation Value 7.5		RCa	+ Target 4.36736	
Name Units Manufac	turer Model Serial	Sensitivity	Offset		Excitation
ICP cg		100 mv / 100 cg	0		Disabled
Dytran N		20 mv 7 100 N	0		7.5 V
F1 F2	F3 Import Sensors F4 Export Sensors	F5 New Sensor Sensor	F7 F8 Physical C	al F9	F10 Manual Command Display

Configure all of the other Sensor parameters as normal.

After configuring the sensor, switch to the Tags and Channels page and apply the Accel sensor to the appropriate sensor:

🛷 Mars Labs TCS 3.1.9 Current	test: Kistler_409	Root Path: C:\Document	s and Setting	s\Greg\My Docu	ments\Mars L	abs\		
Test Device Settings Util He	lp			Local Index:	0000 Free: 3	82.17 GB Devi	ce Index: 0000	Free: 0 KB []
1: Configuration		2	Runtime			3	: Export	
A: Device Configuration		B: Sensors		C: Tags and Char	nnels	[D. Recording & Trig	ggers
■ Mini-Recorder - Accel - Strain_Arm - ICP_Accel - SS_Accel - Chan_06 - Chan_07 - Chan_08 - Chan_10 - Chan_11 - Chan_12 - Chan_13	Name: Accel ✓ Channi Sensor: Dytran Gain: 8 Bal Type: YES Warning: need to ba Editing Channel 1	el Enabled V Def	ault Display	Strict Naming	Eng Units N Range ± 1: Resolution 0.0: Excitation 7.5	280 N 39063 N V		
- Chan_15 - Chan_16		NOTE: Grid is Re	ad-Only					
Device # Name	SensorName Gair	n BalType	CalType	InputDividers	Range	Resolution	Excitation	Displayed
Mini-Recorder 1 Accel	Dytran 8	YES	VCAL	N0 ::	± 1280 N	0.039063 N	7.5 V	True
Pseudo Channel Units	Expression							
F1 F2 F3	F4	F5 Add Pseudo Channel Pseudo	F7 Edit Pseud Channel	do F8	F9	F10 Manual Command	F11 In-Vehicle Display	F12

Switch to the Runtime screen and begin scanning [F3]. Start recording a data set. Using a rubber mallet, strike the wheel 3 times to provide an impulse to the instrumented wheel. Stop recording and scanning and then switch to the Export screen. Select the recently recorded file and double click on it to export it.

In the resulting display, select the Accel channel (accelerometer input) and the WFT channel (Fz1) that show the impulse. Using the cursor, select and drag across an impulse to obtain a magnified view of the data.

Select the 'Show Points' check box and count the number of points between the impulse on the analog channel (Accel) and the impulse (Fz1) on the WFT channel:



The number of points <u>between</u> the two impulses is the delay value in scans, which can be converted to seconds by dividing by the scan rate. For the plot shown above, there are 6 scans between the impulses. For a scan rate of 512, the resulting calculated delay value is 11.7 ms:

Test	Filtor	CAN BAUD	Sample	Delay	Delay time WFT to Titan
Number	The	Rate	Rate	Scans	Analog in mS
006	150	500K	512	6	11.7

FACTORING IN THE DELAY

The TCS Exporter includes a tool to offset the delay between individual digital and analog channels by a known constant. From the Export screen, select "Export Options" then "Edit Delay Values". Enter the calculated delay value in milliseconds as shown at right:

When all delay values are entered, click 'Done'. Before leaving the 'Export Options' window, check the 'Use Delay Values' checkbox. The entered delay values will apply a correction to the digital data during export:

🔽 Use Delay Values	
Edit Delay Values	

😸 Edit Delay Values 🛛 📒	
Values are relative to analog. Negative values move chann forward	els
J1939:	
0	ms
WFT:	
11.7	ms
ECU CAN:	
0	ms
IMU:	
0	ms
Note: Channels will be shifted at export by the closest discre number of analog scans. The actual time adjusted will vary l on the analog sample rate. Done	l back ete based