# Tritex II CANopen Startup

#### **Overview**

The purpose of this application note is to get a Tritex with CANopen system operational "on the bench", without a load connected to the motor. Some additional comments are added at the end to assist with tuning a loaded motor. The application note goes on to explain a basic system layout recommended for Tritex. At the end there is a section entitled "Where to go from here" which provides links to information on more advanced topics.

#### **Features**

The Exlar Expert drive software is a GUI developed to interoperate with the Tritex 485 interface by way of USB interface. All of the functions (Motion profiles) of the drive and user parameters are available through this interface. It may also be used to configure drive user and CANopen interface parameters.

The Exlar Expert drive software is required for tuning and configuring digital I/O.

This method establishes communication and uploads all of the parameters from the drive to the PC, and the drive stays online

## 1. System Setup

System menu allows configuration and viewing of system parameters. Parameters are divided into two segments Factory and user parameters.

#### **1.1.Factory Parameters**

Factory parameters are stored as a block in non-volatile memory. The block contains a CRC (Cyclic Redundancy Checksum) word to guarantee data integrity. At power-up, the factory parameter block is validated and copied to its runtime location in RAM where all parameters are available for both reading and writing through their individual MODBUS identifiers. Factory parameter include, maximum limits and system options.

F	Factory Parameters	
	Identification Options	Limits Actuator Update Rates Position Feedback Position Table
	Fault Trip Current	25.0 AMPS
	Peak Current	20.0 AMPS
	Continuous Current	10.0 AMPS Filter 6.0 seconds
	Board Temp Trip	80.0 C
	Low Voltage Trip	19 VDC
	High Voltage Trip	440 VDC
	Actuator Temp Trip	130.0 C
	Shunt High	393 VDC
	-	

## **1.2.System Setup**

System menu allows one time configuration of:

Power up options	Delay power-up, state machine sequence etc.
Module Control	Which interface (CANopen, Modbus or Digital I/O) has control
User limits	High current warnings and in position window
Reaction methods	Quick Stop 606Ah, Fault reaction 605Eh etc.

iystem Setup
Options   Module Control   Limits   Reaction Methods
Auto switch-on and run at startup Auto-Enable on Startup Auto-Enable Startup Auto-Enable Startup
Require Thermal warnings to clear before enabled
Require Current warnings to clear before enabled
Reverse direction polarity
Power up delay 0.00 seconds

#### **1.3. Factory Calibration**

Factory Calibra	ation	
Bus Voltage	Position Calibration	n   RST Calibration   Temperature   Brake
Bus Volta	ge 172.41	[1]
Vbus Sca	le 440.00	[V full scale]
Vbus Offs	et O	[mv]

#### **1.4.Tuning**

This page allows user to adjust the tuning of the motor base on their application.

wir nor be permane	nt until a downl	oad is exe	cuted or	the s	ave b	outto	n is p	ushe	d.
Inertia Gain	1.00	∩—́-	1.1		1	1	1	1	1
Position Feedforward	0.00000	<u>,</u> .							
Position Damping	0.31502								
			-	]					
Save Tuning Param	eters								

#### **1.5.User units**

The user unit page, allows user to change the units displayed, in the Tritex drive software. It does not change data written and stored in the drive.

C Linear Ac C Rotary M C Combo (F C Custom L Final output Apply	tuator otor / Gear Motor Rotary + Linear Actuator) Iser Defined gear reduction ratio	▼ :1	Where to find drive information on actuator label
	Units	Decimal Pla	aces Display Text
Distance:	Revs	• 0.000	REVS
Velocity:	RevsPerMinute	• 0.0	▼ BPM
			DDW/C

## 2. Digital I/O

The Digital I/O screen is used to assign the input and output functions and LED outputs to the hardware I/O lines; eight discrete inputs and four discrete outputs. Refer to Expert software for additional information on configuring Digital I/O.

Input Assign	ments		
Input 1	On	(unassigned)	
	Off	(unassigned)	
Input 2	On	Switch 2 On	
	Off	Switch 2 Off	
Input 3	On	Switch 3 On	
	Off	Switch 3 Off	
Input 4	On	Switch 4 On	
	Off	Switch 4 Off	
Input 5	On	Switch 1 On	
	Off	Switch 1 Off	
Input 6	On	(unassigned)	
	Off	(unassigned)	
Input 7	On	(unassigned)	
	Off	(unassigned)	
Input 8	On	Halt On	
	Off	Halt Off	

#### 3. Networks

#### 3.1.RS485 Modbus

The Tritex uses an RS485 hardware connection with a Modbus RTU protocol. The RS485 Modbus page allows the user to set the Tritex communication parameters to best connect with their communication. Therefore, an adapter will be required to interface from the RS232 or USB port on the PC to the RS485 port on the actuator (see Installation section for details on the RS485 port).

RS 485 MODBUS						
RS 485						
Drive ID 1						
Baud Rate 19200 💌						
RX Timeout 0 ms						
RX to TX Delay 0 ms						
Changes to Drive ID and Royal Data will not						
be written to drive and saved unless the button is pushed.						
Save parameters to drive	Save parameters to drive					

#### 3.2.CANopen

Exlar have implemented a CANopen protocol based on the 'Communication Profile' (CiA DS 301) in the Tritex, which supports both direct access to device parameters and time-critical process data communication. These parameters are accusable through the CANopen interface and Drive software.

Tritex with CANopen incorporates DS402 motor profile with several additional options that enhances the system use in a system. These additions add flexibilities to the overall system performance.

The Tritex support Variable PDO mapping this means the PDOs can only be mapped or re-mapped during Preoperational state. This can be accomplished through SDO's or using Exlar Drive software. The PDO programming sequence of PDOs is handled using our drive software.

#### **3.2.1.CAN Open**

The CAN Open allows a simple method of changing Drive ID and Baud rate. Note, changes do not take effect until new power cycle.

CAN Open					
CAN Open Drive ID 127					
Baud Rate 125,000 -					
Changes to Drive ID and Baud Rate will not					
be written to drive and saved unless the button is pushed.					

#### **3.2.2.CAN Parameters**

CAN Parameters	
Communications Setup	
Node guarding interval	12 ms
Node guarding lifetime	1 factor
COB-ID EMCY	OFF (hex)
EMCY inhibit time	0 ms
Heartbeat interval	0 ms
COB-ID SYNC	080 (hex)

#### 3.2.3.PDOs Setup

The object linker (translation tables) offers a significant improvement by supporting fully automated mapping/linking of PDOs in only a few steps. All available objects are sorted according to input and output data.

A unique COB-ID (unique with respect to the entire CANopen network, not just the node) must be assigned to each PDO which will be used over the CAN network. It is recommended using the Predefined Connection Set where ever possible. It is the system designer's responsibility to ensure that all PDOs have a unique COB-ID. It is best to assign the COB-IDs in a logical order, with the most important PDOs assigned to the lowest COB-IDs.

RPD0 1   RPD0 2   RPD0 3   RPD0 4		
COB-ID   027F (hexadecimal) Transmission Type 255 Transmit PDD on Prohibit transmission on RTR	TR or event.	27Fh = 200h + 7Fh
Disable PDO		
	Bytes available -2	
(s) Drive Variables	Data to be added to translation table          Parameter         GIDs System Motion Modes Profile Tor gue Command T arget         Second Tores         Second Tores         For Access           POD Mapping         1-GID & CANDpen, Command Contro/Word         -GIDs System Motion Modes Profile/Velocity Comma         -GIDs System Motion Modes Profile/Velocity Comma         -Sopen         <	
	INT16 READ_WRITE Modbus ID 2638	
Description Apply	CAN Index CAN Subindex 6071 0 Add Remove CAN Subindex	
	Save PDD	

PDOs Predefined Connection Set				
COB-ID(s) hex	Slave nodes			
180 + NodelD	1. Transmit PDO			
200 + NodelD	1. Receive PDO			
280 + NodelD	2. Transmit PDO			
300 + NodelD	2. Receive PDO			
380 + NodelD	3. Transmit PDO			
400 + NodelD	3. Receive PDO			
480 + NodelD	4. Transmit PDO			
500 + NodelD	4. Receive PDO			

## 4. Motion

The device profile for drives and motion control defines the functional behavior of controllers for servo drives, frequency inverters and stepper motors. The specification includes a finite state automaton (FSA). The state of the drive determines which commands are accepted and if high power is applied. States are changed by a *control-word* received from the host-controller can be initiated by internal events. The current state is indicated by the *statusword*.

#### **4.1.Home**

The Home Page configures and commands the Home operation.

Home				
──Velocity / Torque :			Butte	ons
Fast Velocity	6.0	RPM		Define Home
Slow Velocity	0.6	BPM		Define Zero
Acceleration	300	RPM/S		D C D C
Current Limit	50.0	% Rated Current		Define Reference
- Homing Method				Undefine Refere
Rositive Direct	ion 🗖 Swite	h		
Negative Direct	tion 🗌 Index			Home
Current Limit	E Reve	rse		LI-10 (
			-0-1	Fildik
Neg SW On Off In	ndex 🔻	T	Stati	us
, -	_	7	A	ctive
-fast SW ON +slow	+slow SW OFF INDEX		Н	omed arget Beached
			E AI	ttained
Home Offsets			E E	rror
Home Offset	0.000	REVS	Гн	alted
	0.000	BEVO		
Index Urrset	0.000	HEV5		
Final Home Position	0.000	REVS		
Auto Home on E	nable			
🗖 Require Home b	efore Default Mod	e operation		
🔲 Require Home b	efore Alternate Mo	ide operation		

#### 4.2.Jog

The Jog Page is used to command jog mode on the Tritex. Once jog mode has been enabled, the jog inputs can be used to produce motion on the actuator. The inputs that will be used as jog inputs are determined by the Jog (+) or Jog (-) command. Once the jog inputs have been enabled, they will remain enabled, until user disable operation.

The motion profile have several option are configurable by the user, Fast, slow velocity and acceleration and deceleration rates.

Jog The velocity and acceleration controls immediately when online. These chan a download is executed.	are dynamic - changes will be effi ges, however, will not be permane	hctive ht until		
Position	20.376 REVS			
Velocity	0.0 RPM			
Jog (+)         Jog (-)           Current Limit         0.0           Fast         Slow           0.0         0.0           -         -           -         -           -         -           -         -           -         -           -         -           -         -           -         -           -         -           -         -	Drive Mode Non Current Mode Prof Accel Decel 1200 1200 RPI    	e  le Position Mode	Active       Jogging +       Jogging Slow       Jogging Fast       At Target Velocity       Following Error       Halted	
☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐		Save Parameters		<sup>(1)</sup> Save Initialization parameters

<sup>(1)</sup> Saves the current displayed as new Initialization value (Fast Slow Velocity, Acceleration, Declaration and Current limit ), when entering mode for the first time.

NOTE! Typical motion profile commands and options could be set each time on power up from host or

set using a configuration file and stored to NVM once. Clicking Jog (+) or (-) changes will automatically generated a enter mode request of Jog.

#### 4.3.Profile Velocity

Profile Velocity	
The velocity and acceleration controls are dynamic - changes will be effective immediately when online. These changes, however, will not be permanent until a download is executed.	
Command Velocity 0.0 RPM	
I arget velocity     UU     HPM       Image: Image of the state o	ctive ctive (+) ctive (-) arget Reached boltic Zero
Save Parameters	(1)Save Initialization parameters

<sup>(1)</sup> Save current displayed as new Initialization value (Acceleration, Deceleration, Current Limit and Target Velocity ), when entering mode for the first time.

**NOTE!** Typical motion profile commands and options could be set each time on power up from host or set using a configuration file and stored to NVM once

## 4.4.Profile Torque

Profile Torque			
The command and mode controls are dynamic - changes to the other controls will not be in effect until	anges will be effective immediately when online. I a download is executed.		
Command Torque	10 z 10 z		
Leat Slope	Drive Mode None  Current Mode Profile Position Mode %/sec	Active     Active (+)     Active (-)     Target Reached     Halted	
	Save Parameters		<sup>(1)</sup> Save Initialization parameters

<sup>(1)</sup> Save current displayed as new Initialization value (Target Torque and Slope), when entering mode for the first time.

**NOTE!** Typical motion profile commands and options could be set each time on power up from host or set using a configuration file and stored to NVM once

#### **4.5.Profile Position**

Profile Position					
The velocity and a immediately when a download is exe	acceleration c online. These cuted.	ontrols are dynamic - cł changes, however, wil	hanges will be effective Il not be permanent until		
Command Vel Command Pos	locity sition	3000.0 10.000	RPM REVS		
Drive Mode Current Mode	None None	•	Halt		Active     Setpoint Active     At Velocity
Setpoint Position Velocity	10.000	REVS RPM	New Set Point Change Set Point Absolute Position		Target Reached Setpoint Acknowledged Following Error
Accel Decel	3000 3000	RPM/S RPM/S	Change On Set Point Fault on Nack		F Setpoint Error Halted
Infinite Distanc Limit Current Current Limit	e 「 「	% Rated Current	Smart Continue Independent Data Auto Reset NSP		
End Velocity	0.0	RPM	Reset NSP on Target Max Buffered	6 Points	

# **NOTE!** Typical motion profile commands and options could be set each time on power up from host or set using a configuration file and stored to NVM once

#### **Options**

#### FAULT ON NACK

A rising edge of NEW\_SETPOINT IMMEDIATE and SETPOINT\_ACK active will normally generate a 'warning' and raise the SETPOINT\_NACK event. If the PP\_OPTION\_FAULT\_ON\_NACK is selected, a fault will be generated instead.

#### SMART CONTINUE

When a new SETPOINT is to be buffered (not immediately executed) and the PP\_CONTROL\_CONTINUOUS flag is set the default action is to modify the END\_VELOCITY of the previous (or active) set-point to its velocity so that it doesn't stop and targets the new SETPOINT's velocity and distance when it completes. The PP\_OPTION\_SMART\_CONTINUE overrides this behavior to set the previous (or active) SETPOINT'S END\_VELOCITY to the lesser of the previous (or active) SETPOINT velocity and the new. SETPOINT velocity.

#### INDEPENDENT DATA

Doesn't copy profile type, acceleration, and deceleration values from global profile data when loading a SETPOINT. The global are copied into the SETPOINT setup structure only at startup.

#### **RESET NSP**

Internally resets CONTROL.NEW\_SETPOINT as soon as the drive is able to accept another SETPOINT.

#### **RESET NSP\_ON TARGET**

Internally resets CONTROL.NEW\_SETPOINT when STATUS.TARGET\_REACHED becomes active.

#### MAXIMUM BUFFERS

Maximum number of set-point buffers, maximum allows valve is 8; set-point buffer array is load only during mode creation

## 5. Diagnostic

The overall system status is displayed on the diagnostic page; user can monitor faults, warnings, position and temperatures. Also contain record of satirical information of history of the drive.

#### **5.1.Status Log**

The Status log page displays the log of Faults and Warning of the drive.

#### **5.2.Diagnostics**

The Diagnostic page displays the current Status and history of Faults of the drive.

## 6. Monitor / Control

#### 6.1.Status

The Status wedge shows an overview the drive status.

Status				
		Non	e	
Position	0.000	REVS	Fault	
Velocity	0.0	RPM	Warning	
Current	0.1	% Rated Current	Reset Faults	Diagnostics

#### **6.2.Drive Status**

The Drive Status wedge indictors show the statusword (6041.0h) states; while the controlword (6040.0h) can be commanded from the Drive Control wedge.

Drive	e Status	
	Run	
	Ready	
	Enabled	
	Fault	
	DC Bus Ready	
	Stop Inactive	
	Setup	
	Warning	
	Homed	
	Remote	
	Target Reached	
	Internal Limit Active	
	Set Point Acknowledge	
	Following Error	
	Halted	

The status word provide the status of the PDS FSA.

	Drive Status									
	Statusword									
15 -10	9	8	7	6	5	4	3	2	1	0
хх	Remote	Homed	x	Setup	Stop	DC Bus	Fault	Enabled	Ready	Run
					Active	Ready				

Figure 1 - Statusword

Bits	Drive control bits		Description
	Exlar	DS402	
0	Run	Ready to run	Drive is in normal runtime operation mode and is ready
			to accept the power command
1	Ready	Switch on	
2	Enabled	Operational	The drive is enabled and ready to command motion.
		enabled	
3	Fault	Fault active	Fault has occurred in the system and fault reaction has
			completed
4	DC Bus	Voltage enable	Tritex voltage is greater than low voltage limits.
	Ready		
5	Stop Active	Quick stop	Indicates the PDS is reacting to deactivate request. The
		actived	final state is determined by Quick Stop option register.
			0= Quick Stop Active
			1= Inactive,
6	Setup	Switch on	Drive is in SETUP mode and not ready for operation.
		disabled	Some commands are available only in SETUP mode. The
			SETUP bit is a 'convenience' event bit and is always the
			inverse of the RUN bit
8	Homed	Manufacture	Drive is homed
		defined	
9	Remote	Remote	0 = indicate that the controlword is not processed
			1 = indicate that the controlword is processed

Figure 2 - Drive status bits

	Mode specific bits					
Mode of Operation	13	12	10			
	oms	oms	tr			
Profile position (pp)	Following error	Set-point	Final target			
		acknowledge	reached			
Profile velocity (pv)	х	х	Target velocity			
			reached			
Profile torque (pt)	х	х	Target torque			
			reached			
Homing (hm)	See Homing Mode					
Profile jog (pj)	See Jog Mode					

Figure 3 - Statusword, Mode specific bits

	Exlar		E	Bits in state	us word			
PDS 402 State	Internal	6	5	3	2	1	0	
	State	setup	Stop active	fault	enable	ready	run	
		(sod)	(as)	(f)	(00)	(50)	(rtso)	DS 402: Bit
		(300)	(43)	07	(02)	(30)	(1130)	definition
Not Ready to Switch On	Not Ready	0	Х	0	0	0	0	
Switch On Disabled	Setup	1	Х	Х	0	0	0	
Ready to Switch On	Run	0	1	0	0	0	1	
Switch On	Ready	0	1	0	0	1	1	
Operational Enabled	Enabled	0	1	0	1	1	1	
Quick Stop Active	Stop Active	0	0	0	1	1	1	
Fault Reaction Active	Fault	0	Х	1	1	1	1	
	Reaction							
	Active							
Fault	Fault	0	Х	1	0	0	0	]

Figure 4 – DS402 state machine states

#### **6.3.Drive Control**

The Drive control wedge button commands controlword (6040.0h) and LED indicators return controlword state. In the similar fashion, statusword (6040.0h) is showed in the Drive Status wedge.

Basic steps in enable drive for manual control of drive through Exlar Expert Software:

- (1) Switch On
- (2) Run
- (3) Enable

**NOTE!** Verify appropriate Drive Status is change base on 'Drive Control 'commands.

Drive	Control [	×
	Switch On	
	Run	
	Stop	
	Enable	
	Reset Faults	
	Halt	
	Define Home	
	Define Zero	
	Define Reference	
	Undefine Reference	
	Jog (+)	
	Jog (-)	
	Jog Fast	

The controlword has a dual purpose, controlword the state machine of the drive and command the motion mode.

15	12	11	10	9	8	7	6	5	4	3	2	1	0
reser	ved	Break	reserved	Mode	Halt	Fault	Mod	e spec	cific	Enable	Quick	Run	Switch
		release		specific		reset					Stop		on
MSB													LSB

Figure 5 - Controlword

Drive Control bits Controlword

15 -7	6	5	4	3	2	1	0
x x	Reset fault	х	х	Enable	Stop	Run	Switch on

Figure 6 - Drive control bits

Bits	Drive Control	DS402	Description
0	Switch on	Switch on	interlock
1	Run	Enable voltage	The DS402 FSA 'ready to switch on' state is waiting for the drive to be set to enable high level power. Since the drive doesn't control its own bus power, this state place for controllers that require an extra command interlock before accepting the ENABLE bit. Controllers that don't want the extra interlock may elect to force this control bit set at start-up.
2	Stop	Quick stop	Command the drive to deactivate, base on Stop option To deactivate stop controlword bit 2 must be equal to 1. Refer to Stop Action (0x605A.0) for more information
3	Enable	Enable operation	Commands drive into operational enable state.
6	Reset Faults	Fault reset	Reset faults on the rising edge.

Figure 7 - Drive control bits

	Operation mode specific bits							
Mode of Operation	9	8	6	5	4			
Profile position (pp)	Change on Set point	Halt	Abs/rel	Change set Immediately	New set			
Profile velocity (pv)	Reserved	Halt	Reserved	Reserved	Reserved			
Profile torque (pt)	Reserved	Halt	Reserved	Reserved	Reserved			
Homing (hm)		Halt						
Profile jog (pj)		Halt						

Figure 8 - Controlword, Mode specific bits

## 7. Motion examples

This section contain sample configuration of the drive.

#### 7.1.Homing

The Tritex drive support many aspects of the homing methods<sup>(1)</sup> described by DS 402. This includes the use of a switch inputs and/or an encoder index pulse to determine the extent of travel, limit inputs, and a specific acceleration, deceleration, normal speed and slow speed to use while homing. These homing inputs are integrated into the Tritex and are user defined.

To configure the drive Inputs it is recommended using the Tritex Expert software. Below is an example of configuring Home method 19.

Homing method 19 - POS\_SW\_ON\_OFF (Home on positive home switch (inactive))<sup>(d)</sup>

<sup>(1)</sup> Refer to Tritex CANopen manual for supported methods.

#### 7.1.1.Configure Inputs

From the Digital I/O page configure the 'Home Switch' to your wired Input 5. (See Hardware interface manual for information on connecting switch to Tritex.) For this example wire the 'Home Switch' to Input 5.

Input Assignr	nents		
Input 1	On	(unassigned)	
	Off	(unassigned)	
Input 2	On	Switch 2 On	1
	Off	Switch 2 Off	
Input 3	On	(unassigned)	I.
	Off	(unassigned)	
Input 4	On	(unassigned)	
	Off	(unassigned)	
Input 5	On	Switch 1 On	1
	Off	Switch 1 Off	
Input 6	On	(unassigned)	1
	Off	(unassigned)	_
Input 7	On	(unassigned)	1
	Off	(unassigned)	_
Input 8	On	(unassigned)	

Figure 9 - Example - Home Switches

DS402 Description	Source of Event
Home Switch	Configurable Input Event
Negative Limit Switch	Configurable Input Event
Positive Limit Switch	Configurable Input Event
Index Pulse	Index Pulse

Figure 10 – Exlar Input Switches vs. DS402

#### 7.1.2.Home drive

#### 7.1.2.1.CANopen interface

Homing Mode – demonstrates home method 19 decimal using Service Data Objects (SDOs).

The below example sets typical motion profile commands a system would configure<sup>1</sup>, enabling the motor power<sup>2</sup> and executing a homing function using SDOs with Node ID 65 (41h).

<sup>1</sup>Typical configuring I/O should be set using Exlar Drive software and stored to NVM once. Motion user parameters could be set each time on power up or configure and stored to NVM once.

<sup>2</sup>Enabling the motor power only has to be done once on power up.

	Typical motion profile commands and enabling sequence									
ID	RTR	Data								Description
DSP402 state machine, 6040.0										DSP402 state machine, 6040.0h
0641	00	2B	40	60	00	06	00	00	00	Send shutdown - transfer to Ready to Switch on
0641	00	2B	40	60	00	07	00	00	00	Switched on
0641	00	2B	40	60	00	0F	00	00	00	Operation Enable
										Typical Motion Parameters
0641	00	23	84	60	00	50	C3	00	00	Set deceleration to 3000 RMP/S, 6084.0h
0641	00	23	83	60	00	50	C3	00	00	Set acceleration to 3000 RMP/S, 6083.0h
										Set to Home Mode
0641	00	2F	60	60	00	06	00	00	00	Set to Profile Home Mode, 6060.0h
										Set Homing Method, Offset and Speeds
0641	00	23	FF	60	00	13	00	00	00	Homing method 19 decimal
0641	00	23	7C	60	00	00	00	00	00	Homing Offset value = 0
0641	00	23	99	60	01	35	82	00	00	Home Speed Fast 2000 RPM
0641	00	23	99	60	02	82	06	00	00	Home Speed Slow 100 RPM
										Start Homing
0641	00	2B	40	60	00	1F	00	00	00	Start Homing and remove active Halt
										Stop Homing after home is acquire
0641	00	2B	40	60	00	0F	00	00	00	Stop Homing (This will Halt Homing and keep
										Operational Enable)

Figure 11 - Example: Home mode

#### 7.1.2.2.Define Home

To define current position as home using PAC commands, can be accomplish using Tritex Drive software or through CANopen. By using accessing drive internal commands through CANopen interface.

	Typical motion profile commands and enabling sequence									
ID	RTR	Data								Description
DSP402 state machine, 6040.0h										
0641	00	2B	40	60	00	06	00	00	00	Send shutdown - transfer to Ready to Switch on
0641	00	2B	40	60	00	07	00	00	00	Switched on
0641	00	2B	40	60	00	0F	00	00	00	Operation Enable
										Set to Home Mode
0641	00	2F	60	60	00	06	00	00	00	Set to Profile Home Mode, 6060.0h
										Define Current Position as Zero
0641	00	23	09	21	00	00	00	20	37	Write Pac <sup>(2)</sup> System.Post.Commands.DefineHome (924942336-> 0x37218000)

Figure 12 - Example: Home Absolute Position

<sup>(1)</sup>Halt is enabled automatically, when a Motion mode becomes active.

<sup>(2)</sup> Same function as "Define Home" within 'Expert Tritex' software

Home	
Halt	
Define Home	

Figure 13 - Drive Software Home Commands

## 7.2.Position

Profile Position Mode – demonstrates the different move types supported for position control executed via Service Data Objects (SDOs).

Exlar support relative and absolute moves to position. Using either relative or absolute moves, the user can also select (by the control word data) if the target position should be reached before another target position is allowed (finish first) or if the actuator should execute a newly received target position even if still in motion (immediate).

The below example sets typical motion profile commands a system would configure, enabling the motor power<sup>2</sup> and the four different move types<sup>2</sup> supported in Profile Position Mode using SDOs with Node ID 65 (41h).

3000 RMP/S	Acceleration:	3000 ÷ 0.06 = 5000 (0xC350)
2000 RPM	Target Velocity:	2000 ÷ 0.06 = 3333 (0x8235)
10.000 REVs	Distance:	10000 ÷ 0.0001 = 100000 (0x0186A0)

<sup>1</sup>Enabling the motor power only has to be done once on power up. Motion user parameters could be set each time on power up or configure and stored to NVM once.

<sup>2</sup>The Control Word data selects the move type.

	Typical motion profile commands and enabling sequence									
ID	RTR	Data	3							Description
										DSP402 state machine, 6040.0h
0641	00	2B	40	60	00	06	00	00	00	Send shutdown - transfer to Ready to Switch on
0641	00	2B	40	60	00	07	00	00	00	Switched on
0641	00	2B	40	60	00	0F	00	00	00	Operation Enable
										Typical Motion Parameters
0641	00	23	84	60	00	50	C3	00	00	Set deceleration to 3000 RMP/S, 6084.0h
0641	00	23	83	60	00	50	C3	00	00	Set acceleration to 3000 RMP/S, 6083.0h
0641	00	23	81	60	00	35	82	00	00	Set max user velocity to 2000 RPM , 6081.0h
										Set to Profile Position Mode
0641	00	2F	60	60	00	01	00	00	00	Set to Profile Velocity Mode, 6060.0h
										Move Absolute (finish first)
0641	00	23	FF	60	00	A0	86	01	00	Set Target Position to 10.000 REVS
0641	00	2B	40	60	00	1F	00	00	00	Set Control Word bit 4 to 1
0641	00	2B	40	60	00	0F	00	00	00	Set Control Word bit 4 to 0
										Move Absolute (immediate)
0641	00	23	FF	60	00	EO	93	04	00	Set Target Position to 30.000 REVS
0641	00	2B	40	60	00	3F	00	00	00	Set Control Word bit 4 to 1
0641	00	2B	40	60	00	2F	00	00	00	Set Control Word bit 4 to 0
										Move Relative (finish first)
0641	00	23	FF	60	00	50	C3	00	00	Set Target Position to 50.000 REVS
0641	00	2B	40	60	00	5F	00	00	00	Set Control Word bit 4 to 1
0641	00	2B	40	60	00	4F	00	00	00	Set Control Word bit 4 to 0
										Move Relative (immediate)
0641	00	23	FF	60	00	A0	86	01	00	Set Target Position to 10.000 REVS
0641	00	2B	40	60	00	7F	00	00	00	Set Control Word bit 4 to 1
0641	00	2B	40	60	00	6F	00	00	00	Set Control Word bit 4 to 0

Figure 14 - Example: Position

## 7.3.Velocity

Exlar supports the ability to move in velocity mode. Once in Profile Velocity Mode, any new target velocity will be executed immediately.

The below example sets typical motion profile commands a system would configure<sup>1</sup>, enabling the motor power<sup>2</sup> and sending a new target velocity using SDOs with Node ID 65 (41h).

3000 RMP/S	Acceleration:	3000 ÷ 0.06 = 5000 (0xC350)
1000 RPM	Target Velocity:	1000 ÷ 0.06 = 16667 (0x411A)

<sup>1</sup>Typical motion profile commands could be set each time on power up from host or set using a configuration file and stored to NVM once.

<sup>2</sup>Enabling the motor power only has to be done once on power up.

	Typical motion profile commands and enabling sequence									
ID	RTR	Data	Data							Description
										DSP402 state machine, 6040.0h
0641	00	2B	40	60	00	06	00	00	00	Send shutdown - transfer to Ready to Switch on
0641	00	2B	40	60	00	07	00	00	00	Switched on
0641	00	2B	40	60	00	0F	00	00	00	Operation Enable
										Typical Motion Parameters
0641	00	23	84	60	00	50	C3	00	00	Set deceleration to 3000 RMP/S, 6084.0h
0641	00	23	83	60	00	50	C3	00	00	Set acceleration to 3000 RMP/S, 6083.0h
										Set to Profile Velocity Mode
0641	00	2F	60	60	00	03	00	00	00	Set to Profile Velocity Mode, 6060.0h
										Motion Mode default condition are loaded
										Send new Target Velocity
0641	00	23	FF	60	00	1A	41	00	00	Target Velocity 1000 RPM, 60FF.0h

Figure 15 - Example: Velocity

<sup>(3)</sup>Halt is enabled automatically, when a Motion mode becomes active.

## 7.4.Jog

Exlar supports the ability to move in Jog mode. The below example sets typical motion profile commands a system would configure<sup>1</sup>, enabling the motor power<sup>2</sup> and sending a new target velocity using SDOs with Node ID 65 (41h).

100 RMF	),	Slow Velocity:	100 ÷ 0.06 = 1666 (0x682)					
5000 RPI	M/S,	Acceleration:	5000 ÷ 0.06 = 8333 (0x14585)					
5000 RN	IP/S,	Deceleration:	5000 ÷ 0.06 = 8333 (0x14585)					
NOTE!	CANopen supports Jog directly with the following functions: Jog Slow - Positive when active							

<sup>1</sup>Typical motion profile commands could be set each time on power up from host or set using a configuration file and stored to NVM once.

<sup>2</sup>Enabling the motor power only has to be done once on power up.

	Typical motion profile commands										
ID	RTR	Data	3							Description	
										DSP402 state machine, 6040.0h	
0641	00	2B	40	60	00	06	00	00	00	Send shutdown - transfer to Ready to Switch on	
0641	00	2B	40	60	00	07	00	00	00	Switched on	
0641	00	2B	40	60	00	0F	00	00	00	Operation Enable	
										Typical Motion Parameters	
0641	00	23	0B	36	00	86	02	00	00	Set Slow Velocity 100 RMP	
0641	00	23	0C	36	00	85	45	01	00	Set Acceleration 5000 RPM/S	
0641	00	23	0D	36	00	85	45	01	00	Set Deceleration 5000 RPM/S	
0641	00	23	60	60	00	FE	00	00	00	Jog Mode (-2)	
										Jog Function	
0641	00	2B	40	60	00	8F	00	00	00	Halt Jog	

Figure 16 - Example Jog

#### 7.5.Torque

If a torque that is relative to current of 2 amps is needed, and object 0x6075 (Motor Rate Current "Continuous Current") is 3200 mA, then:

Target Torque: [6071.0] = 2000 mA x 1000 / 3200 mA = 625 ( 271h) Slope: [6087.0] = 180.0 % / sec

	Typical motion profile commands and enabling sequence									
ID	RTR	Data	Data							Description
										DSP402 state machine, 6040.0h
0641	00	2B	40	60	00	06	00	00	00	Send shutdown - transfer to Ready to Switch on
0641	00	2B	40	60	00	07	00	00	00	Switched on
0641	00	2B	40	60	00	0F	00	00	00	Operation Enable
										Typical Motion Parameters
0641	00	2B	87	60	00	50	46	00	00	Set slope 180.0 %/sec, 6087.0h
										Set to Profile Velocity Mode
0641	00	2F	60	60	00	04	00	00	00	Set to Profile Torque Mode, 6060.0h
										Disable Motion Halt
0641	00	2B	40	60	00	0F	00	00	00	Clear Halt <sup>(3)</sup>
										Send new Target Torque
0641	00	2B	71	60	00	71	02	00	00	Target Torque 62.5 % 6071.0h
Figure 1	7 5.00									

This number means 62.5 % of Motor Rate Current

Figure 17 - Example Torque

<sup>(3)</sup>Halt is enabled automatically, when a Motion mode becomes active.

## 7.6.PDO Mapping

The following is an example of mapping PDO for position Profile:

Device ID = 127 (7Fh) RPDO -1, COB-ID = 27Fh (Controlword-6040h, Target Position-607Ah) TPDO -1, COB-ID = 1FFh Transmit on Change (Statusword-6041h)

	Typical motion profile commands and enabling sequence									
ID	RTR	Data	1							Description
										Typical Motion Parameters
067F	00	23	84	60	00	50	C3	00	00	Set deceleration to 3000 RMP/S, 6084.0h
067F	00	23	83	60	00	50	C3	00	00	Set acceleration to 3000 RMP/S, 6083.0h
067F	00	23	81	60	00	35	82	00	00	Set max user velocity to 2000 RPM , 6081.0h
										Configure RPDO-1
067F	00	23	00	14	01	7F	02	00	80	Disable RPDO-1 COB-ID
067F	00	2F	00	16	00	00	00	00	00	Write zero to entries
067F	00	23	00	16	01	10	00	40	60	Configure Map1 with 6040.0 -Controlword
067F	00	23	00	16	02	20	00	7A	60	Configure Map2 with 607A.0 -Target Position
067F	00	2F	00	16	02	FF	00	00	00	Configure Transmission Type
067F	00	2F	00	16	00	02	00	00	00	Write 2 to Entry count
067F	00	23	00	14	01	7F	02	00	00	Enable RPDO-1 COB-ID
	Configure TPDO-1									
067F	00	23	00	18	01	FF	01	00	80	Disable TPDO-1 COB-ID
067F	00	2F	00	1A	00	00	00	00	00	Write zero to entries
067F	00	23	00	1A	00	10	00	41	60	Configure Map1 with 6041.0 ,Statusword
067F	00	2F	00	18	02	FF	00	00	00	Configure 1600.5, Transmit on Change
067F	00	2F	00	1A	00	01	00	00	00	Write 1 to Entry count
067F	00	23	00	18	00	FF	01	00	00	Enable TPDO-1 COB-ID
	Mode of Operation - Position									
067F	00	2F	40	60	00	06	00	00	00	Write 6 to Mode of Operation
										Enable NMT Operation Mode
000	01	00								Operational Mode
	1									DSP402 state machine
01FF	70	02								< Current Status (Switch on Disabled)
027F	06	00	00	00	00	00				> (Shutdown - )
01FF	31	02								< Drive sends TPDO1- (Ready to Switch on)
027F	07	00	00	00	00	00				> (Switched on)
01FF	33	02								< Drive send TPDO1 – (Switch on)
027F	OF	00	00	00	00	00				> (Operation Enable)
01FF	23	06								< Drive sends TPDO1 – response (Enable)
										Command Position
027F	OF	00	EO	93	04	00				> Set Target Position to 30.000 REVS
027F	1F	00	EO	93	04	00				> Set Control Word bit 4 to 1 (New Set Point)
01FF	12	B7								< Drive sends TPDO1 – response
027F	OF	00	EO	93	04	00				> Set Control Word bit 4 to 0
01FF	02	B7								< Drive sends TPDO1 – (Set Point ACK)
01FF	06	B7								< Drive sends TPDO1 – (In Position)

Figure 18 – Example: PDO Mapping Position

## 8. Access Drive Internal functions

GID or Global Identification is the method used by the Tritex drive to map internal variables. These GID's are then cross reference to installed protocols. For example a GID of 0x3C000000 represents the System warnings and is identify as "SYSTEM.MOTION.EVENTS.FAULTS" cross reference to Modbus ID " 1900 " and CANopen ID "Index 3384, subindex 0".

#### 8.1.GID access

The following demonstrates method to access internal registers using GID. For example read and write to CANopen ID register:

> Node ID 65 (41h) GID name: CANOPEN.PARAM.ID GID address: 0x82200000

	Reading / writing Drive GID sequence										
ID	RTR	Data	Data							Description	
										Reading Drive Parameter	
0641	00	23	02	20	01	00	00	20	82	Write GID to System Read, Object 2002.1	
0641	00	40	02	20	02	00	00	00	00	Read Data, Object 2002.2	
										Write Drive Parameter	
0641	00	23	03	20	01	00	00	20	82	Write GID to System Write , Object 2003.1	
0641	00	2B	03	20	02	01	00	00	00	Write Data: ID = 1, 2 bytes, Object 2003.2	

Figure 19 - Example System Read

#### 8.2. PAC's Access

Programmable Access Commands (PAC's) are functions that perform operations in the system. For example the below PAC function will define current absolute position as home, while home mode is active. Refer to Interface section (UI Modbus, and CANopen) for methods of sending PACs to drive. Note, if interface does not have control rights command will not execute.

The following demonstrates method to access internal registers using PAC (Programmable Access Commands). Node ID 65 (41h)

	Writing PAC sequence										
ID	RTR	Data	Data							Description	
										Write PAC	
0641	00	23	09	21	00	00	00	20	37	Write Pac	
										CommandSystem.Post.Commands.DefineZero	
										(924844032-> 0x3720.0000)	

Figure 20 - Example PAC Access

#### **8.3.User Units example**

CANopen associates a scale factory to a group of registers, for example scale factory 1 is always assigned to Position measurements. This conversion is transparent to CANopen interface.

Name	Units	Att	Description	GID	Modbus	CO
Scale Factor 1 – Numerator	UINT32	RW	Desition	CANOPEN.PARAM.CONVERT.0.MULTIPLIER	7560	2102.1
Scale Factor 1 – Denominator	UINT32	RW	Position	CANOPEN.PARAM.CONVERT.0.DIVISOR	7562	2102.2
Scale Factor 2 – Numerator	UINT32	RW	Valacity	CANOPEN.PARAM.CONVERT.1.MULTIPLIER	7564	2103.1
Scale Factor 2 – Denominator	UINT32	RW	velocity	CANOPEN.PARAM.CONVERT.1.DIVISOR	7566	2103.2
Scale Factor 3 – Numerator	UINT32	RW	Acceleration	CANOPEN.PARAM.CONVERT.2.MULTIPLIER	7568	2104.1
Scale Factor 3 – Denominator	UINT32	RW	ACCERTATION	CANOPEN.PARAM.CONVERT.2.DIVISOR	7570	2104.2

Figure 21 – User Units CANopen

Internal units= (user value) * (Numerator1 / Denominator1)	Write operation
User value = (internal units) * (Denominator1 / Numerator1)	Read operation

NOTE! Default Numerator and Denominator are 1

The following example demonstrates reading/ writing using 'User Units' for Target Position (607A.h):

Scale Fa Scale Fa Interna	actor 1 – Numerator: actor 1 – Denominator: units:	1 2 0.0001 Rev
Write		
	Target Position	2000
	Internal Units	= 2000 * 1/2
Read		
	Target Position	= 1000 * (2 /1)

# **NOTE!** Thirty-two bit conversion is used and rounding error could occur between read and write values.

# 9. Appendix

#### **9.1.Tips**

Highlighting and right clicking display variable ID and help information.

COB-ID	027F	(hexadecimal)						
Transmission Type	265	T 1000 0T0						
Prohibit transmission on BT	Write current value to connected drive B Read value from connected drive							
	Vier	View Helpfile						
Jisable PUU	Set	Set default value						
	Mo	dbus ID: 7362						
	CAN Open Index: 1400.2							

Figure 22 - Expert Software Tips

#### 9.2.Notations

0.001 rated	Percentage of Rated (GID=SYSTEM.BUS.FACTORYPARAM.IRATED)
	(CANopen -6075.0, Motor Rated Current)
mrps/s	Acceleration
mrps	Velocity
0.0001 rev	Distance
ms	milliseconds

Figure 23 - Units

(b)	When read/write from Modbus data length is word, while from CANopen it is a byte.
(M) (d)	CANopen Object is mappable CANopen Profile –Motion DS402 specification name

Figure 24 – Superscript

## **10. Additional information**

Expert Software Manual.pdf Tritex\_CO.eds Tritex CANopen.pdf Tritex CANopen Getting Started.pdf Expert Drive software manual CANopen EDS file Tritex CANopen user manual Tritex CANopen Getting started manual

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