3L Power Triton CAN Interface

CAN Communications Interface

Date	Rev	Description	Author	Approved by
3/06/2019	0	First Draft	V Bun	C Cheek

Description

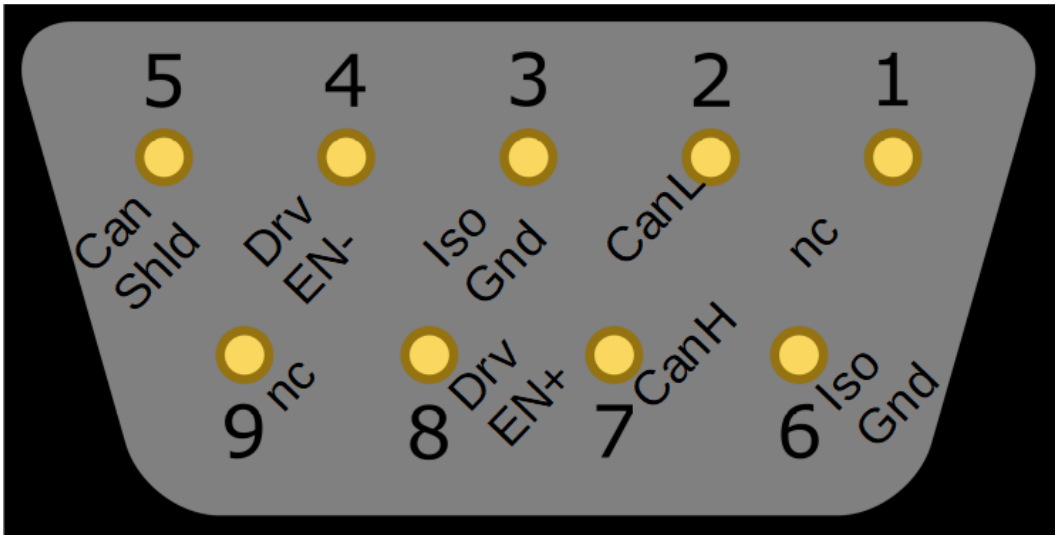
The Triton100 Motor Drive is a three-phase motor drive that switches at PWM frequencies exceeding 100 kHz. It is a parallel SiC-based semiconductor drive that is configurable for voltages up to 900Vdc. This spec sheet describes the main CAN-based interface for communication with the drive.

Specification

Nominal transceiver voltage	5 V
Isolation voltage	2 kV
Termination	120 Ohms, removable
Default baud rate	500 kHz

Communication Description

CAN communications occur via pins 2 and 7 on the CAN DB9 receptacle as shown below. Pins labeled "Iso Gnd" are connected to the isolated ground used for the CAN transceiver.



The Triton drive CAN communication logic adheres to the base frame format shown on the last page of this document.

The drive communication logic acts as a slave and only generates responses to commands from the host. It never asynchronously generates a message of its own. There is always a response to all commands sent to the Triton drive controller. The Triton drive response message will always contain the CANbus identifier of 0x28 in the identifier field. Furthermore, the Triton drive will only listen for commands with a CANbus identifier of 0x09.

The Canbus baud rate is 500 kHz.

Data payload size is always 8 bytes (64 bits).

The first byte (DB0) of every message (payload) contains the message type identifier.

The 3L controller expects to receive at least 1 message per second from the host controller as a means to confirm that communication is working properly. If a message is not received with a 1 second period, the 3L controller will generate an internal watchdog timeout fault which will result in the motor drive transitioning to the IDLE state (the propulsion motor will no longer be driven).

Values that require more resolution than an integer (such as phase current) will use the Q number format:

https://en.wikipedia.org/wiki/Q_(number_format)

An example of the floating point number 8.25 being represented in a 16 bit field using Q12.4 format:

0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0
8												4 / 16 = 0.25			

Common CANbus header for all 3L commands.

Note – this is the CANbus header (not part of the data field). See the last page for details on the CANbus bit stream.

3L Controller ID = 0x08											Data Length is always 8 bytes				
ID10	ID9	ID8	ID7	ID6	ID5	ID4	ID3	ID2	ID1	ID0	RTR	DLC3	DLC2	DLC1	DLC0
0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0
x01								x08							

Host Controller ID = 0x28											Data Length is always 8 bytes				
ID10	ID9	ID8	ID7	ID6	ID5	ID4	ID3	ID2	ID1	ID0	RTR	DLC3	DLC2	DLC1	DLC0
0	0	0	0	0	1	0	1	0	0	0	0	1	0	0	0
x05								x08							

Propulsion Command (ID = 0x01)

Propulsion Command

DB0	DB1	DB2	DB3	DB4	DB5	DB6	DB7
0x01	Unused	Motor Speed Command (RPM)		Unused	Unused	Unused	Unused

Propulsion Command Data Field Details

Bit Position	Function	Data Info
DB0	Message type identifier (always 0x01)	Unsigned, 8 bit
DB1	Unused	Unsigned, 8 bit
DB2	Motor speed command, legal range -1000 to +1000 RPM	Signed, 16 bit
DB3		
DB4 thru DB7	Unused	Unsigned, 8 bit

Propulsion Reply

DB0	DB1	DB2	DB3	DB4	DB5	DB6	DB7
0x01	Status Bits	Actual Motor Speed		Fault Bits			

Propulsion Reply Data Field Details

Bit Position	Function	Data Info
DB0	Message type identifier (always 0x01)	Unsigned, 8 bit
DB1	Motor Drive Status Bits Bit0 – IDLE (not enabled, no PWM switching) Bit1 – DC READY (VDC bus is in normal range) Bit2 – DRIVE READY (no faults, VDC ready, not rotating) Bit3 – RUNNING (active motor regulation, PWM switching) Bit4 – FAULT (a fault has occurred and has been latched) Bit5 – ROTATING (shaft is rotating faster than 1 RPM) Bit6 - reserved Bit7 – TORQUE LIMITED (torque output limited, does not apply to PSU motor)	Unsigned, 8 bit
DB2	Actual Motor Speed in RPM	Signed, 16 bit
DB3		
DB4	Fault Bits Bit0 – test fault Bit1 – max speed exceeded Bit2 – over current phase A Bit3 – over current phase B Bit4 – over current phase C Bit5 – over voltage DC bus Bit6 – under voltage DC bus Bit7 – unused	Unsigned, 8 bits
DB5	Fault Bits Bit0 – over temperature Cold Plate (> 60 degC) Bit1 – resolver lost tracking Bit2 – resolver degradation of signal Bit3 – resolver communication Bit4 – watchdog (DSP didn't update FPGA in a timely manner) Bit5 – FPGA unresponsive Bit6 – dead time violation in PWM state machine Bit7 – bad flash memory	Unsigned, 8 bits
DB6	Fault Bits Bit0 – parameters corrupted Bit1 – calibration data corrupted Bit2 thru Bit7 - unassigned	Unsigned, 8 bits
DB7	Fault Bits Bit0 thru Bit7 – unassigned	Unsigned, 8 bits

Phase Current Command (ID = 0x02)

Phase Current Command							
DB0	DB1	DB2	DB3	DB4	DB5	DB6	DB7
0x02	Unused	Unused	Unused	Unused	Unused	Unused	Unused

Phase Current Command Data Field Details		
Bit Position	Function	Data Info
DB0	Message type identifier (always 0x02)	Unsigned, 8 bit
DB1 thru DB7	Unused	Unsigned, 8 bit

Phase Current Reply							
DB0	DB1	DB2	DB3	DB4	DB5	DB6	DB7
0x02	unused	Phase A Current		Phase B Current		Phase C current	

Phase Current Reply Data Field Details		
Bit Position	Function	Data Info
DB0	Message type identifier (always 0x02)	Unsigned, 8 bit
DB1	Unused	Unsigned, 8 bit
DB2 - DB3	Phase A Current (Arms)	Unsigned, 16 bit Q12.4 format
DB4 - DB5	Phase B Current (Arms)	Unsigned, 16 bit Q12.4 format
DB6 - DB7	Phase C Current (Arms)	Unsigned, 16 bit Q12.4 format

Drive Power Command (ID = 0x03)

Drive Power Command							
DB0	DB1	DB2	DB3	DB4	DB5	DB6	DB7
0x03	Unused	Unused	Unused	Unused	Unused	Unused	Unused

Drive Power Command Data Field Details		
Bit Position	Function	Data Info
DB0	Message type identifier (always 0x03)	Unsigned, 8 bit
DB1 thru DB7	Unused	Unsigned, 8 bit

Drive Power Reply							
DB0	DB1	DB2	DB3	DB4	DB5	DB6	DB7
0x03	Cold Plate Temperature	Power in HP		Power in kW		DC bus voltage	

Drive Power Reply Data Field Details		
Bit Position	Function	Data Info
DB0	Message type identifier (always 0x03)	Unsigned, 8 bit
DB1	Cold Plate Temperature in degC	Unsigned, 8 bit
DB2 - DB3	Power in HP	Unsigned, 16 bit Q12.4 format
DB4 - DB5	Power in kW	Unsigned, 16 bit Q12.4 format
DB6 - DB7	DC bus voltage	Unsigned, 16 bit Q12.4 format

PWM Frequency Command (ID = 0x04)

PWM Frequency Command

DB0	DB1	DB2	DB3	DB4	DB5	DB6	DB7
0x04	Unused	PWM Frequency (kHz)		Unused	Unused	Unused	Unused

PWM Frequency Command Data Field Details

Bit Position	Function	Data Info
DB0	Message type identifier (always 0x04)	Unsigned, 8 bit
DB1	Unused	Unsigned, 8 bit
DB2	PWM Frequency, legal range 20 kHz to 120 kHz Only use when output current is less than 40 Arms	Signed, 16 bit
DB3		
DB4 thru DB7	Unused	Unsigned, 8 bit

PWM Frequency Reply

DB0	DB1	DB2	DB3	DB4	DB5	DB6	DB7
0x04	Unused	Present PWM Frequency		Unused		Unused	

PWM Frequency Reply Data Field Details

Bit Position	Function	Data Info
DB0	Message type identifier (always 0x04)	Unsigned, 8 bit
DB1	Unused	Unsigned, 8 bit
DB2 - DB3	Present PWM Frequency	Signed, 16 bit
DB4 thru DB7	Unused	Unsigned, 8 bit

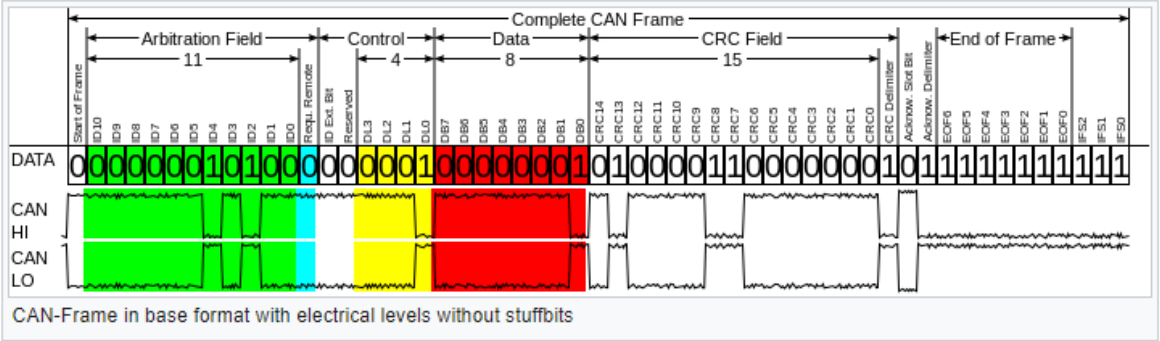
Extensions

There are other data collected by the drive controller that could be communicated, as well as other commands that can be made available by request. These parameters include:

Possible extended feedbacks	
Phase Currents	Filter constant
Phase voltages	Ramp rate
Current offsets	Flux command
Voltage limits	Resolver position feedback
Temperatures	Theta
Proportional value	Commanded torque
Integral value	State Vector
Duty Cycle	Status
Horse power	efficiency

Possible extended commands	
Max Voltage	Resolver sine correction
Min Voltage	Resolver cosine correction
Temperature Limit	Resolver frequency
Switching frequency	Ramp Rate
Maximum Torque	Spread spectrum enable
Torque shudder	

Base frame format [edit]



CAN-Frame in base format with electrical levels without stuffbits

The frame format is as follows: The bit values are described for CAN-LO signal.

Field name	Length (bits)	Purpose
Start-of-frame	1	Denotes the start of frame transmission
Identifier (green)	11	A (unique) identifier which also represents the message priority
Remote transmission request (RTR) (blue)	1	Must be dominant (0) for data frames and recessive (1) for remote request frames (see Remote Frame, below)
Identifier extension bit (IDE)	1	Must be dominant (0) for base frame format with 11-bit identifiers
Reserved bit (r0)	1	Reserved bit. Must be dominant (0), but accepted as either dominant or recessive.
Data length code (DLC) (yellow)	4	Number of bytes of data (0–8 bytes)[a]
Data field (red)	0–64 (0-8 bytes)	Data to be transmitted (length in bytes dictated by DLC field)
CRC	15	Cyclic redundancy check
CRC delimiter	1	Must be recessive (1)
ACK slot	1	Transmitter sends recessive (1) and any receiver can assert a dominant (0)
ACK delimiter	1	Must be recessive (1)
End-of-frame (EOF)	7	Must be recessive (1)