The TD series is a sensorless motor driver intended for UAV/drone use.
It controls PMSM or BLDC motors in the range 100-1000W.

Sensorless control:
Brushless motors need electronics to perform the commutation of the motor windings. Typically, this is done with sensors in the motor to know the rotor position. It is also possible to estimate rotor position by measuring on the motor phases. This scheme is called sensorless control.
The advantage of sensorless control is a robust and cost-effective solution with no sensors in the motor and less cabling. As a result of sensorless control the motor can only operate in the range from of 10-20% to 100% of the rated motor speed. Lower speeds than 10-20% is hard to achieve without sensor.
For sensorless control, the driver software also needs to be matched with the particular motor that will be used.

Motor and electronics separation:
In some cases it is an advantage to have the electronics placed in another location than the motor. With the TD motor driver there are only the 3 motor phase cables that needs to be routed between the driver and the motor.

Motor speed regulation:
The TD motor driver is mainly intended for constant speed applications. It is possible to use it for constant speed regulation, or just constant voltage control (where actual speed will also depend on loading torque).

Easy control:
The typical control interface to the TD motor driver is standard RC PWM control. DSHOT control interface will also be available later.
The standard RC PWM pulse uses a repeating positive going pulse of 1000-2000us length for speed control.

Wide operating conditions:
The supply voltage is 10-24V, with absolute maximum 30V.
Current is up to 40A continuous and 50A peak. The continuous rating is heavily dependent on the mounting of the device and its ability to conduct heat from the driver.

Mechanical design:
The TD motor driver is delivered with an aluminium base plate that is intended to be mounted on a metallic structure to conduct heat away from the driver. This is necessary for high powered applications.

Customer adaptable:
The control interface to the driver can be reconfigured on request. The hardware supports interfaces such as RS232 TTL and I2C.

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1 Technical data

Important characteristics and limits for the Simplex Motion TD050A products.

Electrical specifications		
Power Supply voltage	Min	10 V
	Typical	24 V
	Max	30 V
Supply Current	Idle	0.01 A (at 24V)
	Continuous	10-40 A (at 24V) – Depending on mounting
	Peak	50 A (at 24V)
Controller specifications		
Switching frequency		20 kHz
Efficiency		More than 99% at best operation
Motor commutation	Sensorless	Space vector modulation with field orientation control
Motor control	Constant speed regulator or Voltage control	
Speed input	RC PWM 1000-2000us	The actual speed range is set in firmware.
Motor requirements		
Motor type	PMSM or BLDC	Both conventional inrunners and outrunners.
Pole pairs	4-14 tested	
Speed	Up to 10 000 rpm	Less for large number of poles
Power	Up to 1000W to motor	
Mechanical specifications		
Dimensions	Body (L x W x H)	60 x 30 x 12 mm
Weight		24g
Ambient specifications		
Protection class		IP00, needs external protection
Temperature	Operating	-20..+60°C, power derating above 40°C
	Storage	-40..+85 °C

1.1 Maximum output power

The following table shows maximum continuous output power, and is valid for 24V power supply, and for a connected motor running at close to 24V. It is important to select motor KV value for optimising the entire system of driver + motor. To allow high power output from the driver, the motor should operate at a voltage close to the supply voltage.

Mounting	Max current	Max power
In free air	16A	380W
With additional cooling flange (accessory)	22A	520W
With cooling flange and forced air cooling	40A	960W

The metal side of the device can preferably be mounted on a surface that allows heat conduction from the device. An extra heatsink is available as an accessory for high powered applications.

1.2 Electrical connections

Connectors on the TD050A

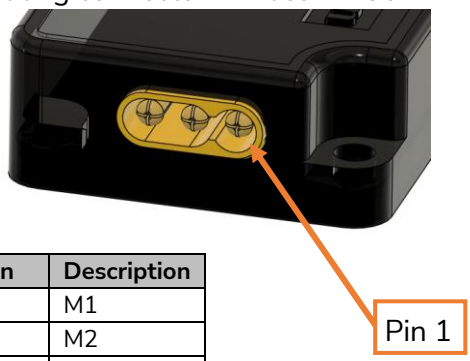
1.2.1 Power connector

Connection of power supply 10-24V: Amass XT30
Mating connectors: Amass XT30U-F

Pin	Description
1	+10-24V
2	GND

1.2.2 Motor connector

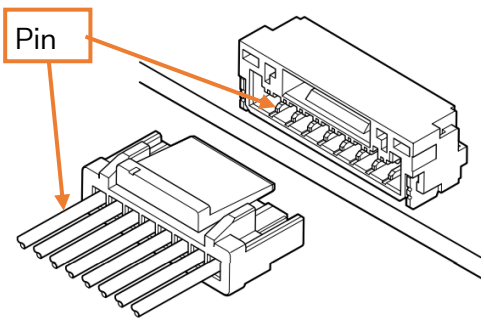
Motor phases M1-M3: Amass XT30
Mating connector: Amass MR30-FB



Pin	Description
1	M1
2	M2
3	M3

1.2.3 Interface connector

Low voltage control interface: 8-pol JST GH
Mating connector: GHR-08V-S.



Pin	Standard	Use
1	RCPWM	RC PWM input pulse
2	DSHOT	For later implementation of DSHOT protocol
3	EXTRA	Spare input for future use
4	PGC/RX	Programming connection, or serial port
5	PGD/TX	Programming connection, or serial port
6	GND	Ground
7	+3.3V	3.3V output, max 100mA external load
8	MCLR	Reset input for programming, and later for start of bootloader.

Typical connections are GND and RCPWM.

2 Operation

The motor driver performs speed control of a brushless motor in a speed range of typically 10-100% of the motor nominal speed. The actual minimum and maximum speed is configured in the driver firmware.
At motor start a specific startup sequence is performed to get the motor rotating and bring it up to the minimum speed of typically 10% of nominal speed. This startup sequence is configured in the firmware.
The firmware also needs to know basic motor settings such as number of pole pairs, the motor constant and nominal/maximum motor current.
At the current time these settings need to be done at compile time for the firmware, and thus Simplex Motion creates a custom firmware for each motor and customer case.

Control input is typically the standard RC PWM pulse input. A positive going pulse with length 1000-2000us is converted into requested speed.
Current settings start the motor when the pulse length is above 1150us, and stops the motor when it is less than 1050us.

2.1 Error codes

The LED indicator of the device will blink red in case of an error. The blinking pattern provides 3 numbers to identify the error code.

Error code	
1 2 2	Undervoltage error
4 1 2	Overvoltage error This will happen if deacceleration is too high and the power supply can not sink current, as the driver regenerates electrical power when braking the motor.
3 1 2	Overcurrent error

3 Firmware releases

The following list contains specific notes for certain firmware releases.

Date	Revision	Notes
250411	TD050A_MN5006KV450_01a	Tested with T-motor MN5006KV450 motor up to 2kg thrust.

4 Change history

Revision	Note
01a	First release