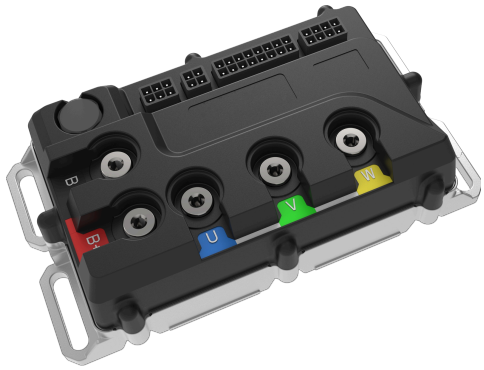
VECTOR MOTOR CONTROL

T-400 Series

PMSM MOTOR CONTROLLER



Datasheet

DATASHEET · EN

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DATASHEET

T-400 PMSM Motor Controller

400

Specifications, functions, block diagram, dimensions, pinout and typical wiring for quick selection and system design.

Model: T-400 2026.10.14

400 A	12.0 kW	48/60/72 V	IP67
Peak phase current	Peak power	Rated voltage	Ingress protection

1 Overview

The T-400 is a permanent magnet synchronous motor (PMSM) controller. It uses field-oriented control (FOC) with SVPWM modulation to drive the motor with sinusoidal current. A 32-bit Cortex®-M4 MCU runs the power, torque, flux and speed loops in real time and responds promptly to all protection events.

- Advanced algorithms: dead-time compensation, feed-forward control, harmonic injection, active field weakening, torque estimation, anti-jerk start
- Multiple control loops (speed, power, torque, flux) for consistent performance under complex operating conditions
- Online motor parameter identification (Ld, Lq, flux linkage, resistance) with sensor + PLL fusion for a precise model, better NVH and wider motor compatibility
- Interfaces: CAN, RS-485, UART, SIF; PC tuning software, OBD fault diagnostics, BootLoader and OTA updates
- IP67 enclosure, UL94-V2 flame rating, ambient temperature −40 to +85 °C

2 Compliance Standards

FUNCTIONAL SAFETY

Item	Standard
EMC	EN 13309 / ISO 14982 / ISO 11452-2
ESD	IEC 61000-4-2 / ISO 10605
Electrical Load	GB/T 28046.2-2011
Mechanical Load	GB/T 28046.3-2011
Environmental Load	GB/T 28046.4-2011

3 Specifications

SPECIFICATIONS

Item	Parameter	Unit
Overall Dimensions (Max.)	180 × 94.8 × 48.1	mm
Weight	≤0.95	kg
Ingress protection	IP67	—
Flammability Rating	UL94-V2	—
Waterproof Vent	≥2.9 L/min @7 kPa	—
Heat Sink Material	ADC12	—
Housing Material	PA66 + GF30	—
Connector Mating/Unmating Force	≥15	N
Connector Pin Count	34	Pin
Cooling	Natural convection	—
Ambient Temperature	−40 ~ +85	°C
Operating Altitude	≤4000	m
HV/LV Isolation	No	—
Rated voltage	48/60/72	V
Peak Voltage	84	V
Min. Voltage	36	V
Max. Quiescent Current	≤30 @72 VDC	mA
Rated Power	4.5	kW
Peak power	12.0	kW
Peak DC Bus Current	≤150	A
Peak phase current	≤400	A
Switching Frequency	≤16	kHz
Precharge Capacitance	≤1320	μF
Insulation Leakage Current	≤10 mA @500 VDC	—
Control Method	FOC	—
Operating Modes	Speed / Torque / Power	—
Communication Interfaces	CAN, RS-485, UART, SIF	—
CAN Termination Resistor	120	Ω
Motor Feedback Interface	HALL ABC/GMR ABZ	—

4 Functions

BASIC FEATURES

Feature	Feature
Start / Stop	Gear Selection
Reverse	Cruise Control
Eco Mode	Power Mode
Limp-Home Mode	Brake Cut-Off
Kickstand Cut-Off	Charging Cut-Off
Anti-Theft Lock	Runaway Detection
Acceleration Curve	Regenerative Braking
CAN Communication	RS-485 Communication
3-Speed Selection	Push Assist
Boost Mode (Nitro)	Emergency Brake Alarm
Field-Weakening Boost	Motor Parameter Learning
Traction Control (TCS)	Hill Hold Control (HHC)
Hill Descent Control (HDC)	

PROTECTION FEATURES

Feature	Feature
Undervoltage Protection	Overvoltage Protection
Short-Circuit Protection	Stall Protection
FOC Execution Fault Monitoring	Software Fault Monitoring
DC Bus Current Sensing Fault Monitoring	Phase Current Sensing Fault Monitoring
Throttle Voltage Fault Monitoring	Controller Temp. Monitoring
Motor Temp. Monitoring	Motor Hall Fault Monitoring
Motor Phase-Loss Monitoring	Gate-Drive Voltage Fault Monitoring

EXTENDED FEATURES

Feature
Fault Buzzer Alert
OBD Fault Diagnostics
PC Tool Parameter Tuning
Bootloader Update
OTA Update

5 Block Diagram

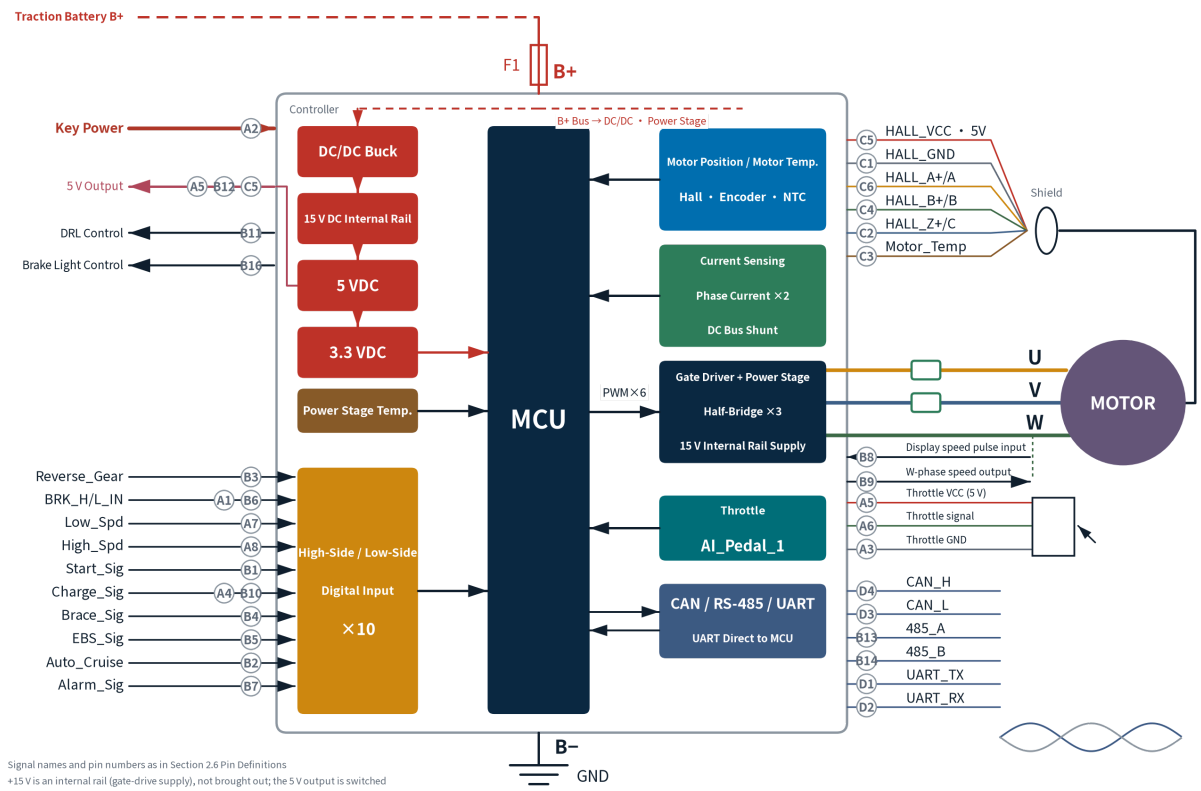


Figure 5-1 T-400 System Block Diagram

Note: +15 V is an internal rail (gate-drive supply) and is not brought out.

6 Connector Terminals

Symbol	Parameter	Typ.	Min.	Max.	Unit
W	Contact Width	1.12	—	—	mm
T	Contact Thickness	1.12	—	—	mm
I_C	Current per Contact	1.5	—	3	A
T_{OP}	Operating Temperature	25	-40	125	°C

Note: Mating plug housings: 5557-8Y, 5557-16Y, 5557-4Y, 5557-6Y

Note: Mating female terminals: 5556

Note: Wire size for female terminals: insulated wire, 0.5 mm^2 to 0.75 mm^2 recommended

7 Outline & Interface Dimensions

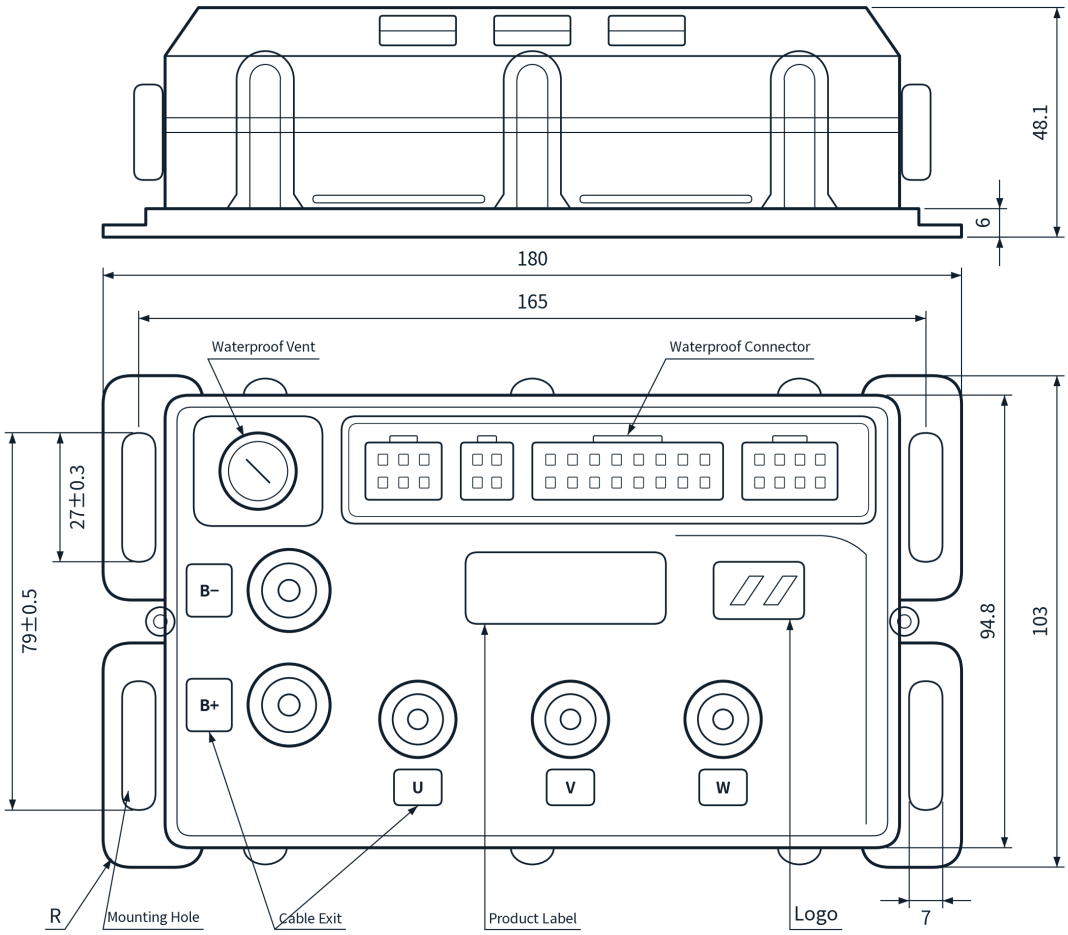


Figure 7-1 Outline and Interface Dimensions (mm)

8 Mounting Guidelines

- Fix the controller to the frame with M6 bolts, recommended torque 9–12 N·m. Keep the heat-sink face flat against the mounting surface; do not mount it suspended or under load.
- Connect the U / V / W / B+ / B− power cables to the terminal posts with M5 combination bolts, recommended torque 2.0 N·m; do not over-torque.
- Prefer an open, well-ventilated position, ideally with ram air over the heat sink. Do not block, coat or remove the breather valve.

9 Pin Definitions

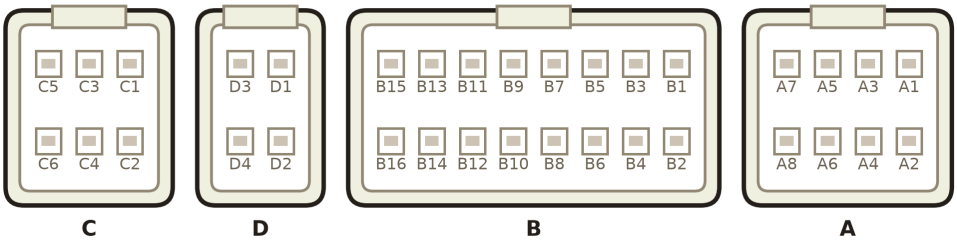


Figure 9-1 Connector Pin Numbering (Viewed from the Controller Connector Face)

Pin	Signal	Type	Signal Type	Description	Signal Range
A1	BRK_H_IN	DI	Digital Input	High brake input	ON = 12 V, OFF = open
A2	KEY_IN	PWR	Power Input	Battery positive via key switch	36~84 V
A3	DGND	GND	Digital Ground	Throttle reference GND	0~0.2 V
A4	Charge_Sig	DI	Digital Input	Charging-port enable detection	0~0.2 V
A5	5V VDD	PWR	5 V Output	Throttle 5 V supply	5 V
A6	Throttle_Sig	AI	Analog Input	Throttle analog input	0~5 V
A7	Low_Spd	DI	Digital Input	Low-speed enable detection	ON = 0 V, OFF = open
A8	High_Spd	DI	Digital Input	High-speed enable detection	ON = 0 V, OFF = open
B1	Start_Sig	DI	Digital Input	Start enable detection	ON = GND, OFF = open
B2	Auto_Cruise	DI	Digital Input	Cruise enable detection	ON = 0 V, OFF = open
B3	Reverse_Gear	DI	Digital Input	Reverse enable detection	ON = 0 V, OFF = open
B4	Brace_Sig	DI	Digital Input	Kickstand enable detection	ON = GND, OFF = open
B5	EBS_Sig	DI	Digital Input	Regen braking enable detection	ON = 0 V, OFF = open
B6	BRK_L_IN	DI	Digital Input	Low brake input	ON = 0 V, OFF = open
B7	Alarm_Sig	DI	Digital Input	Anti-theft alarm input, active low	ON = GND, OFF = open
B8	Spd_Rotate	DI	Digital Input	Single-wire PWM speed input; speed read from duty cycle	ON = GND, OFF = open
B9	WSpdOut	AO	W-phase speed output	W-phase back-EMF, motor rotation sensing	0 V~BAT+
B10	Charge_Sig	DI	Digital Input	Charging-port enable detection	0~0.2 V
B11	DRL_CTRL	PO	Power Output	Drives external DRL load	0 V~BAT+
B12	5V VDD	PWR	5 V Output	Reserved 5 V	5 V
B13	485_A	BUS	RS-485 Bus	RS-485 bus A	0~5 V
B14	485_B	BUS	RS-485 Bus	RS-485 bus B	0~5 V
B15	DGND	GND	Digital Ground	Reserved GND	0~0.2 V
B16	WD_{CTRL}	PO	Power Output	Drives external brake light load	0 V~BAT+
C1	DGND	GND	Digital Ground	Motor Hall reference GND	0~0.2 V
C2	HALL_Z+/C	PI	Pulse Input	Encoder Z+ / Hall C input	0~5 V
C3	Motor_Temp	AI	Analog Input	Motor NTC input, internal pull-up	0~3.3 V
C4	HALL_B+/B	PI	Pulse Input	Encoder B+ / Hall B input	0~5 V
C5	5V VDD	PWR	5 V Output	Motor Hall 5 V supply	5 V
C6	HALL_A+/A	PI	Pulse Input	Encoder A+ / Hall A input	0~5 V
D1	UART_TX	BUS	UART	UART TX, direct to MCU	0~3.3 V
D2	UART_RX	BUS	UART	UART RX, direct to MCU	0~3.3 V
D3	CAN_L	BUS	CAN Bus	CAN bus low	0~3.3 V
D4	CAN_H	BUS	CAN Bus	CAN bus high	0~3.3 V

10 Typical Wiring

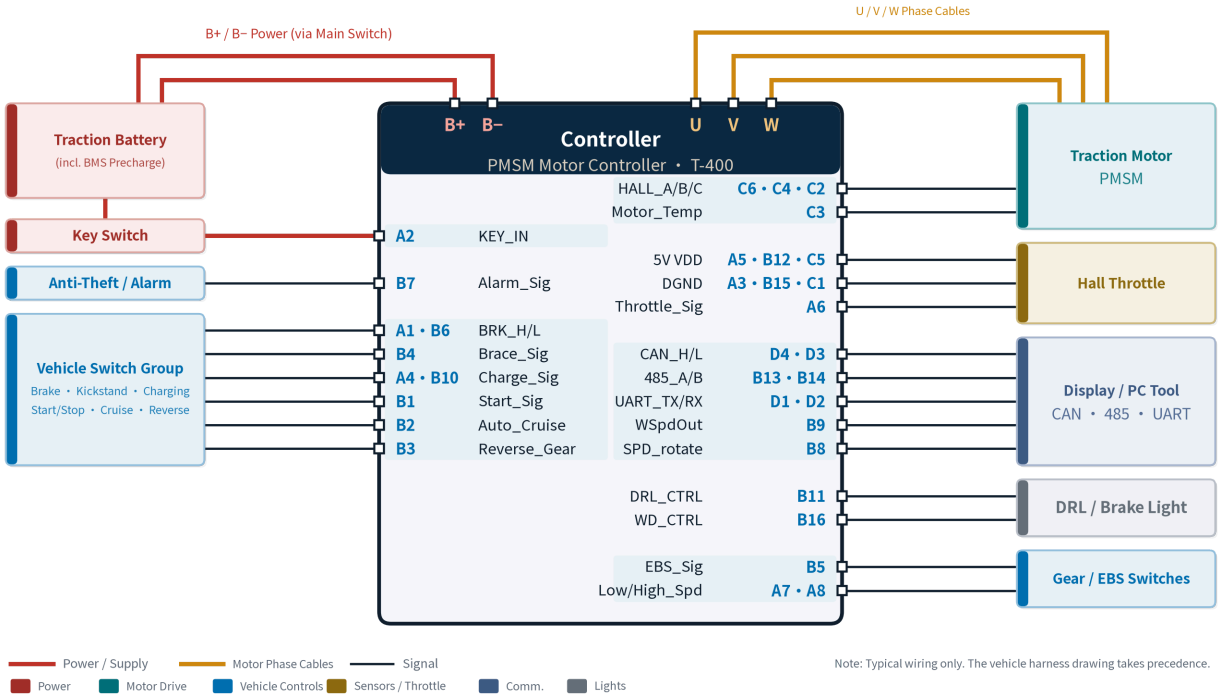


Figure 10-1 T-400 Typical Vehicle Wiring Diagram

- Route B+ / B− through the main battery switch and size the cables for the peak bus current. With a BMS, the pre-charge circuit must be enabled.
- All signal ports reference the controller DGND (pins A3, B15, C1); never connect them directly to the battery negative.
- The CAN bus needs a 120 Ω terminator at each end; one is integrated in the controller. Use shielded cable for Hall / encoder harnesses, shield grounded at the controller end only.
- For detailed port electrical characteristics and the Reference Circuit sections, see the T-400 User Manual (VT_RD4_006).

11 Revision History

Date	Rev.	Description of Change
2026.10.11	V1.0	Initial release: unified layout; data, functions and figures aligned with User Manual VT_RD4_006 V1.0
2026.10.14	V1.1	Power-terminal torque revised per GB/T 14048.1 (M5: 2.0 N·m)
2026.10.14	V1.1	Cross-reference renamed to the Reference Circuit sections