
Roboteq Drive's 3.0 Firmware Release Notes

Iss:1/Rev.:0

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Introduction

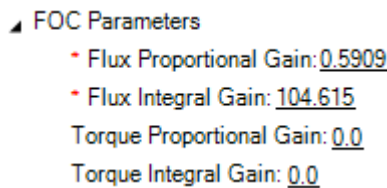
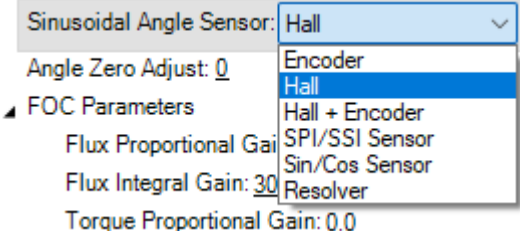
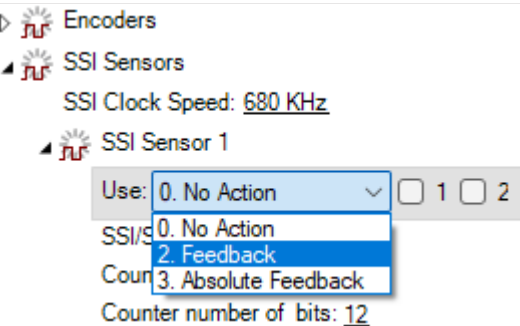
Firmware v3.0 has been validated and released for use with the new generation of RoboG4 drives. The RoboG4 products are the successors to the non-G models, offering the same dimensions, power specifications, and connections to enable a seamless transition. RoboG4 drives retain all the features of the previous generation and introduce advanced features that, when enabled, can enhance application performance.

Important Note

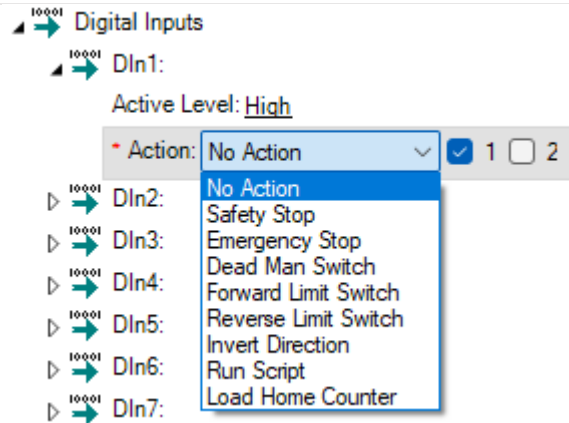
Make sure you use the latest Roborun+ PC Utility (v3.0 or newer) when configuring and operating drives running firmware 3.0. The latest released version can be downloaded from Roboteq's website.

List of Features

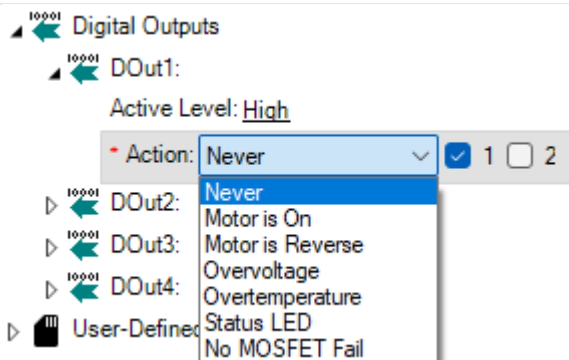
Operational Features

Sinusoidal Commutation with Field Oriented Control (FOC): Allows for precise and efficient motor control with reduced torque ripple by synchronizing the stator and rotor fields. It is enabled by configuring the FOC Flux and Torque gains.	 FOC Parameters - Flux Proportional Gain: <u>0.5909</u> - Flux Integral Gain: <u>104.615</u> - Torque Proportional Gain: <u>0.0</u> - Torque Integral Gain: <u>0.0</u>
Support for Multiple Sensors for Motor Commutation: Compatible with a variety of sensors including Hall, Encoder, SSI, Sin/Cos, and Resolver, enabling flexible motor control setups.	 Sinusoidal Angle Sensor: <u>Hall</u> Angle Zero Adjust: <u>0</u> FOC Parameters - Flux Proportional Gain: <u>0.5909</u> - Flux Integral Gain: <u>104.615</u> - Torque Proportional Gain: <u>0.0</u>
Support for Multiple Sensors for Motor Feedback: Extends flexibility in feedback systems, accommodating Hall, Encoder, SSI, Sin/Cos, Resolver, analog, and pulse sensors.	 Encoders SSI Sensors SSI Clock Speed: <u>680 KHz</u> SSI Sensor 1 Use: <u>0. No Action</u> SSI/S: <u>0. No Action</u> Count: <u>2. Feedback</u> Counter number of bits: <u>12</u>

Multifunctional Inputs: Offers versatile input options that can be configured for various control tasks and signals, including digital, analog and pulse functions.



Configurable digital output action: Digital outputs can implement functions that serve status LEDs and critical fault indicators.



Customizable Scripting Language: Provides the ability to tailor functions to specific applications through easy-to-use native scripting. MicroBasic language enables control over the drive's I/Os, runtime variables, and allows modification of the drive's configuration during operation.

```
start:

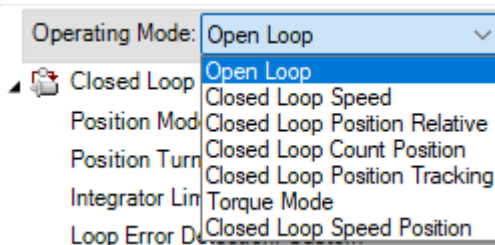
up = getvalue(_DI,UP_SW)
down = getvalue(_DI,DOWN_SW)

if up and not down

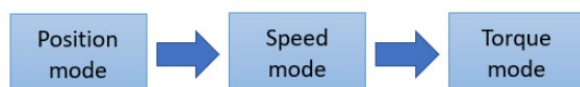
    setcommand(_S,CC,UP_SPEED)

end if
```

Various Control Modes: Includes Open Loop, Speed, Position, and Torque modes to suit a wide range of motor control requirements.

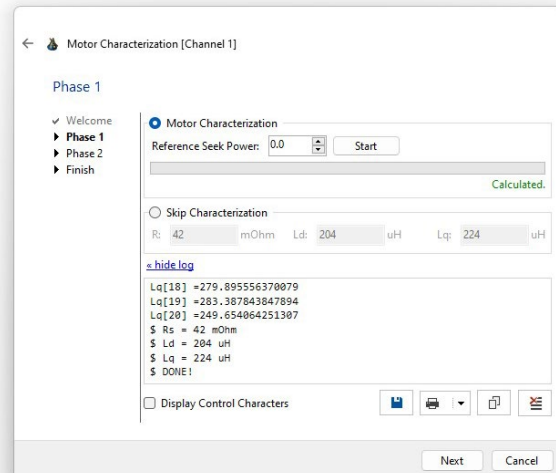


Cascaded Control Modes: Three control loops—Torque, Speed, and Position—each with its own PI gains, operate in a cascaded manner, allowing for optimal motor control. Cascade operation is enabled by setting the FOC Torque gains.



Automatic Motor Characterization:

Automatically estimates the motor's RL specifications that are necessary for tuning the FOC loop to optimize current control and sinusoidal commutation.



Motor Characterization [Channel 1]

Phase 1

- ✓ Welcome
- ▶ **Phase 1**
- ▶ Phase 2
- ▶ Finish

☒ Motor Characterization

Reference Seek Power: 0.0

☐ Skip Characterization

R: 42 mOhm Ld: 204 uH Lq: 224 uH

[hide log](#)

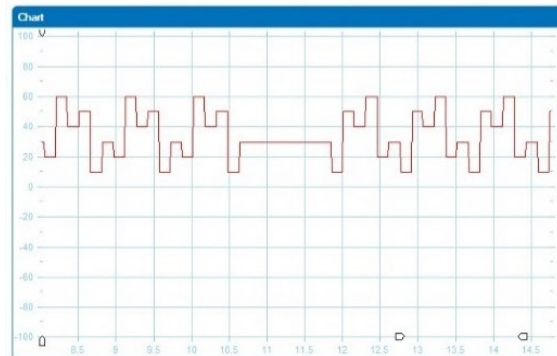
```

Lq[18] = 279.895556370079
Lq[19] = 283.387843847894
Lq[20] = 249.654064251307
$ Rs = 42 mOhm
$ Ld = 204 uH
$ Lq = 224 uH
$ DONE!
    
```

☐ Display Control Characters

Motor/Sensor Calibration Process: An

automatic calibration process aligns the zero position of the sensor with the motor. This process ensures that precise sensor placement is not required for operation. The motor/sensor setup should be completed at least once for each different motor.



Configurable Low Pass Filter for Speed

Control: Enhances control stability and performance by filtering out high-frequency noise.

Closed Loop Feedback Sensor: Other

Speed feedback filter bandwidth (Hz): 45

16 kHz Current Loop (New Feature): Having a 16 times faster control loop than before allows for the ultimate control of the motor current even at most demanding command or load changes.



Motor Configuration Wizard (New Feature):

Guides users through motor setup with an intuitive step-by-step process.

Motor Sensor Setup - Setup Procedure

- ✓ Welcome
- ✓ Motor Sensor Setup
- ✓ Configure
- **Setup Procedure**
 - Current Loop Auto Tuning
 - Motor Characterization
 - Current Gains
 - Step Command
 - Finalize
- Speed Loop Auto Tuning
- Feedback Sensor Config
- Auto Tuning Config
- Auto PI Tuning
- Speed Gains
- Step Command
- Ramped Command
- Finalize

Summary:
Channel: 1
Number of Pole Pairs: 5
Motor Direction: Inverted
Motor Input: Hall-Sin/Cos Sensors
Sinusoidal Angle Sensor: Hall
Amps Limit: 10 Amps
Reference Seek Power: 10 Amps

CAUTION

- Emergency stop will be released.
- Make sure that, in all controller channels, motors are free to move & disconnected from any load!
- The motor will start moving.

Run Setup Procedure

Automatic Field Weakening (New Feature):

Enhances high-speed motor performance by automatically reducing field magnetization when the requested speed surpasses the motor's nominal range. Automatic field weakening is enabled by reducing the maximum allowed voltage ratio.

Motor Parameters

Stator Resistance (R_s - Ohm): 0.0

* D-axis Stator Inductance (L_d - mH): 0.196

* Q-axis Stator Inductance (L_q - mH): 0.209

* Voltage Constant (V_k - V/kRPM): 15.17

* Field Weakening Voltage Ratio (%): 80.0

Maximum Motor Output Power (W): 1200.0

Current Decoupling Terms (New Feature):

Improves motor control precision by separating torque-producing current from magnetizing current. Decoupling control is automatically enabled when D-axis, Q-axis and Voltage Constant parameters are both set.

Motor Parameters

Stator Resistance (R_s - Ohm): 0.0

* D-axis Stator Inductance (L_d - mH): 0.196

* Q-axis Stator Inductance (L_q - mH): 0.209

* Voltage Constant (V_k - V/kRPM): 15.17

Feedforward Control (New Feature):

Improves response times and control accuracy by preemptively compensating for the system's inertia. Feedforward control is enabled by setting the system's inertia and friction coefficients. In position mode is enabled by setting The Velocity Feedforward gain.

Closed Loop Position

* Position Proportional Gain: 1.0

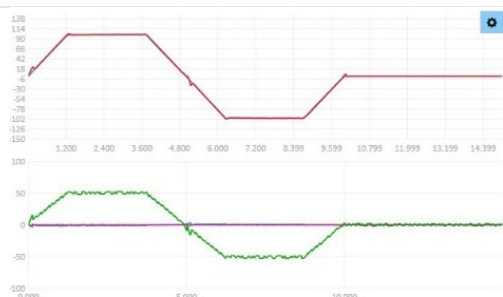
Position Integral Gain: 0.0

Position Differential Gain: 0.0

* Velocity Feedforward Gain: 0.1

Automatic PID Load Tuning (New Feature):

This feature automatically computes the system's inertia and the coefficients of rotating friction to enable the prediction of optimal closed-loop PID gains. It is a part of the Motor Sensor and Tuning Setup Wizard.



Protections and Safety Features

Sensor Error Detection: The drive continuously checks for sensor-related errors during operation, applicable for Hall sensors, Hall+Encoder combinations, Sin/Cos sensors, and Resolvers. The detection level is configurable.

Stall Detection: 500ms @ 25% Power

Sensor Error Detection: Strict
Switching Mode: Trapez
Reference Seek Power: Strict
Safety Switch Connected: No

Amps Limiting function: The drive can limit the maximum motor current, with the allowable value set by the user's Amp Limit, in conjunction with the I2T configuration and the Max Power setting.

Motor Output
Amps Limits
Amps Limit (A): 60.0
Amps Trigger (A): 60.0
Amps Trigger Action: No Action
Amps Trigger Delay (ms): 500

Amps Trigger Function: This protection will trigger an error if the motor current exceeds a permissible value for longer than the defined time.

I2T protection: This feature safeguards the motor from thermal overload by monitoring the integral of the current squared over time (I^2T), preventing damage due to excessive current draw over a period. It allows for brief current surges but limits long-term overcurrent conditions.

I2T Configuration
Nominal Current: 30.0
Time (sec): 2

Stall detection: An error is triggered if there is no change in the sensor signals for a defined amount of time and at a minimum PWM duty cycle.

Stall Detection: 500ms @ 25% Powe
Sensor Error D: Disabled
Switching Mode: 500ms @ 10% Power
Reference Seek: 500ms @ 25% Power
Reference Seek: 1s @ 50% Power

Overvoltage/Undervoltage Detection: The power stage is disabled if the DC bus voltage gets out of the permissible limits.

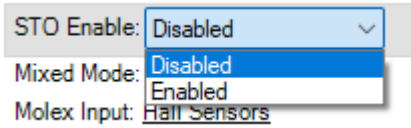
General
Voltage Limits
Over Voltage Limit (V): 60.0
Over Voltage Hysteresis (V): 5.0
Under Voltage Limit (V): 10.0

Loop Error Detection: An error is triggered when the Loop Error runtime value surpasses a predefined threshold for a specified duration, allowing for the detection of load variations or mechanical faults.

Loop Error Detection: Custom
Loop Error Limit: 250
Loop Error Time: 500
Closed Loop Torque: Disabled
Closed Loop Speed: 250ms @ 100 Error Units
Closed Loop Torque: 500ms @ 250 Error Units
Closed Loop Speed: 1s @ 500 Error Units
Closed Loop Torque: Custom

Customizable Loop Error Detection (New Feature): The specific Loop Error duration and level are fully customizable in 3.0+ firmware

Loop Error Detection: Custom
Loop Error Limit: 250
Loop Error Time: 500

Short circuit detection: The drive immediately disables the power stage if the measured motor current exceeds 120% of the drive's maximum current rating, protecting against potential damage from short circuits.	- Not Configurable -
MOSfail detection: The drive checks the health of the MOSFETs at every startup and when a specific command is issued. If a failed MOSFET is detected, the H-bridge is disabled.	- Not Configurable -
STO-Certified Function: STO-certified circuitry prevents the motor from generating any additional torque when the STO is triggered. The motor will continue to rotate with the existing torque until it is stopped by the friction of the mechanical parts.	

Important Note

For additional information regarding Operational Features and Protections, refer to the latest Roboteq Drives User Manual.

Important Note

To configure a RoboG4 drive from scratch, please refer to the latest Roborun+ Utility User Manual (v3.0), the latest Roboteq Drives User Manual, and the relevant Quick Startup and Configuration Guides.

References

Please refer to the below table for the documentation and support resources related to RoboG4 products.

Table 1: References

Document	Source
Roborun+ 3.0 latest User Manual	https://www.roboteq.com/support/documentation-download
Roboteq Drives 3.0 latest User Manual	https://www.roboteq.com/support/documentation-download
Roborun+ 3.0 latest software update	https://www.roboteq.com/support/files-download
Latest v3.0 Firmware	https://www.roboteq.com/support/files-download
Quick Startup and Configuration guides	https://roboteq.freshdesk.com/en/support/solutions/folders/70000481967