E-Qube Reference Manual

Version 2.0 — 15 April 2022

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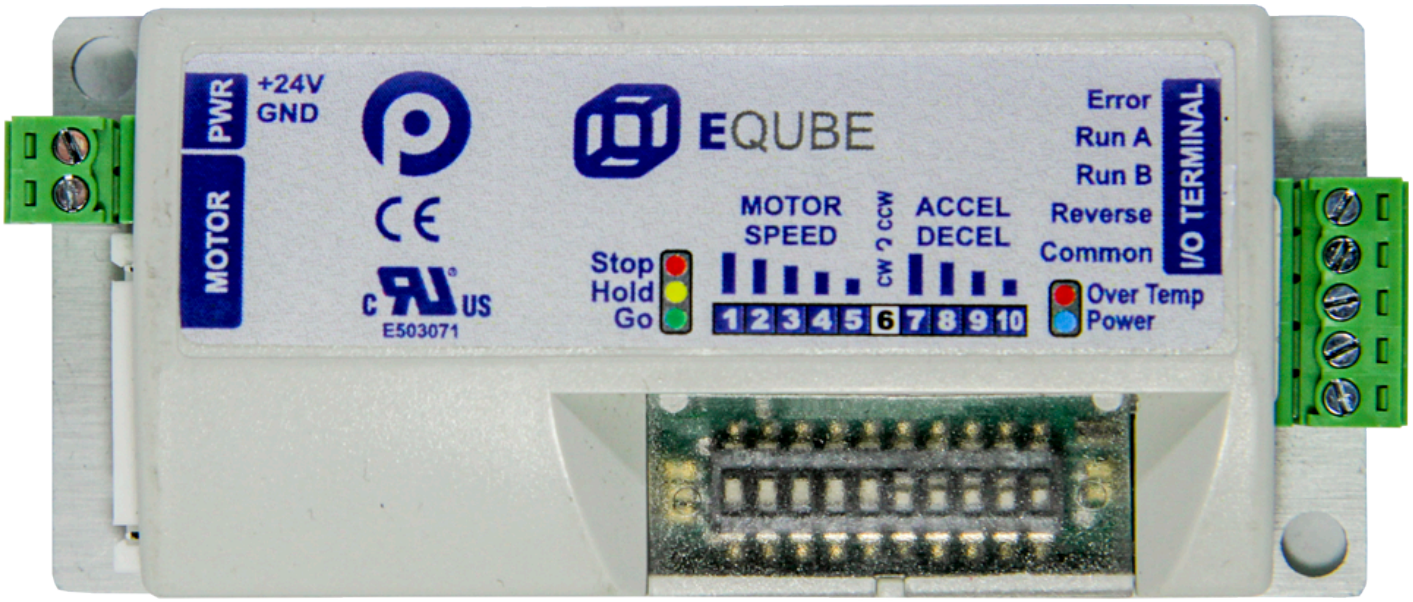
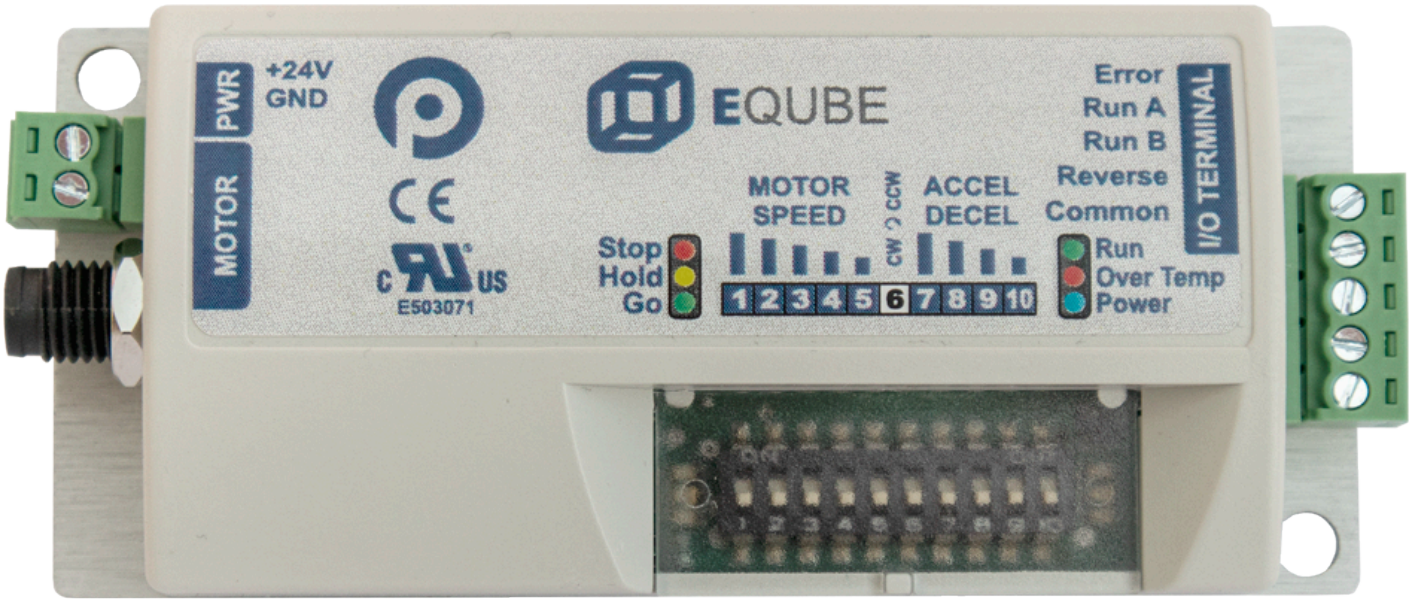
1. About This Manual

Products Covered in this Manual

E-QUBE-N – Article Number 1310-5000
E-QUBE-P – Article Number 1310-6000



E-QUBE-Ai-N – Article Number 1321-5000
E-QUBE-Ai-P – Article Number 1321-6000



Symbol Conventions

! This symbol indicates that special attention should be paid in order to ensure correct use as well as to avoid danger, incorrect application of product, or potential for unexpected results

* This symbol indicates important directions, notes, or other useful information for the proper use of the products and software described herein

Important User Information

! Modules contain ESD (Electrostatic Discharge) sensitive parts and components. Static control precautions are required when installing, testing, servicing or replacing these modules. Component damage may result if ESD control procedures are not followed. If you are not familiar with static control procedures, reference any applicable ESD protection handbook. Basic guidelines are:

- Touch a grounded object to discharge potential static
- Wear an approved grounding wrist strap
- Do not touch connectors or pins on component boards
- Do not touch circuit components inside the equipment
- Use a static-safe workstation, if available
- Store the equipment in appropriate static-safe packaging when not in use

! Because of the variety of uses for the products described in this publication, those responsible for the application and use of this control equipment must satisfy themselves that all necessary steps have been taken to assure that each application and use meets all performance and safety requirements, including any applicable laws, regulations, codes, and standards

! The illustrations, charts, sample programs and layout examples shown in this guide are intended solely for purposes of example. Since there are many variables and requirements associated with any particular installation, Pulseroller does not assume responsibility or liability (to include intellectual property liability) for actual use based on the examples shown in this publication

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Not Included in this Manual

! Because system applications vary; this manual assumes users and application engineers have properly sized their power distribution capacity per expected motor loading and expected operational duty cycle. Please refer to conveyor equipment and/or motor roller manufacturer's documentation for power supply sizing recommendations

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2. Glossary of Terms

Term	Definition
Brushless DC Motor	A D.C. motor with a permanent magnet rotor and coils in the stator. The stator coil currents are sequenced by an external brushless D.C. motor controller. In such motors, current and torque, voltage and rpm are linearly related. The main advantage to this type of motor is the elimination of EMI caused by the arcing brushes and improved motor life
Hall Effect Sensor	Special sensor embedded within the brushless DC motor of an MDR used to provide motor rotor position feedback to the motor controller
JST	This is the name of a particular connector manufacturer that produces a specific plug/ socket arrangement for MDR connection to control cards. This name is accepted within the conveyor and MDR industry as a simple description of the particular socket style used on E-Qube hardware.
LED	Light Emitting Diode – In the context of this document, LED's are used on the E-Qube to provide visual indication of module status
MDR	Motorized Drive Roller or Motor Driven Roller – Brushless DC motor and gearbox assembly integrated into a single conveyor roller
M8	This is an industry standard 4 pin threaded connector used to connect a Senergy-Ai motor to the E-Qube module
NPN / PNP	Electronics term that indicates the type of transistor circuit used for a logical input or output for controllers. NPN devices will provide a common or ground connection when activated and a PNP device will provide a logic voltage connection when activated
PLC	Programmable Logic Controller – A wide variety of industrial computing devices that control automatic equipment
PWM	Pulse Width Modulation – a control scheme that utilizes high speed switching transistors to efficiently deliver power in a controlled fashion from the E-Qube controller to MDR
Senergy-Ai	PulseRoller brand proprietary motor control platform that provides electronic intelligence inside the motor that can be read by the E-Qube control module. The connection from the motor to the controller is via 4-Pin M8 style connector
Senergy ECO	Mode of performance that provides the highest speed for the selected gear reduction option of the PulseRoller Senergy brand motor roller and gear drive units
Senergy BOOST	Mode of performance that provides the highest torque for the selected gear reduction option of the Pulseroller Senergy brand motor roller and gear drive units

3. Module Hardware

E-Qubes are designed to be installed and integrated into the conveyor's mechanical side frame assembly. The **E-Qube** is a controller for a single Senergy brand Motorized Drive Roller (MDR) or Senergy brand Pulse Gear Drive (PGD) unit.

Module Features

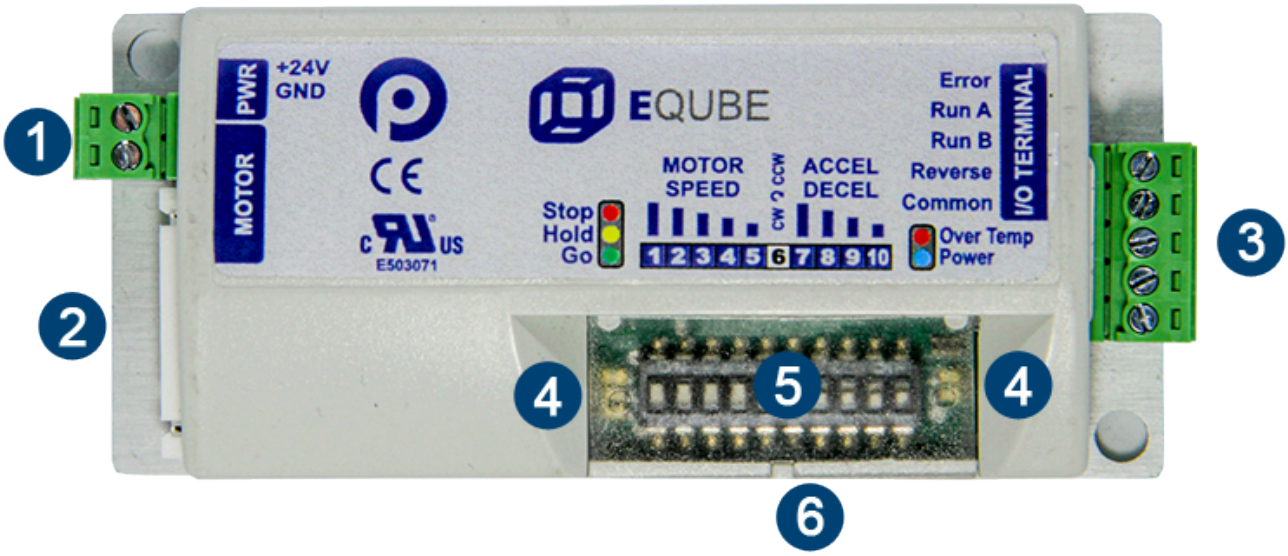
- Over-voltage protection with transient voltage suppressor
- Internal SMD fast 8 Amp fuse
- Protection from over-voltage produced by over-speeding of MDR
- Thermal and Over-Current Protection for module and MDR
- Reverse polarity protection against incorrect wiring of the power terminals
- Sensing and indication of over voltage from power supply and/or MDR (32 Volts)
- Sensing and indication of under voltage from power supply (18 Volts)
- PID speed regulation mode with 32 fixed speed settings
- Adjustable acceleration and deceleration with 16 fixed settings
- Dynamic brake control mode
- Automatic error recovery
- Five status LEDs
- Removable power and control signal terminal blocks
- Motor reversing capability while motor is running.
- Error Output signal and LED indication for module and MDR diagnosis
- Selectable default rotation direction
- Hinged clear protective cover for DIP Switch and LEDs
- Options for PNP or NPN control signal wiring accommodation
- Options for Senergy and Senergy-Ai motor rollers and gear drives

Learn more:

Identifying E-Qube Components
Mounting Dimensions
Motor Ports
LED Status Indicators

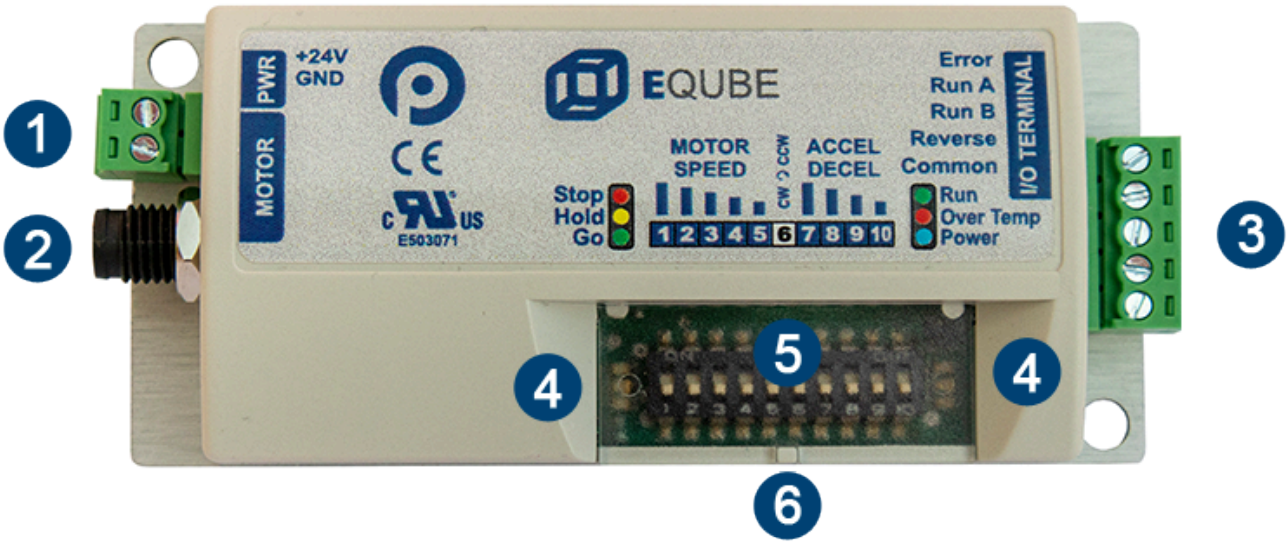
3.1. Identifying Module Components

E-Qube-N and E-Qube-P



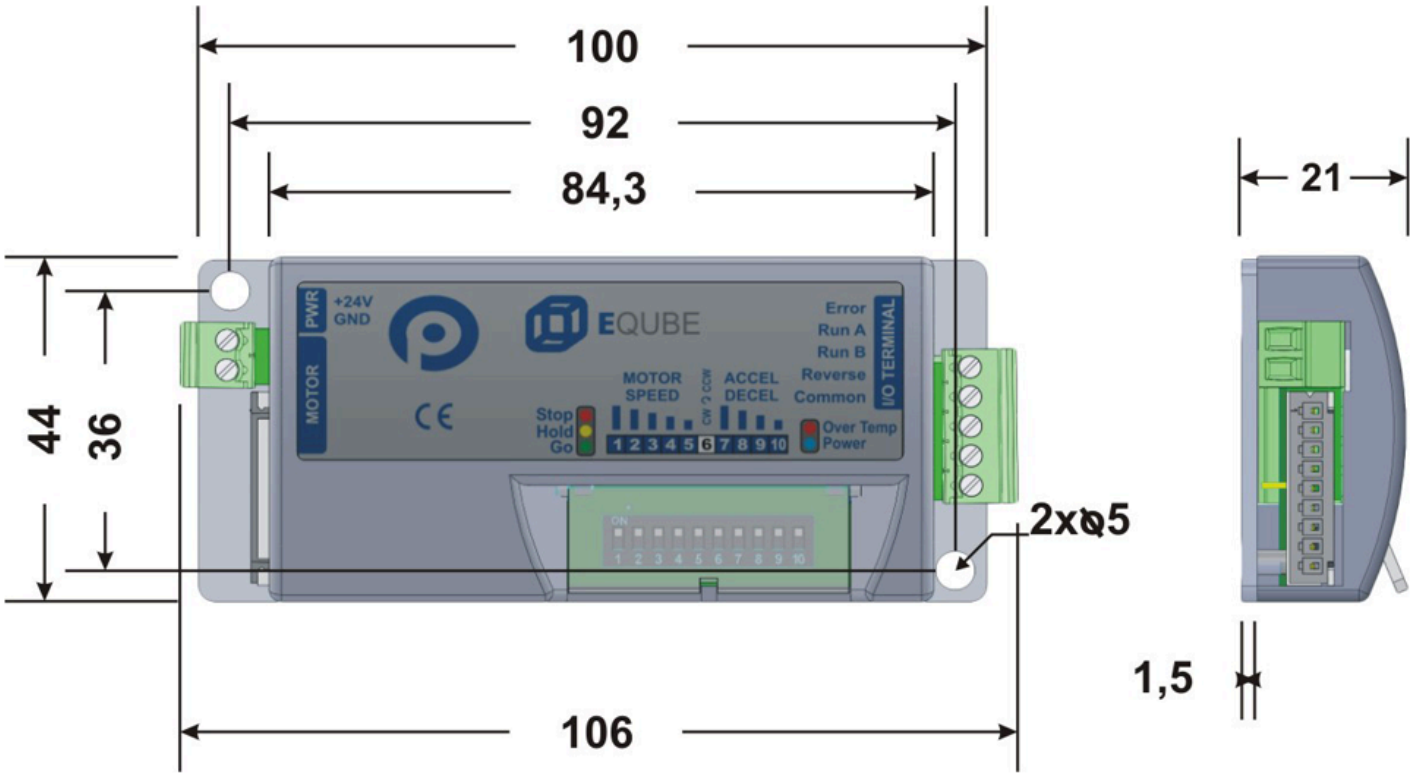
Item	Description
1	Removable 24VDC Power Connector Terminal Block
2	Senergy Motor Port – 9-pin JST style header for MDR/PGD connection
3	Removable I/O Terminal Block
4	Module Status LEDs
5	Speed & Configuration 10 Position DIP Switch
6	DIP Switch and LED Hinged Clear Protective Cover

E-Qube-Ai-P



Item	Description
1	Removable 24VDC Power Connector Terminal Block
2	Senergy-Ai Motor Port – 4-pin M8 style header for MDR/PGD connection
3	Removable I/O Terminal Block
4	Module Status LEDs
5	Speed & Configuration 10 Position DIP Switch
6	DIP Switch and LED Hinged Clear Protective Cover

3.2. Mounting Dimensions



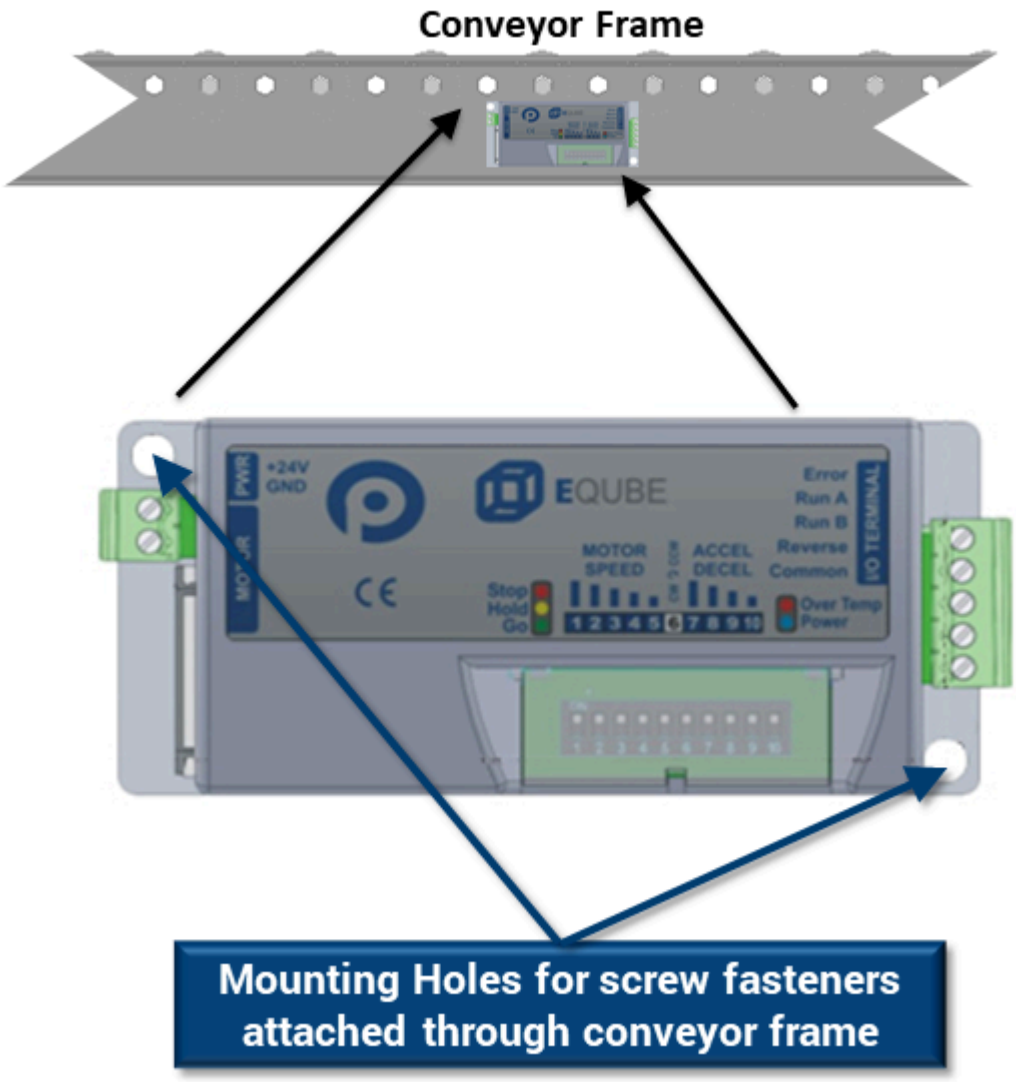
Mounting dimensions are identical between all E-Qube models.

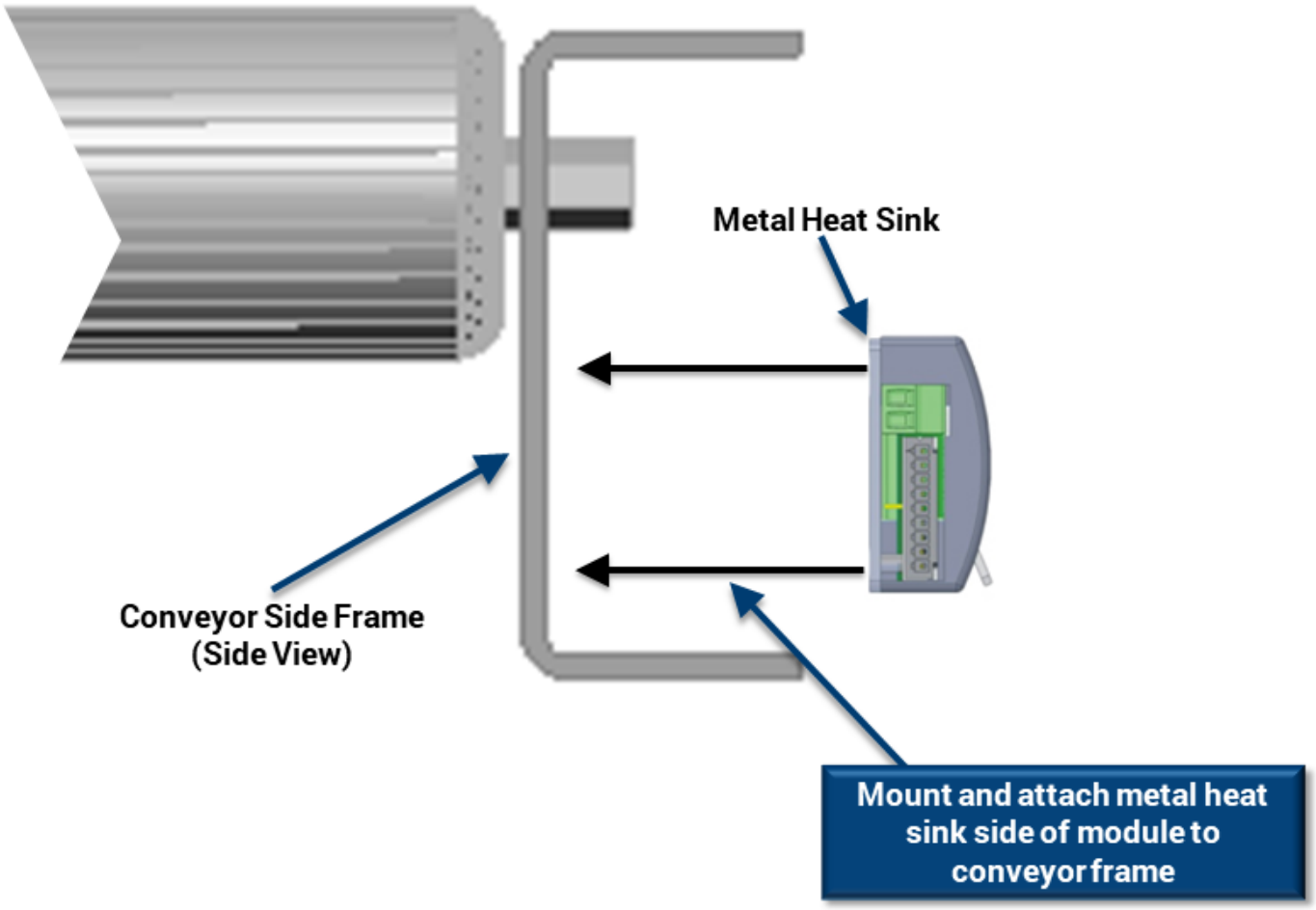
Mounting Considerations

EZ-Qube module must be mounted with its long side parallel to the conveyor frame and with its heat sink plate in contact with the conveyor frame. Attach module to frame using fasteners through the 2 mounting holes on the module through matching holes drilled into conveyor frame.

Other mounting and installation requirements:

- Metal Heat Sink surface must face the conveyor frame and Heat Sink must not be accessible by any personnel without removing the module from the frame
- Module must be mounted on electrically grounded metal surface or provided with a conductor wire connecting the module's metal heat sink plate to electrical ground.
- Module must be mounted in such a way such that there are no interferences with an operator's ability to remove or unplug the power, motor, and control signal connectors.
- Module should be mounted in such a way and location such that any personnel can easily retreat away from the module in the event of a device failure
- Module must be mounted such that it can be accessed by personnel of any height


Conveyor Frame
PWR
+24V
GND
EQUBE
Error
Run A
Run B
Reverse
Common
I/O TERMINAL
MOTOR SPEED
ACCEL DECEL
Stop
Hold
Go
1 2 3 4 5 6 7 8 9 10
Over Temp
Power
Mounting Holes for screw fasteners attached through conveyor frame


Metal Heat Sink
Conveyor Side Frame
(Side View)
Mount and attach metal heat sink side of module to conveyor frame

3.3. Power Connector

Power Connector Plug	
Part Number	Pulseroller Order Code: 1397-0000 (Degson 15EDGK-3.5-02P-14)
Wire Size	28 – 16AWG (0.2 – 1.3 mm ^{2})
Strip Length	5 – 6 mm

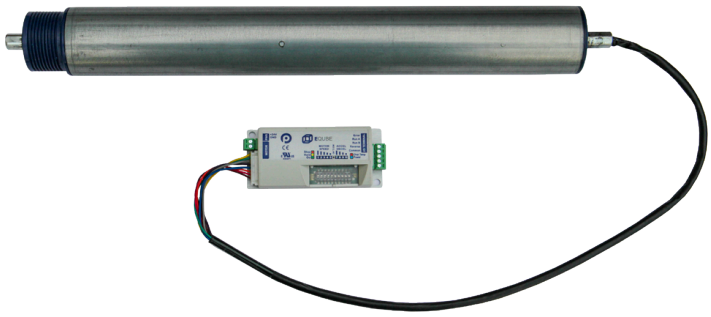
Pin	Signal	Description
1	+24VDC	Module 24VDC Supply
2	GND	0V DC Common

Power connector is the same part number for all E-Qube models

3.4. Motor Connector

For E-QUBE-N – Article Number 1310-5000 and E-QUBE-P – Article Number 1310-6000

The E-Qube motor port is a 9 pin JST Style connector that accommodates Pulseroller Senergy motor rollers and PGD units.

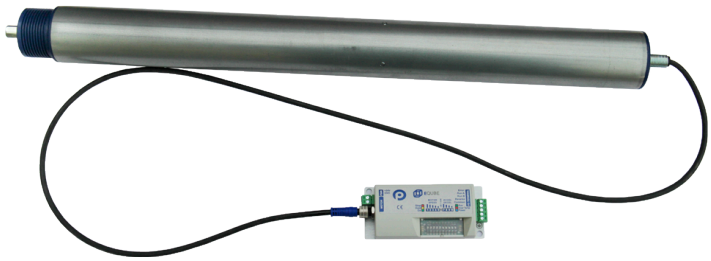


Pin	Description
1	GND
2	Vcc – Hall Effect Sensor Power
3	Motor Winding U
4	Motor Winding V
5	Motor Winding W
6	Hall Effect Sensor U
7	Hall Effect Sensor V
8	Hall Effect Sensor W
9	Not Used

✻ Please note the JST connector is keyed so you cannot plug it in upside down

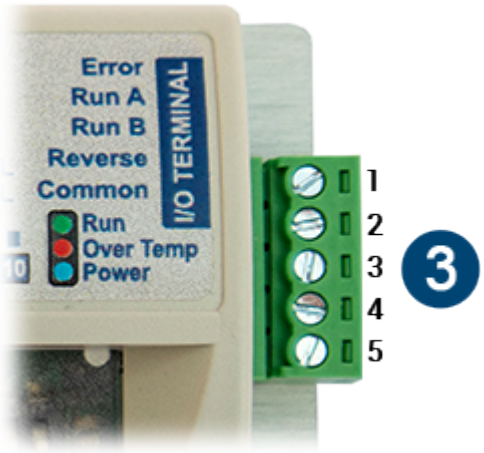
For E-QUBE-Ai-P – Article Number 1321-6000

The E-Qube-Ai motor port is a 4 pin M8 Style connector that accommodates Pulseroller Senergy-Ai motor rollers and PGD units.



Pin	Description
1	Communication
2	Motor Winding U
3	Motor Winding V
4	Motor Winding W

3.5. I/O Connector



The I/O Connector is the same part number for all E-Qube models

I/O Connector Plug	
Part Number	Pulseroller Order Code: 1397-0001 (Degson 15EDGK-3.5-05P-14)
Wire Size	28 – 16 AWG (0.1 – 1.3 mm ^{2})
Strip Length	5 – 6 mm

Pin	Signal	Direction	Description
1	Error	Output	Provides +24V or 0V output when Error condition is active
2	Run A	Input	Accepts +24V or 0V input for run at speed control (see section Run A and Run B Inputs)
3	Run B	Input	Accepts +24V or 0V input for run at speed control (see section Run A and Run B Inputs)
4	Reverse	Input	Accepts +24V or 0V input to run motor in opposite direction that is set on DIP Switch 6
7	Common	PNP Versions	DC common for optocouplers of Inputs (Run A, Run B, Reverse)
		NPN Versions	+24V common for optocouplers of Inputs (Run A, Run B, Reverse)

3.6. Inspection and Cleaning

When inspecting the device, the operator or maintenance personnel should visually inspect all mechanical parts and connections. The inspection should be performed on a monthly basis unless the device is not functioning as expected.

> ! In case of damage or if specific maintenance is required, it should be handled only by the manufacturer or buy a technician authorized by the manufacturer to perform such maintenance

For cleaning, use dry or slightly damp piece of cloth to wipe off the exterior of the module. Do not use solvents or abrasives.

> ! Do not allow any liquids to penetrate inside the module cover. Any liquids inside the cover may result in damage

3.7. Technical Specifications

Input Power Supply Requirements	24.0VDC +15% / – 25%	
Standby Current Consumption	< 30 mA without Motor	
Built-in Current Limits	Max. Peak Current	16 A
	Max. Starting Current	3A
	Max. Rated Current	2.8A
Motor PWM Frequency	20 kHz	
Initialization Time	<= 20 msec from power on	
Motor Start Response	<= 5 msec	
Storage temperature	-40ºC to 85º C (-40ºF to 185ºF)	
Ambient Operating temperature	-10ºC to 40ºC (15°F to 104°F)	
Humidity	5% to 95% non-condensing	
Enclosure IP Rating	IP20 – Indoor Use Only	
Altitude	up to 2000m	
Environmental Pollution	Class 2	
Weight	Approximately 60g	

4. Module Wiring

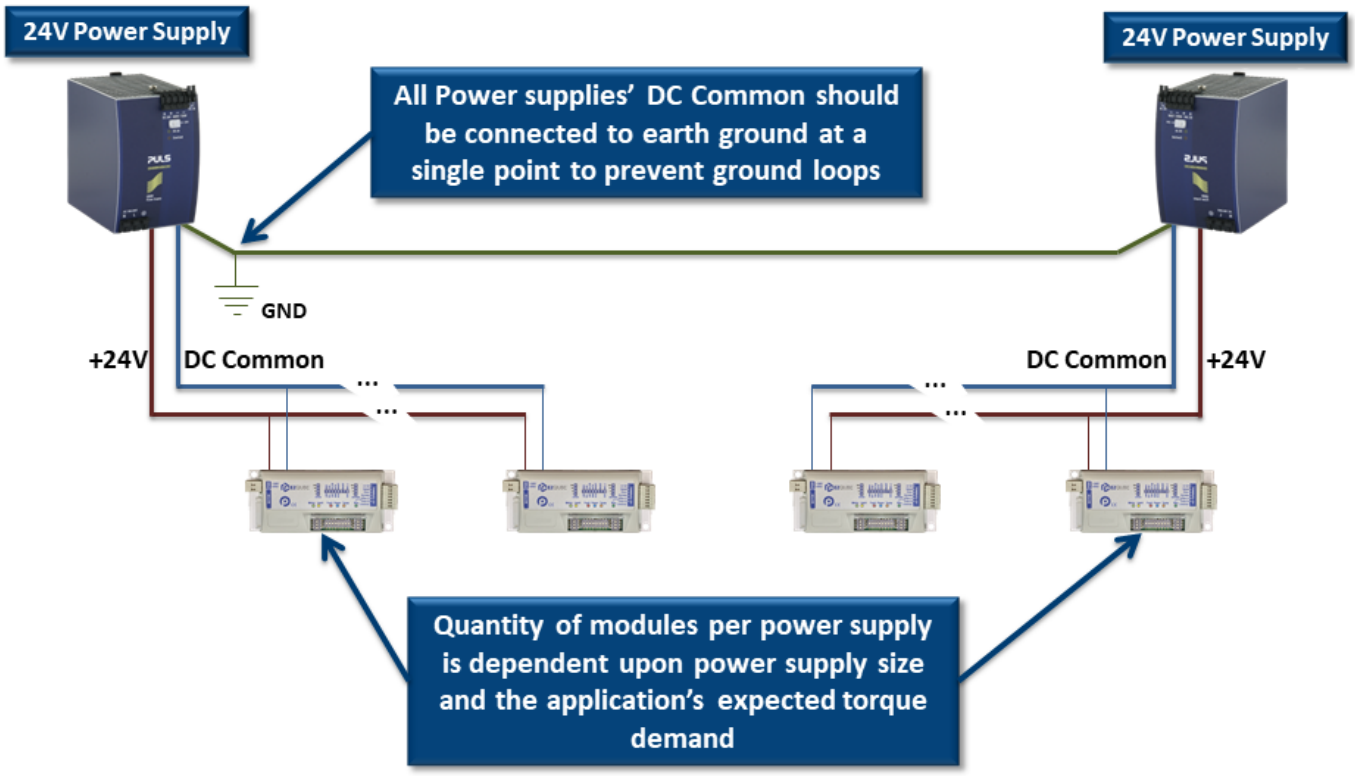
4.1. Power Supply

Power Supply Requirements

The power supply for any and all E-Qube modules should meet the following requirements:

- Certified as a NEC Class II device
- Capable of detecting and properly handling short circuit and overload of its DC power output
- Capable of supplying 24VDC at a minimum of 5 A for 1.5 seconds (BOOST Mode starting current time)

Power Supply Grounding



! Improper grounding of MDR and/or Power Supply Common may result in premature MDR and/or E-Qube module failure. Proper grounding techniques MUST be observed for all applications

Power Supply Sizing

The current loading on the power supply for a group of E-Qubes depends upon the Motor Type selected. Each of the motor types available has an associated rated current that the motor will draw at rated torque

and maximum speed. Each motor type also has an associated allowed current draw that is available for a period of time upon the initial starting of the motor. Theses current values and starting times are shown in the following chart:

Item	Value
Power supply load at rated torque at maximum speed	2.5 A
Power supply load during motor starting period	3.0 A
Duration of motor starting period	1.5 sec

✻ The current values are at rated speed and at rated torque. The current will be less if rated torque is not required by the motor.

4.2. Proper Motor Grounding Practice

Motor roller drive end shaft and/or fixing bracket must be electrically bonded to the conveyor frame and conveyor frame connected to electrical ground.

! Improper grounding of MDR and/or Power Supply Common may result in premature MDR and/or E-Qube module failure. Proper grounding techniques MUST be observed for all applications

4.3. PNP Version

The PNP versions of the E-Qube module are:

E-QUBE-P – Article Number 1310-6000

E-QUBE-Ai-P – Article Number 1321-6000

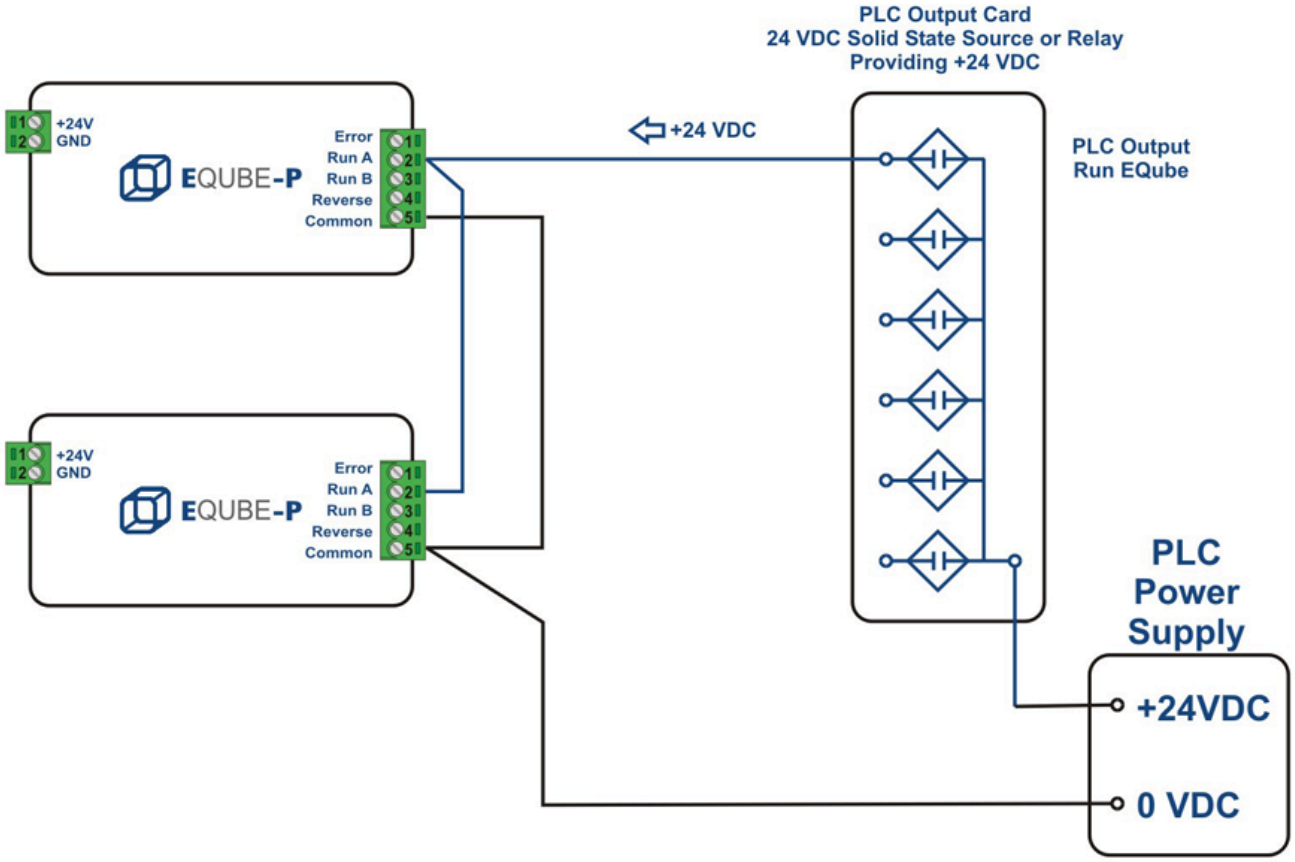
Run/Reverse Input Wiring
Error Output Wiring

4.3.1. Run/Reverse Inputs

Single PNP Module Wiring

! To use the REVERSE input, either RUN A or RUN B must also be energized. Please note that you DO NOT have to de-energize both RUN A and RUN B signals in order to change MDR direction with the REVERSE input.

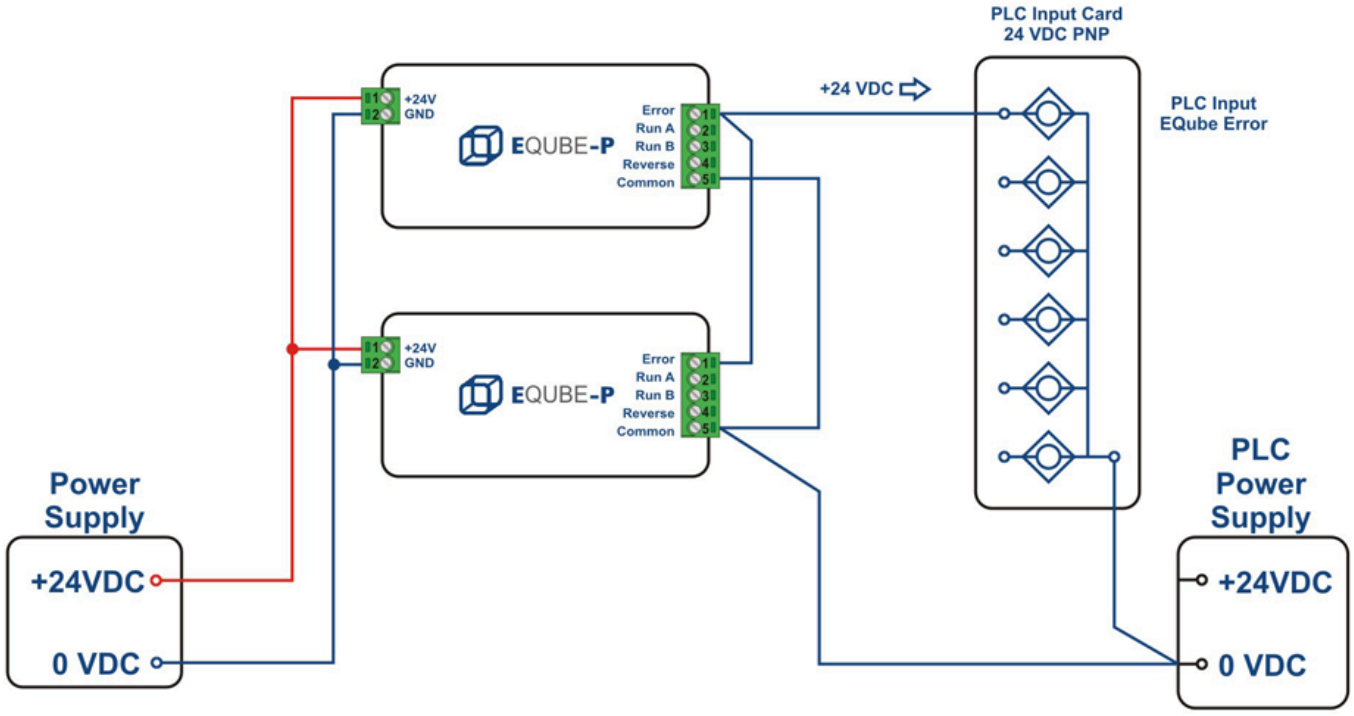
Wiring Multiple PNP Modules in Parallel



4.3.2. Error Output

Single PNP Module Wiring

Wiring Multiple PNP Modules in Parallel



4.4. NPN Version

The NPN version of the E-Qube module is:

E-QUBE-N – Article Number 1310-5000

E-Qube-Ai-N – Article Number 1321-5000

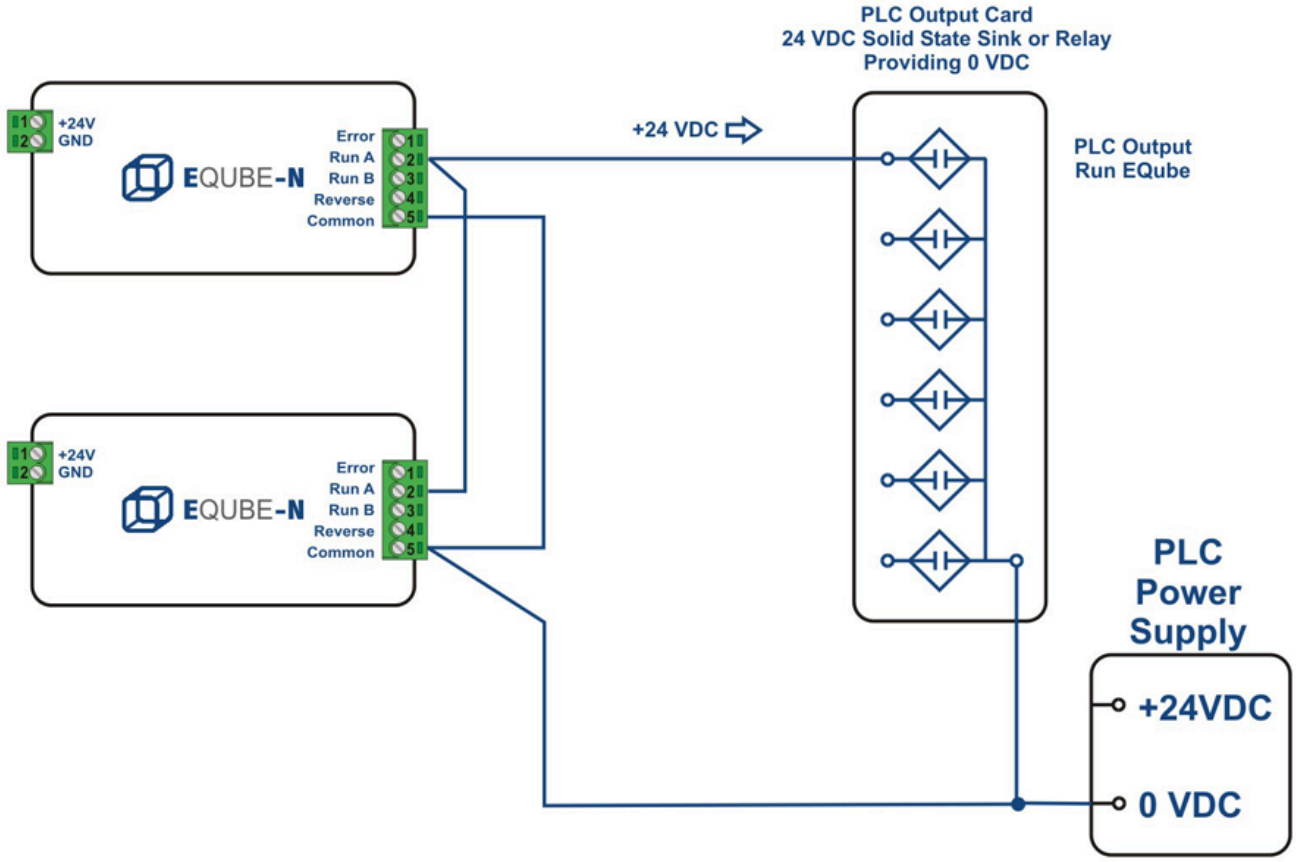
Run/Reverse Input Wiring
Error Output Wiring

4.4.1. Run/Reverse Inputs

Single NPN Module Wiring

! To use the REVERSE input, either RUN A or RUN B must also be energized. Please note that you DO NOT have to de-energize both RUN A and RUN B signals in order to change MDR direction with the REVERSE input.

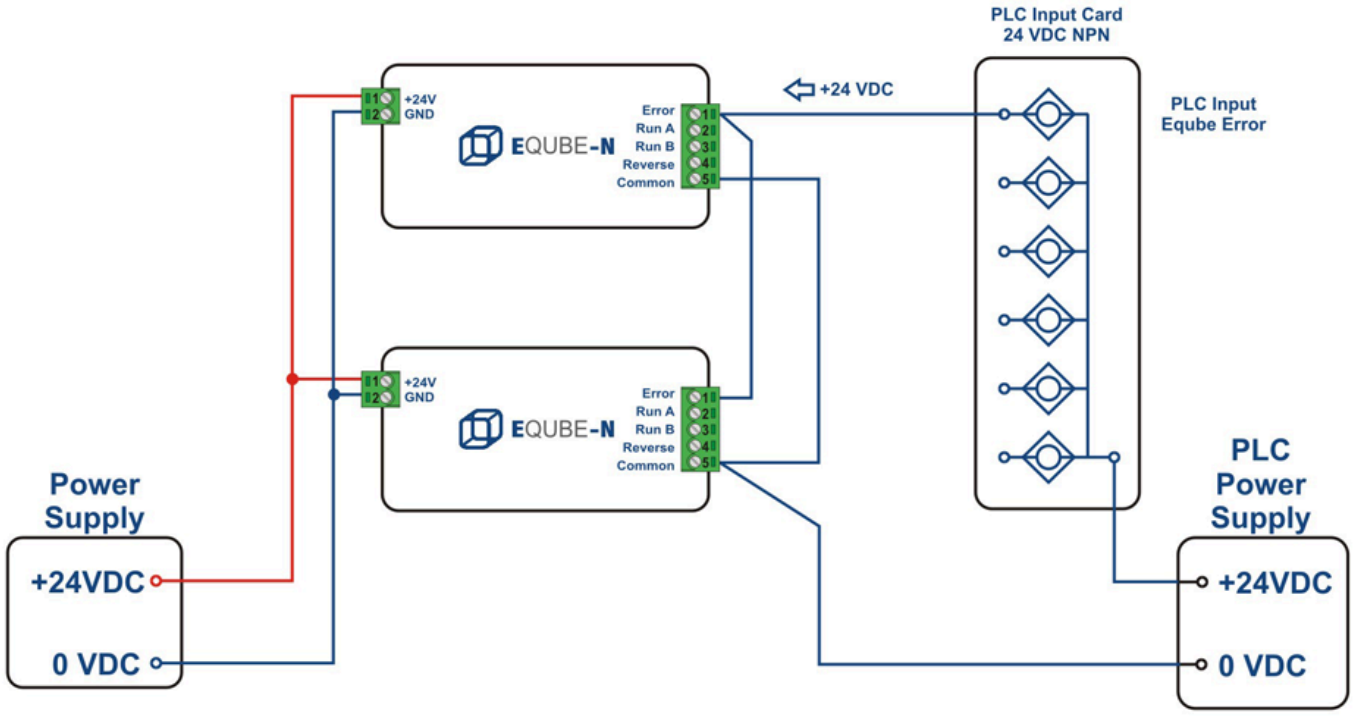
Wiring Multiple NPN Modules in Parallel



4.4.2. Error Output

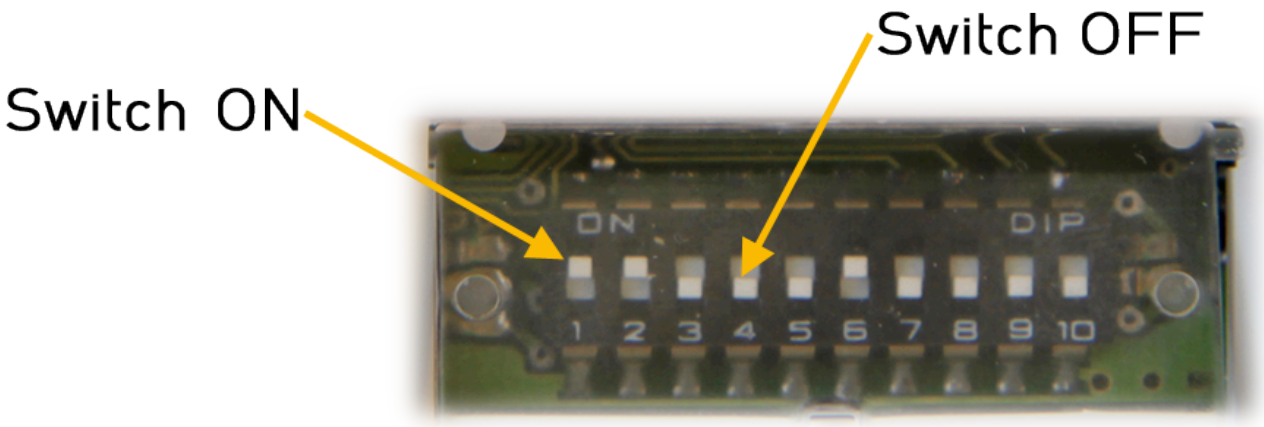
Single NPN Module Wiring

Wiring Multiple NPN Modules in Parallel



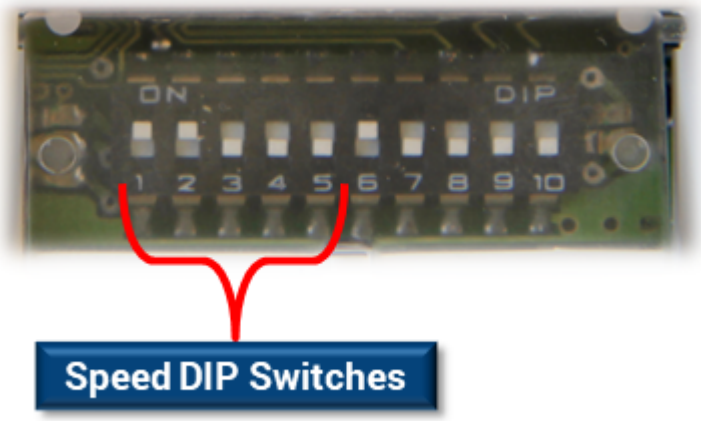
5. DIP Switch Settings

Each E-Qube module has a 10 position DIP Switch that provides settings for ***Speed***, ***Direction***, and ***Accel/Decel***. Switch ON and OFF positions are shown below.



✻ Please note that all switch actions take effect immediately except DIP Switch 6 “Direction of Rotation”. It will take effect only when the motor is NOT running.

5.1. Speed DIP Switches 1 thru 5



The motor speed is set by the ON or OFF state of DIP switches 1 through 5.

No.	SW 1	SW 2	SW 3	SW 4	SW 5	Frequency	Motor RPM
1	OFF	OFF	OFF	OFF	OFF	49	580
2	OFF	OFF	OFF	OFF	**ON**	67	800
3	OFF	OFF	OFF	**ON**	OFF	84	1000
4	OFF	OFF	OFF	**ON**	**ON**	100	1200
5	OFF	OFF	**ON**	OFF	OFF	117	1400
6	OFF	OFF	**ON**	OFF	**ON**	134	1600
7	OFF	OFF	**ON**	**ON**	OFF	150	1800
8	OFF	OFF	**ON**	**ON**	**ON**	167	2000
9	OFF	**ON**	OFF	OFF	OFF	184	2200
10	OFF	**ON**	OFF	OFF	**ON**	200	2400
11	OFF	**ON**	OFF	**ON**	OFF	217	2600
12	OFF	**ON**	OFF	**ON**	**ON**	234	2800
13	OFF	**ON**	**ON**	OFF	OFF	250	3000
14	OFF	**ON**	**ON**	OFF	**ON**	267	3200
15	OFF	**ON**	**ON**	**ON**	OFF	284	3400

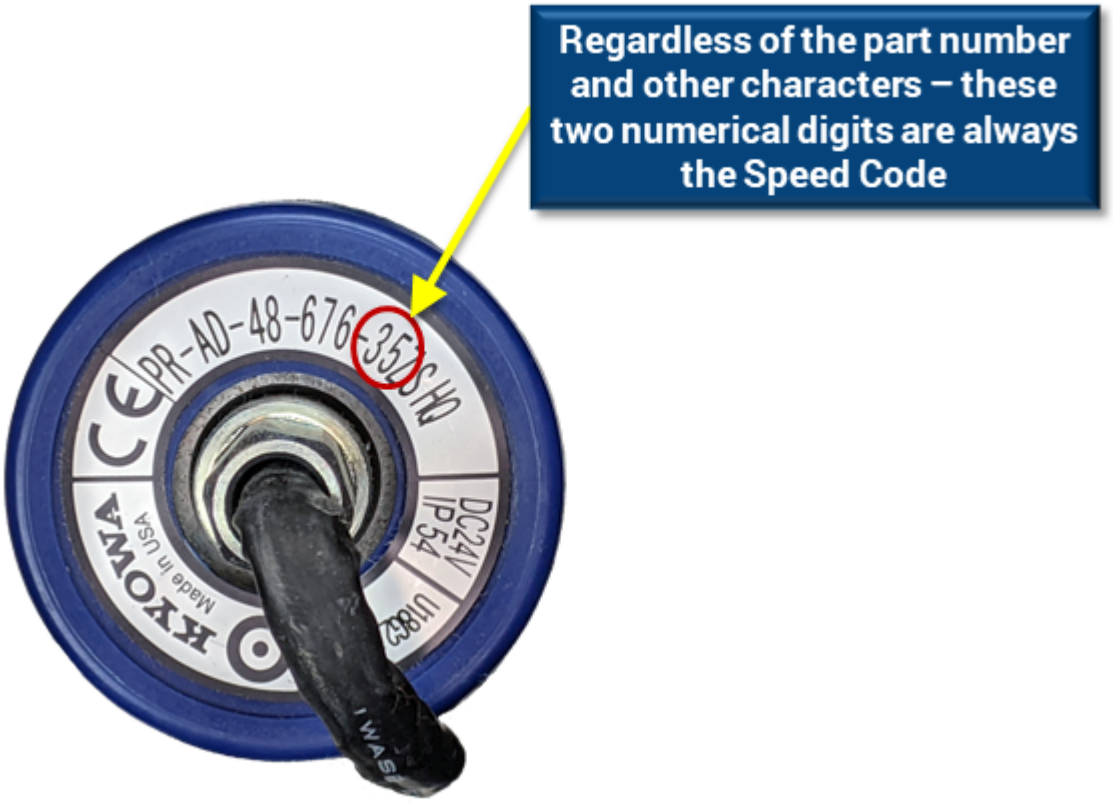
16	OFF	**ON**	**ON**	**ON**	**ON**	300	3600
17	**ON**	OFF	OFF	OFF	OFF	317	3800
18	**ON**	OFF	OFF	OFF	**ON**	334	4000
19	**ON**	OFF	OFF	**ON**	OFF	350	4200
20	**ON**	OFF	OFF	**ON**	**ON**	367	4400
21	**ON**	OFF	**ON**	OFF	OFF	384	4600
22	**ON**	OFF	**ON**	OFF	**ON**	400	4800
23	**ON**	OFF	**ON**	**ON**	OFF	409	4900
24	**ON**	OFF	**ON**	**ON**	**ON**	417	5000
25	**ON**	**ON**	OFF	OFF	OFF	425	5100
26	**ON**	**ON**	OFF	OFF	**ON**	434	5200
27	**ON**	**ON**	OFF	**ON**	OFF	442	5300
28	**ON**	**ON**	OFF	**ON**	**ON**	450	5400
29	**ON**	**ON**	**ON**	OFF	OFF	459	5500
30	**ON**	**ON**	**ON**	OFF	**ON**	467	5600
31	**ON**	**ON**	**ON**	**ON**	OFF	475	5700
32	**ON**	**ON**	**ON**	**ON**	**ON**	484	5800

5.1.1. Speed Calculation

To determine the speed of the roller, you must **know the diameter** of your roller tube and the **gear reduction ratio** of the motor roller in order to calculate the speed based upon the Motor RPM you have selected with Speed DIP Switches 1 thru 5.

Speed Code and Gear Ratio Table

The ***Speed Code*** for any Pulseroller is a 2 digit number found on the label at the cable end of the unit.



Once you know your ***Speed Code***, you can then reference these charts to get the corresponding ***Gear Ratio***

Speed Code	Gear Reduction Ratio
10	66.978 : 1
15	45 : 1
20	32.94 : 1

25	**27 : 1**
35	**18.3 : 1**
45	**15 : 1**
60	**10.98 : 1**
75	**9 : 1**
95	**6.818 : 1**
125	**5 : 1**
175	**3.66 : 1**
215	**3 : 1**

The formula for calculating the speed in m/s is:

$$\textbf{Speed (in meters/second)} = \left[\frac{\textbf{Motor RPM}}{\textbf{Gear Reduction}}\right] \times \pi \times \left[\frac{\textbf{Tube Diameter (in meters)}}{60}\right]$$

For example, for a 75 speed code roller with a 50 mm tube diameter running at 5000 RPM the calculation is:

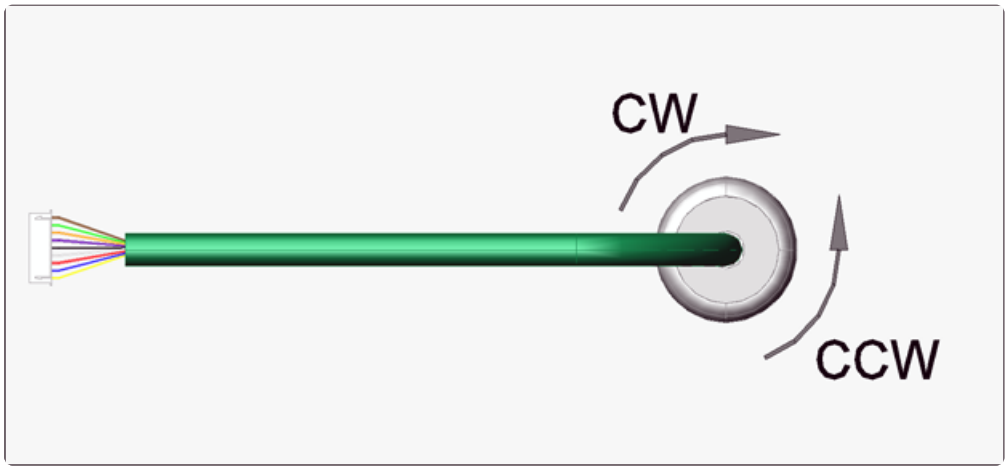
$$\text{Speed} = \frac{5000}{9} \times \pi \times \frac{0.05}{60} = 1.45\ Meters/sec$$

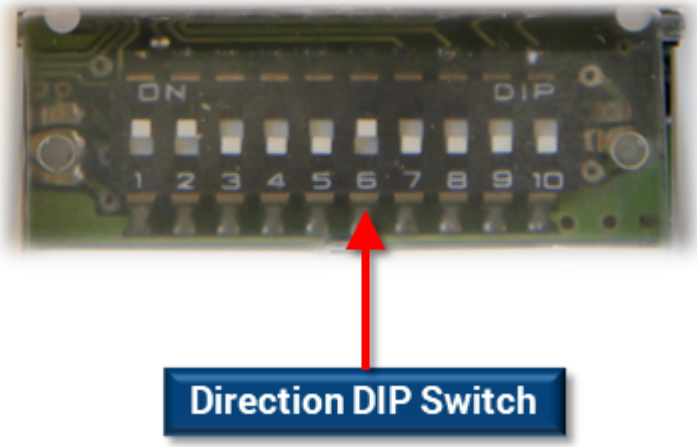
5.2. Direction DIP Switch 6

Motor Rotation Definition

The E-Qube uses a ***Clock-Wise (CW)*** and ***Counter Clock-Wise (CCW)*** motor rotation definition. The reference for this distinction is based upon viewing the MDR from the cable exit end of the roller.

> ✻ This definition is the same for both Senergy and Senergy-Ai MDRs and Gear Drives



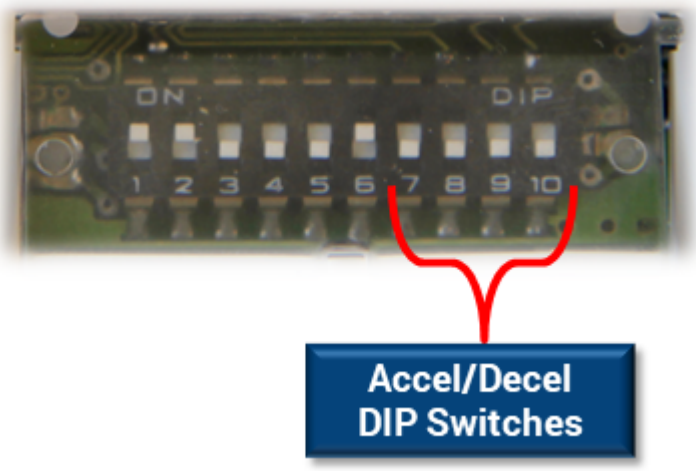


Switch	Function	OFF	ON
6	Direction of Rotation	CW	CCW

5.3. Acceleration/Deceleration DIP Switches 7 thru 10

These switches are used to select the acceleration and deceleration ***G force*** the control uses when starting and stopping the motor respectively. The E-Qube acceleration/deceleration control is designed to provide a ***constant G force or ramp slope*** regardless of the speed setting for a given SPEED DIP switch setting.

> ✻ The actual expected time elapsed for a given ramp selection is dependent on the motor RPM selected



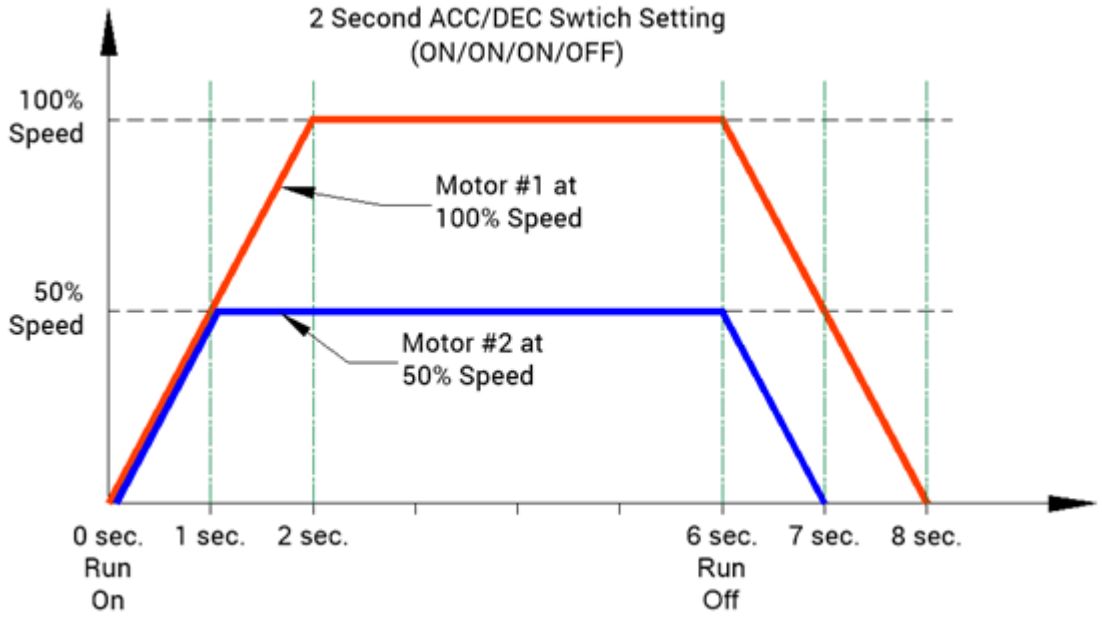
The following chart shows the 16 possible ACC/DEC DIP switch settings for ***G force ramp*** and the expected ramp ***time*** to reach full speed (when accelerating) or to stop (when decelerating) when the motor speed is set to ***maximum*** (Switch setting item 32 from the Speed DIP Switch chart).

Accel/Decel Times when SPEED setting is 100% maximum				
SW 7	**SW 8**	**SW 9**	**SW 10**	**Accel/ Decel Time (sec)**
OFF	OFF	OFF	OFF	0.050
OFF	OFF	OFF	**ON**	0.100
OFF	OFF	**ON**	OFF	0.200
OFF	OFF	**ON**	**ON**	0.300
OFF	**ON**	OFF	OFF	0.400

OFF	**ON**	OFF	**ON**	0.500
OFF	**ON**	**ON**	OFF	0.600
OFF	**ON**	**ON**	**ON**	0.700
ON	OFF	OFF	OFF	0.800
ON	OFF	OFF	**ON**	1.000
ON	OFF	**ON**	OFF	1.200
ON	OFF	**ON**	**ON**	1.400
ON	**ON**	OFF	OFF	1.600
ON	**ON**	OFF	**ON**	1.800
ON	**ON**	**ON**	OFF	2.000
ON	**ON**	**ON**	**ON**	2.500

Example with Graph

We have 2 motors, Motor #1 speed is set to 100% maximum RPM and Motor #2 speed is set to 50% speed. If we set the ACC/DEC DIP Switches 4 thru 1 to ON, ON ,ON, OFF we can see from the chart that we should have a 2.000 second acceleration time and a 2.00 deceleration time when our speed is set to 100% maximum. Because the Accel/Decel ramps are the same, if our speed is at 50% of maximum, then our acceleration and deceleration times would be 1/2 of maximum, thus 1.000 seconds for each. In our example, we start both motors at the same time and let them run for 6 seconds and then stop both at the same time. This is shown in the following graph:



5.3.1. Accel/Decel Time Formula

To find the Acceleration/Deceleration times for speed settings other than 100%, the following simple formula can be used to calculate the value:

$$T = \left(\frac{Speed}{Max\ RPM}\right) \times T_{Max}$$

Where:
- *T* = New Ramp Up/Down time
- *Speed* = New Speed in RPM from Speed switches 1 thru 5
- *Max RPM* = 5800
- *TMax* = Time value from Accel/Decel chart

Example

For example, let's say we have selected the Speed DIP switches for the 4000 RPM setting:

Speed switches 1 thru 5 = ***ON/OFF/OFF/OFF/ON***

And we have selected Accel/Decel switches for the 1.200 second setting:

Accel/Decel switches 7 thru 10 = ***ON/OFF/ON/OFF***

The calculated time will be:

$$T = \left(\frac{4000}{5800}\right) \times 1.2 = 0.828\ sec$$

6. Operation

The combination of signals on the ***Run A*** and ***Run B*** terminals allows you to dynamically set the speed with your digital run signals to the E-Qube module. The following chart lists the signal states and their respective speed control:

Run A	Run B	Description
ON	OFF	Start motor and run at 100% of the speed selected on DIP Switches 1 thru 5
ON	**ON**	Start motor and run at 75% of the speed selected on DIP Switches 1 thru 5
OFF	**ON**	Start motor and run at 50% of the speed selected on DIP Switches 1 thru 5
OFF	OFF	Stop motor

7. Output Signals & LED Indicators

ERROR Signal

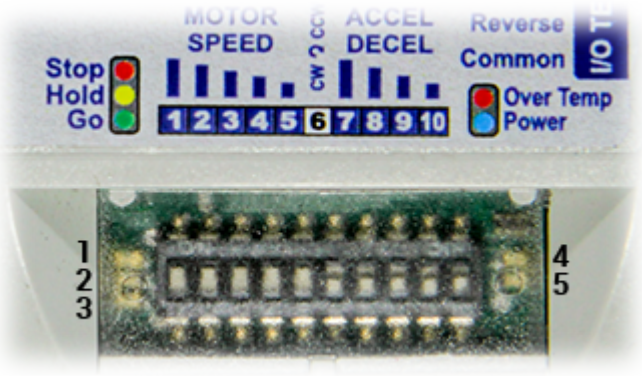
The ***ERROR*** signal is a digital output that is used in conjunction with the ***LED Status Indicators*** to display specific conditions of the module. In general, when any one of several error conditions is active, the ***ERROR*** signal will be ON. If no error condition exists, then the ***ERROR*** signal will be OFF

How to Wire the ***ERROR*** signal for a PNP type E-Qube
How to Wire the ***ERROR*** signal for a NPN type E-Qube

Error Output and LED Status

7.1. Error Output and LED Status

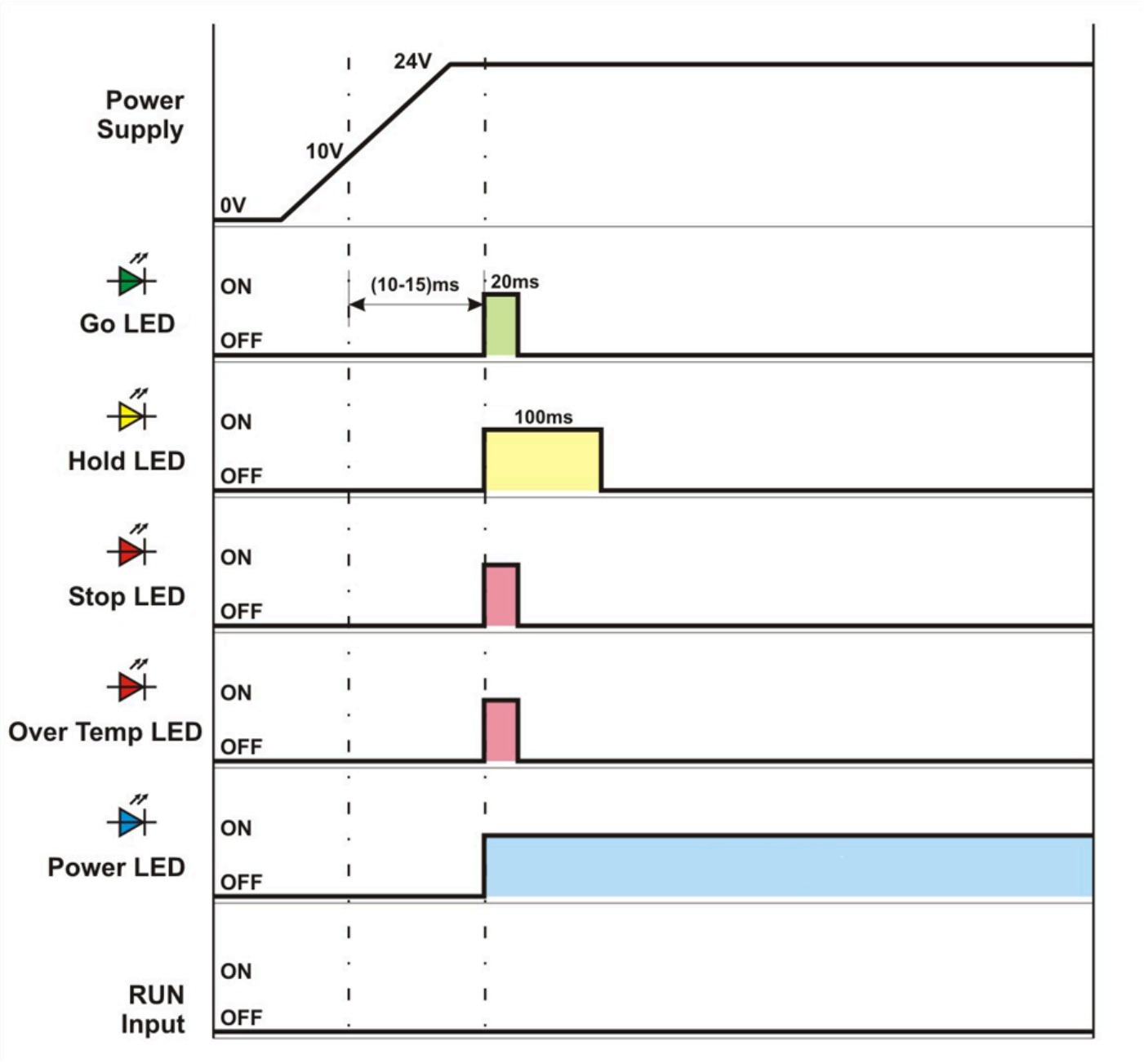
LED Status Indicators



Item	LED	LED State	Description
5	**Power**	ON at normal brightness	Input power is between 18V and 31V
		FLASH at 0.1s interval	Input power is below 18V
		ON at high brightness	Input voltage is greater than 31V
3	**Go**	Flashing	RUN signal(s) are on and flash rate is proportional to motor speed
2	**Hold**	ON	Current is being limited to motor
		Flash & Blink	See Timing Diagrams in the following sections
4	**Over-Temp**	ON	Calculated motor temperature is above 105˚C
1	**Stop**	0.2s Flash at 0.4 sec interval	Motor roller is disconnected
		Flash at 1.0 s interval	Controller has stopped the motor due to error condition
		Other flash rates	See Timing Diagrams in the following sections

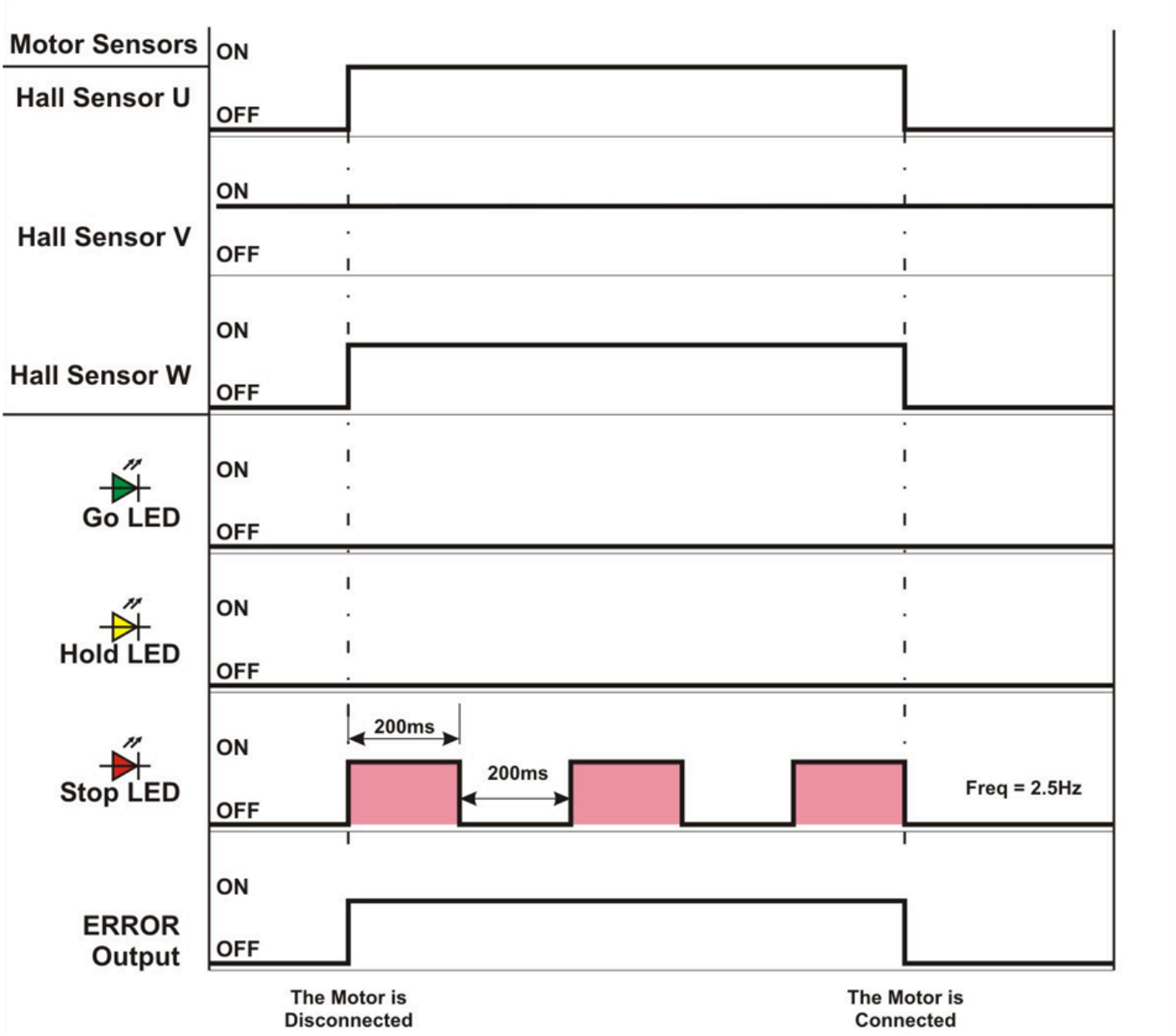
LED Status Timing Diagrams for Various Conditions

7.1.1. Power Supply ON with Motor Connected

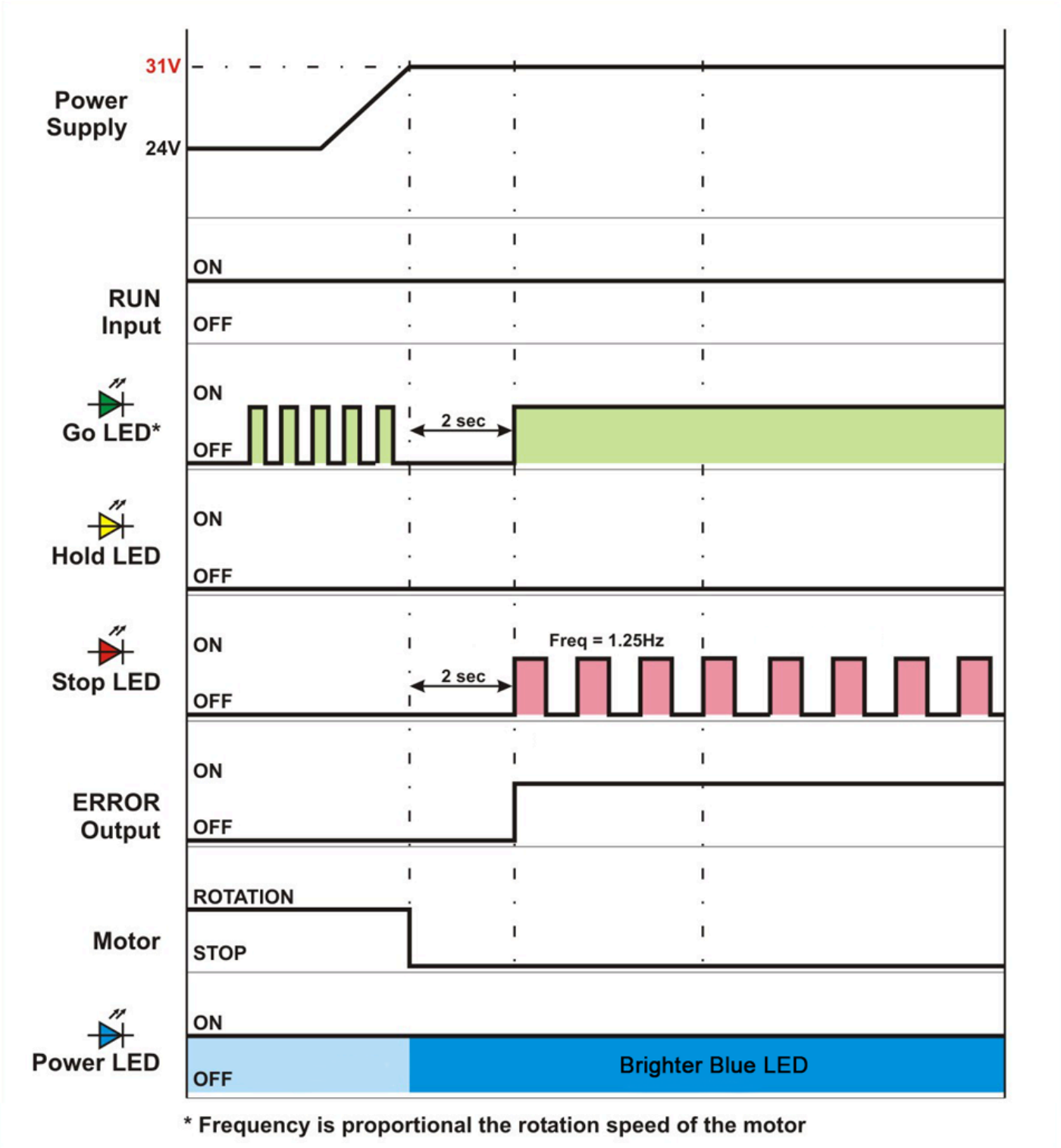


7.1.2. Motor Not Connected

When the CPU sees that all Hall Effect signals are logically on, it means that the motor is not connected

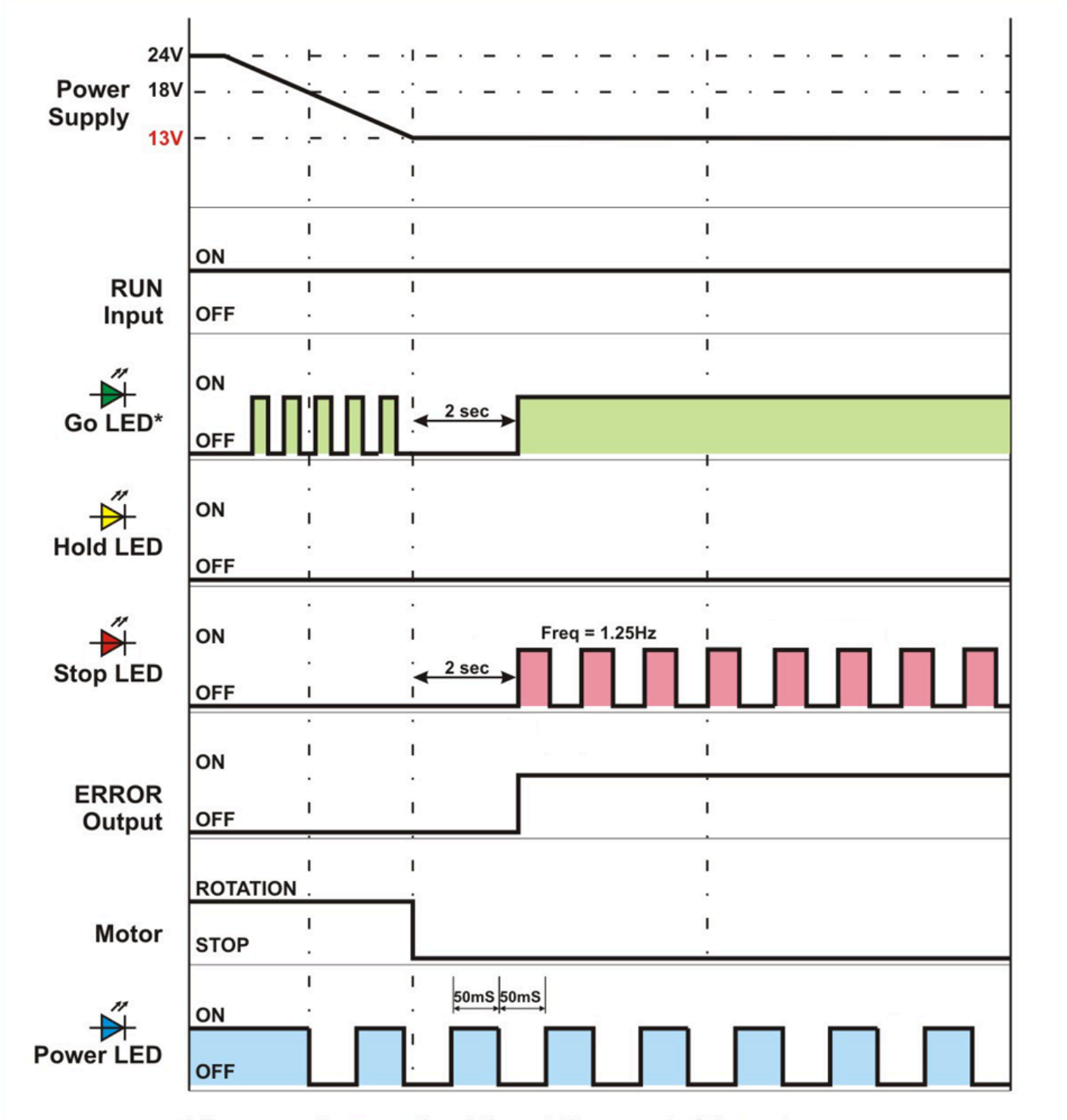


7.1.3. Power Supply Voltage > 32V



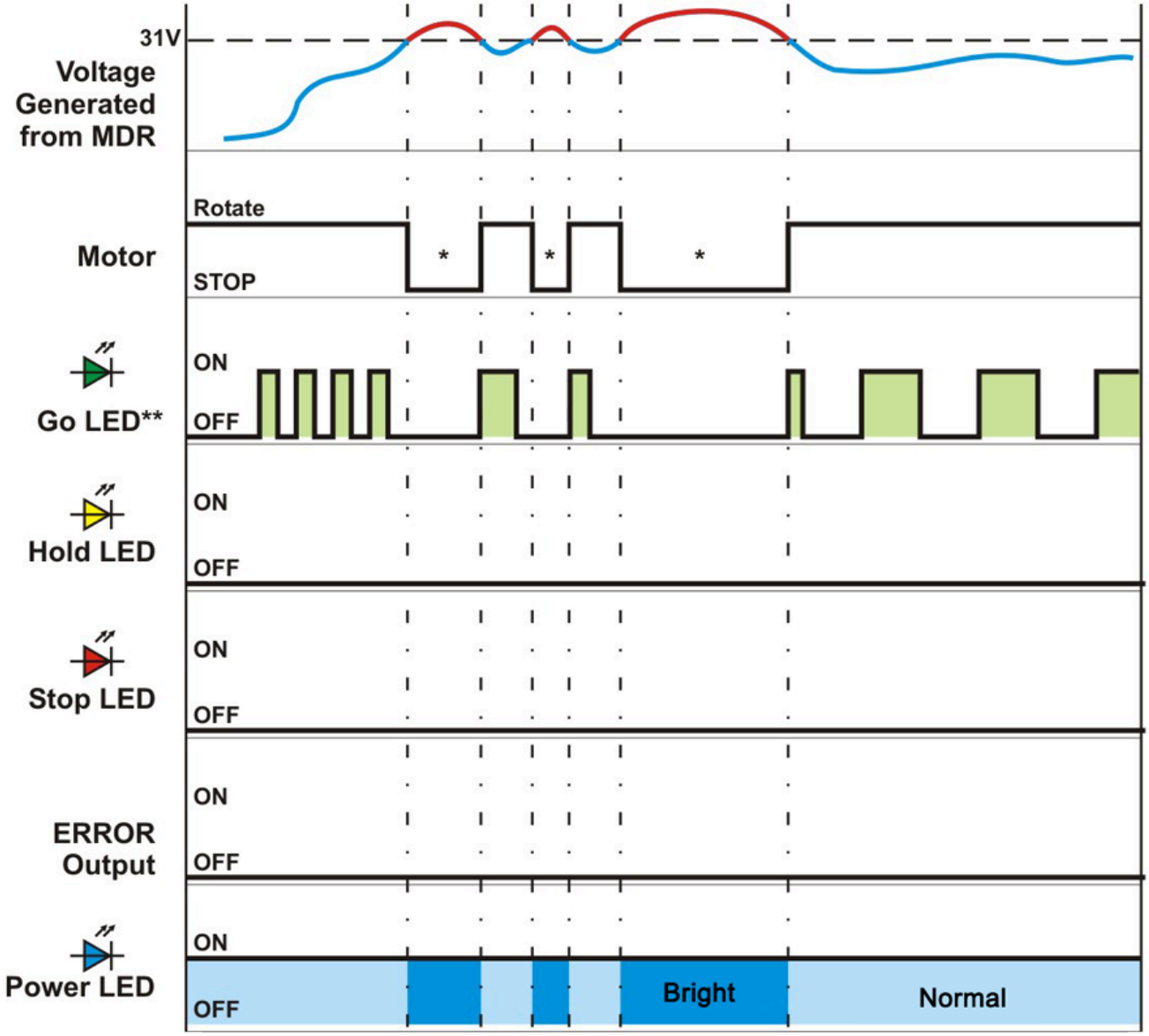
* Frequency is proportional the rotation speed of the motor

7.1.4. Voltage Drop Below 18V and Voltage Drop Below 13V



* Frequency is proportional the rotation speed of the motor

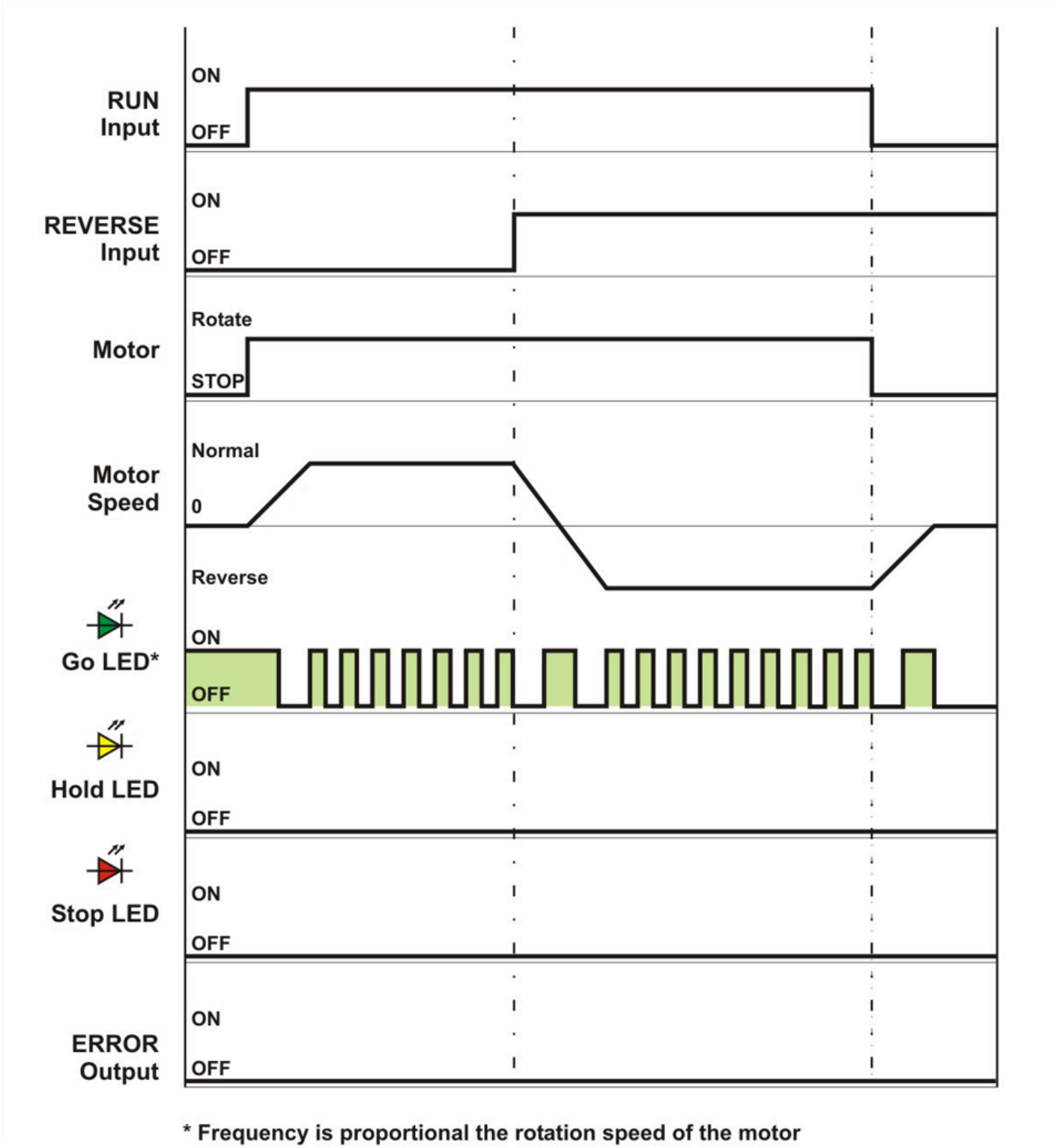
7.1.5. Voltage Over 32V Due to Motor Overspeed



* EQUBE absorbs extra energy generated by the motor

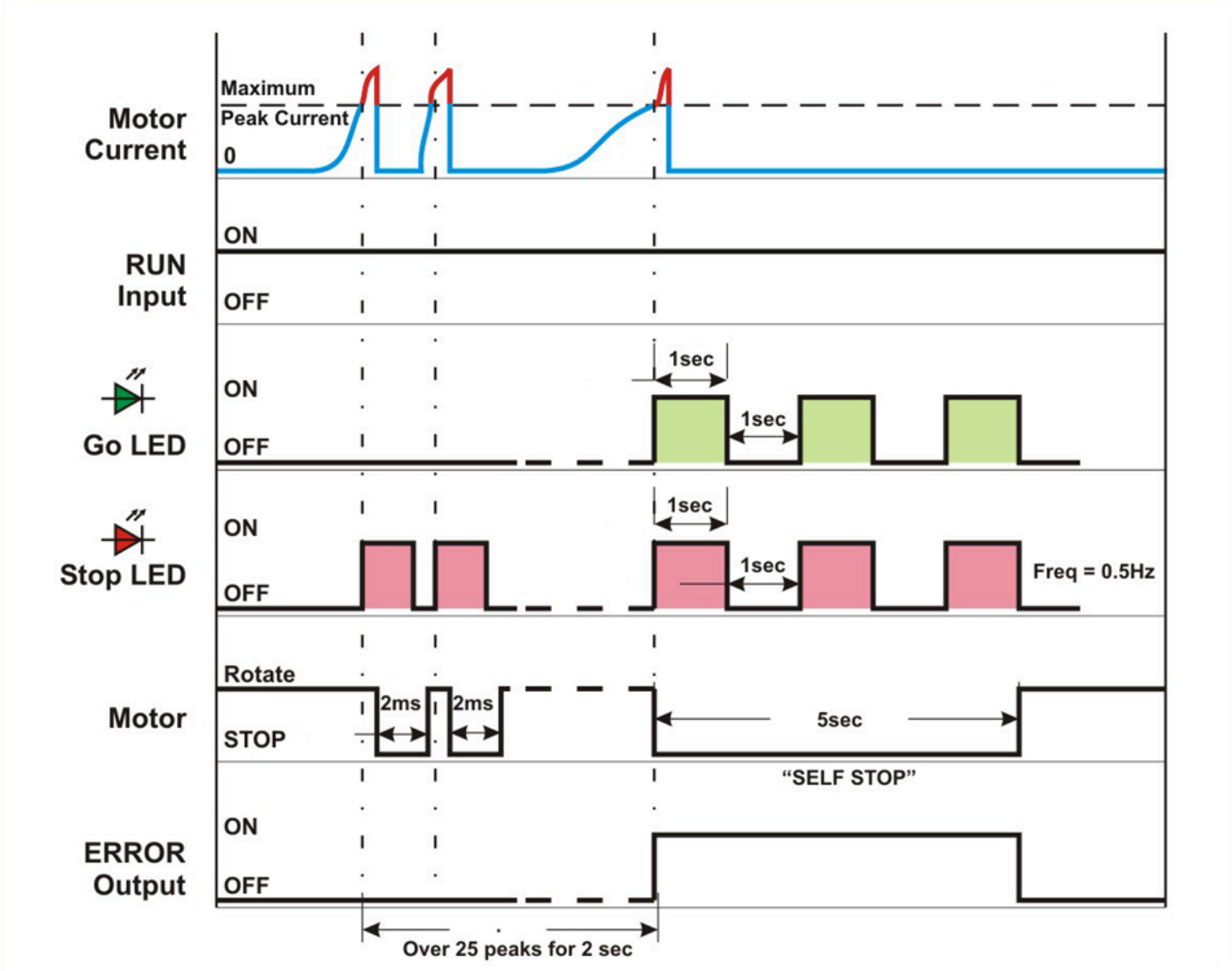
** Frequency is proportional the rotation speed of the motor

7.1.6. Normal Operation with Motor Running then Reverse Signal

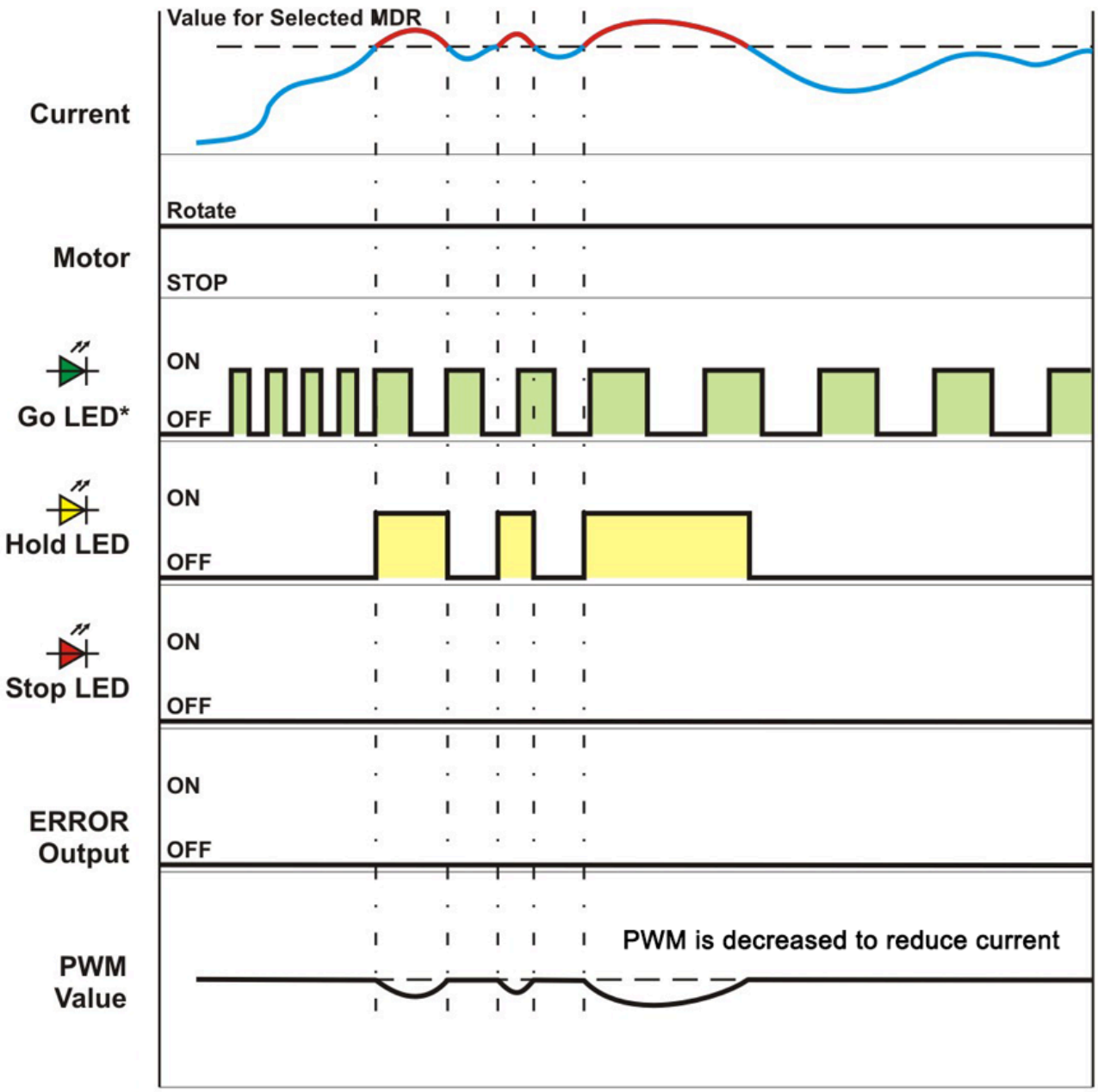


* Frequency is proportional the rotation speed of the motor

7.1.7. Motor Current Exceeding Peak Limit

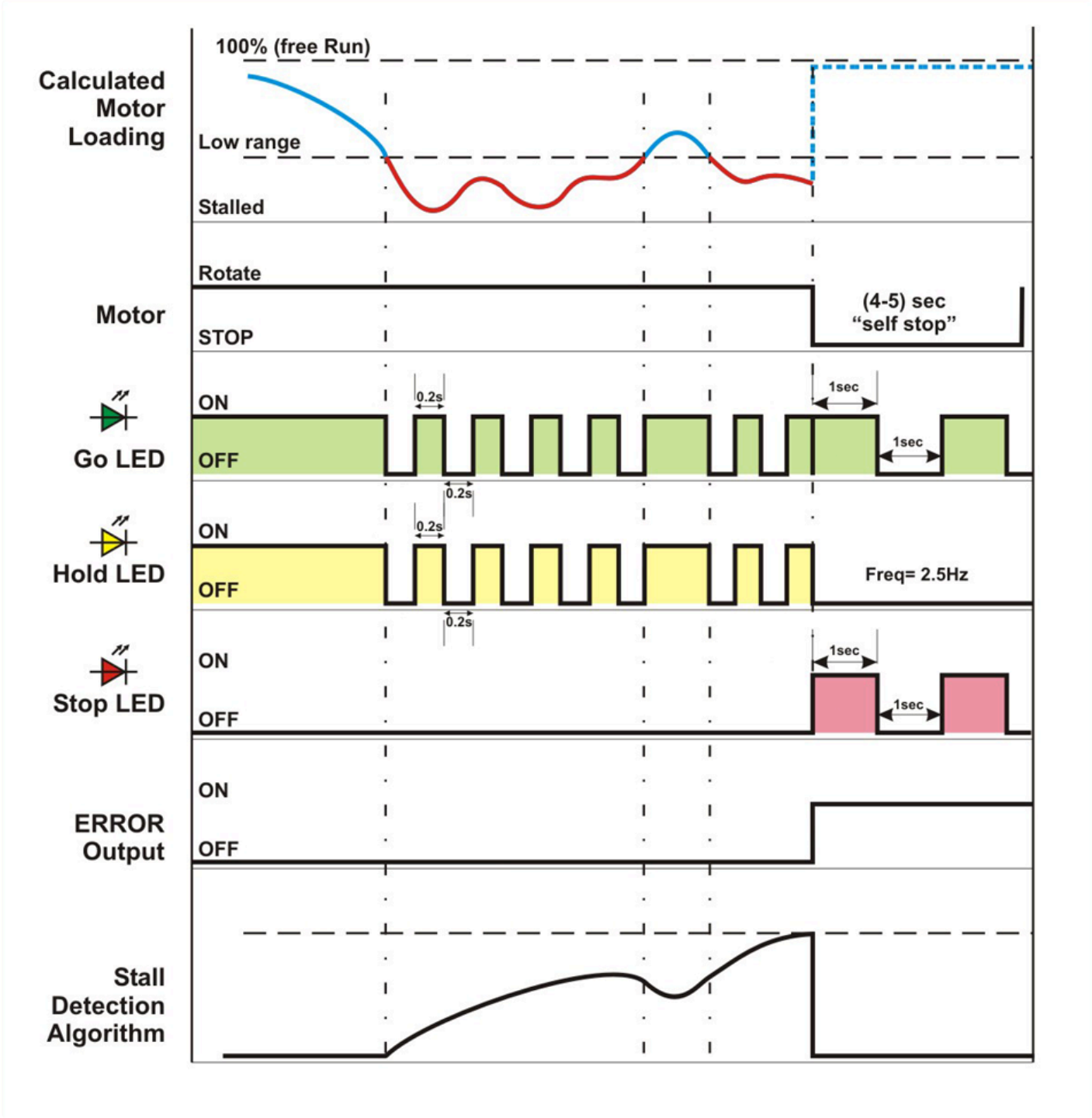


7.1.8. Over Current with PWM Limiting



* Frequency is proportional the rotation speed of the motor

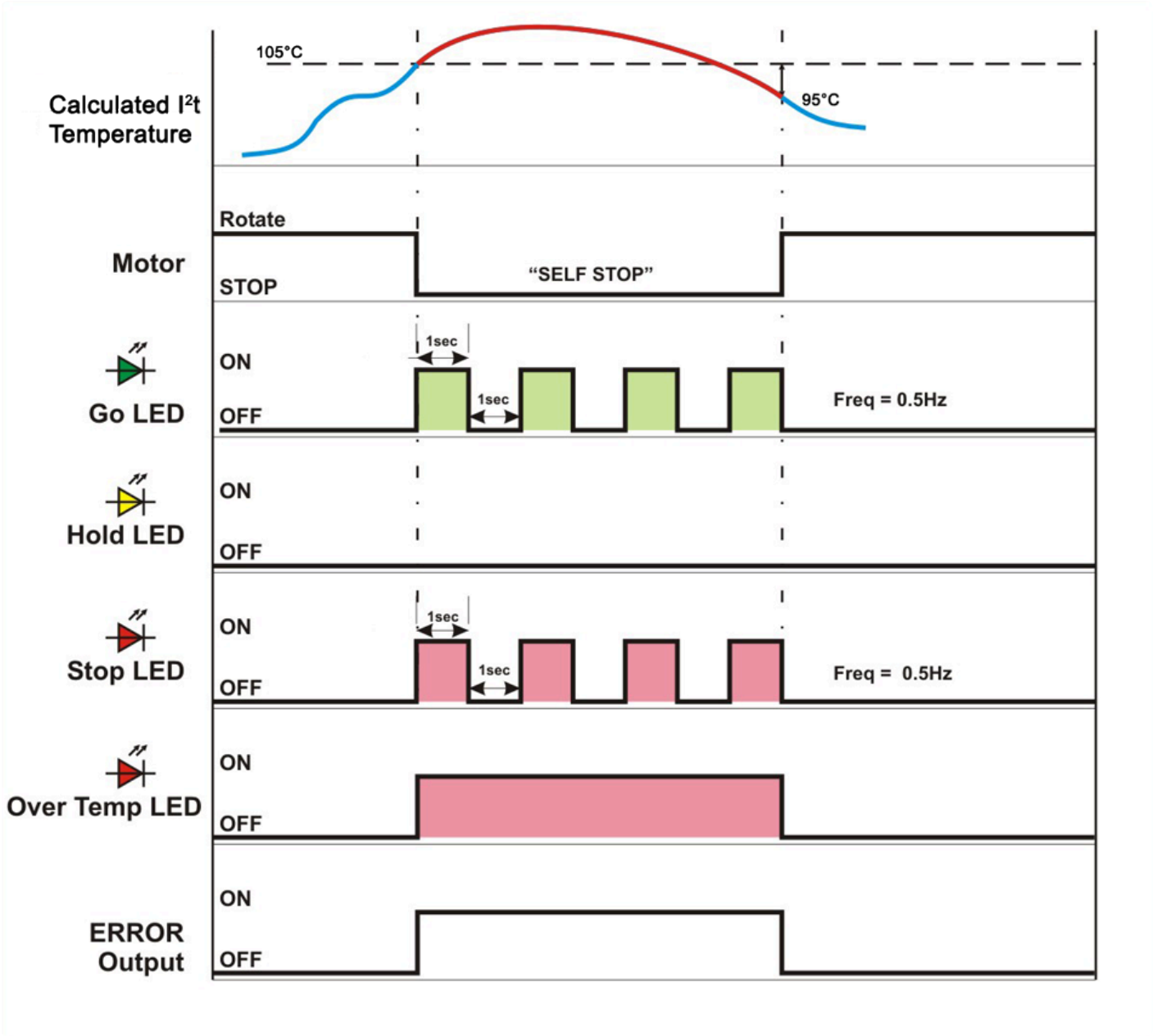
7.1.9. Motor Stalled with Self Stop



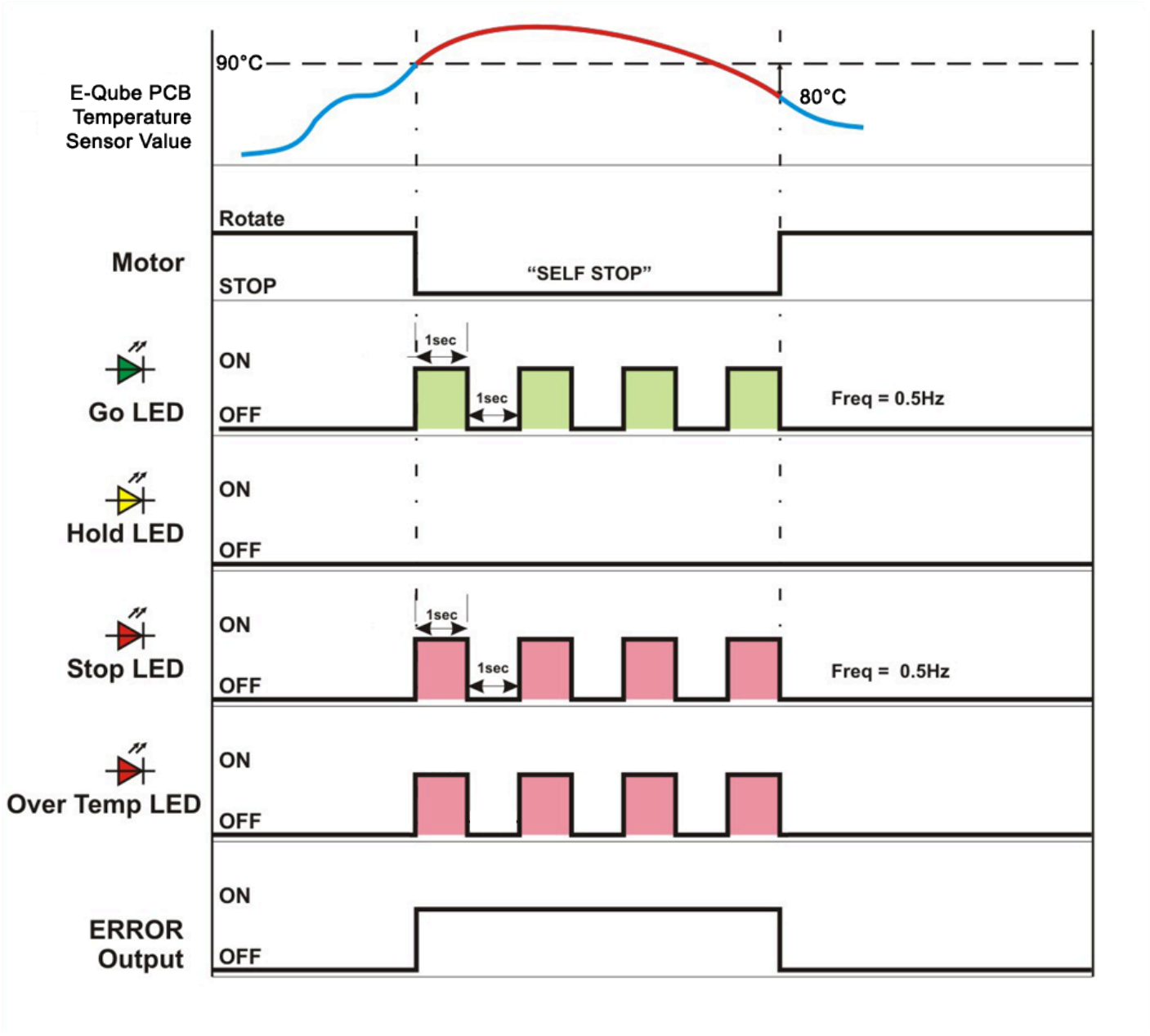
7.1.10. Motor Overload with Self Stop

When the calculated motor temperature reaches **105°C**, the motor enters a ***Self Stop Period***. This period lasts until the calculated temperature reaches **95°C** and maintains this for 5 seconds after which the motor will restart.

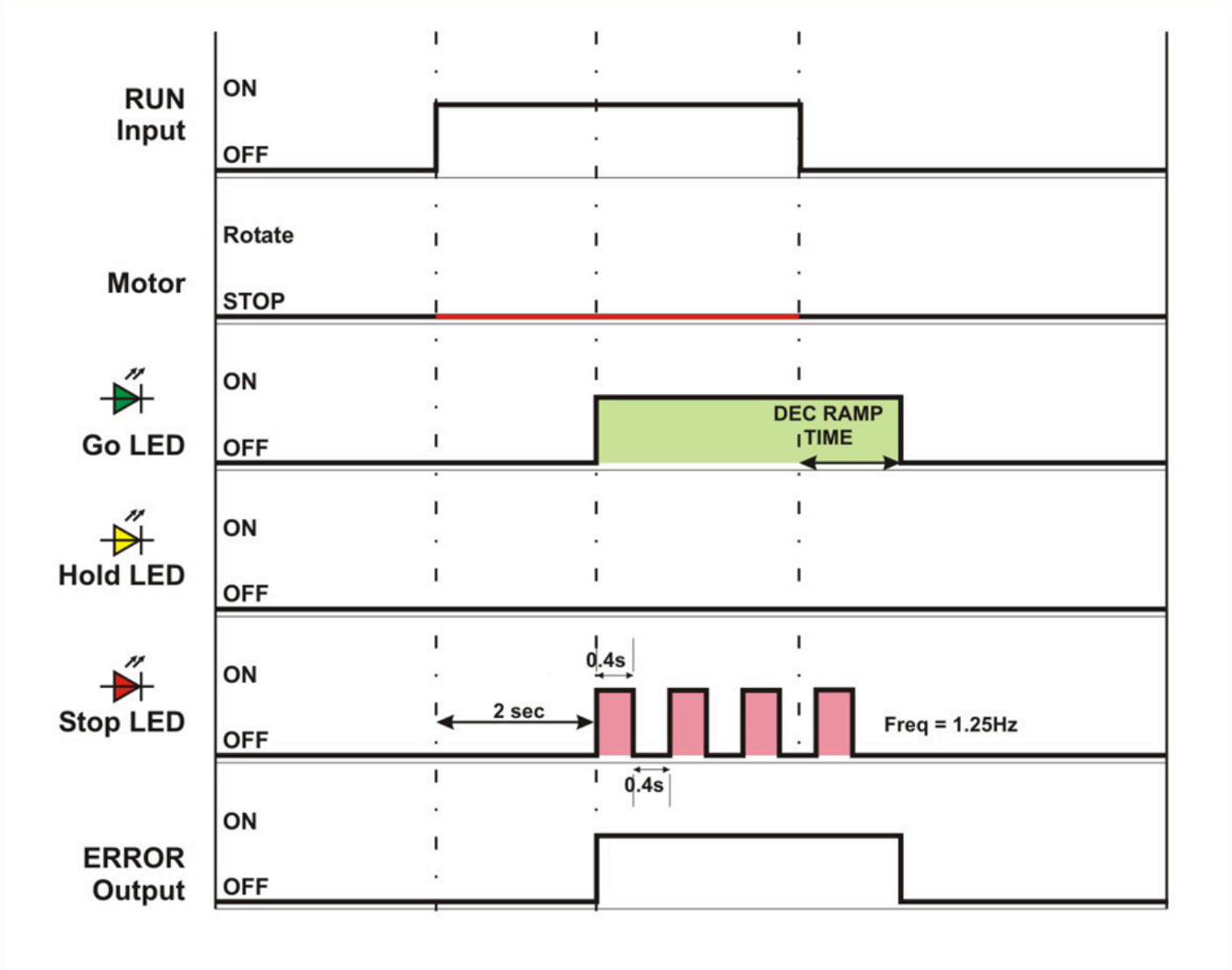
> ✻ The Self Stop Period duration is dependent upon the amount of current given to the motor over time and is not a fixed time value. A typical Self Stop Period is approximately 1 minute.



7.1.11. Module Over Heat with Self Stop



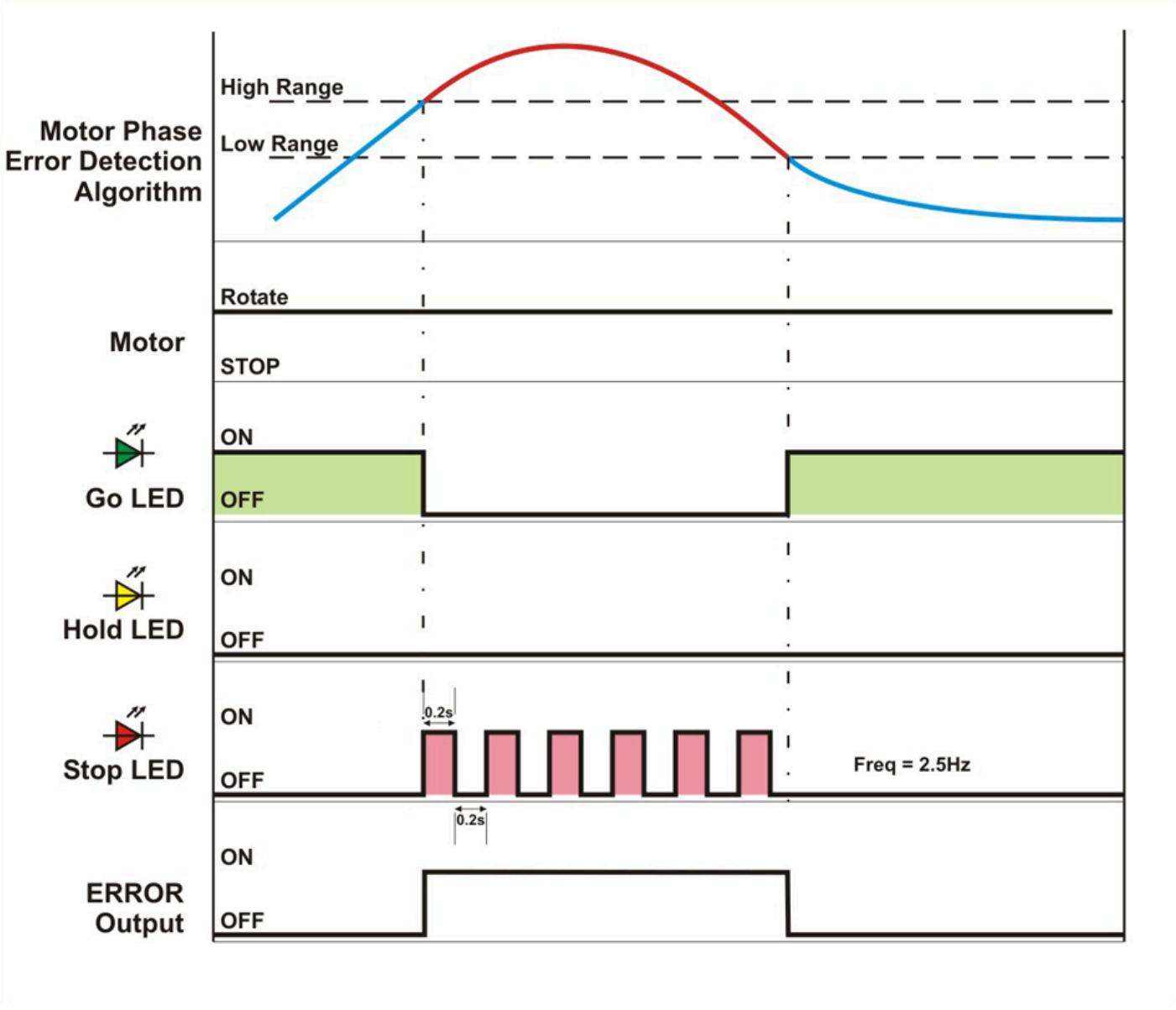
7.1.12. Motor Not Running when RUN is ON



7.1.13. Motor Phases Error Detected

The Motor Phase Detection Algorithm analyzes the Hall Effect sensor inputs into the CPU and looks for invalid and out of sequence logical states. These conditions are typically the result of a Hall Effect sensor failure or short/open circuit within the sensor circuit's cabling or connections.

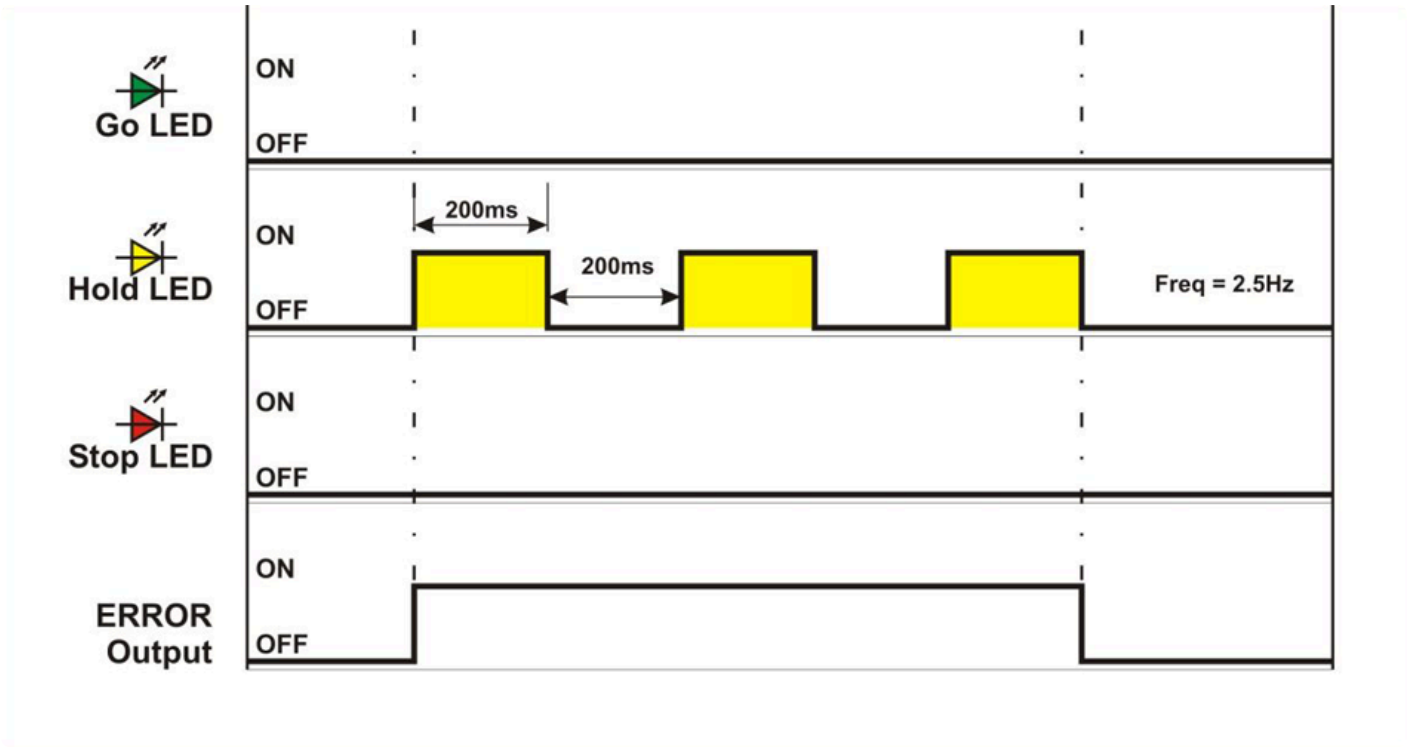
> ✻ If the Motor Phase Detection Algorithm detects an out of range condition for more than 10 seconds, the motor will stop.



7.1.14. Motor/Module Data Mismatch

This condition is only valid for:

E-QUBE-Ai-P – Article Number 1321-6000
E-QUBE-Ai-N – Article Number 1321-5000



7.1.15. Motor Data Missing

This condition is only valid for:

E-QUBE-Ai-P – Article Number 1321-6000
E-QUBE-Ai-N – Article Number 1321-5000