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Revision History

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Rev.** |  | **Date** |  | **Initials** |  | **Description** |
| 0.1 |  | 06-Jun-2019 |  | KW |  | First Draft |
| 0.2 |  | 17-Jun-2019 |  | KW |  | Changed Serial Number Command from 15 to 10 |
| 0.3 |  | 26-Jun-2019 |  | KW |  | Moved the Motor Table and Serial Number Commands from the DII RS485 Accessory Protocol specification |
| 0.4 |  | 03-Jul-2019 |  | KW |  | Added more info for Not Supported Command Requests |
| 0.5 |  | 10-Sep-2019 |  | KW |  | Corrected Program Page Timeout from 400ms to 500ms to reflect code |
| A |  | 26-Sep-2019 |  | DAT |  | Updated to Revision A |

Glossary

MDU – Motor Drive Unit

NAK – Negative Acknowledgement

References

15000286 – DYONICS II RS485 Accessory Protocol

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# Overview

This document details the Reliant MDU commands and data of the DYONICS II RS485 Accessory Protocol (15000286) used in communication to the DYONICS POWER II System Controller.

# Protocol Elements

## Command Requests and Responses

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Command Request** | **Value** | **Encoded byte sent by Master: P E4 E2 E1 <Cmd>** | **Response bits 9-0** | **Max Response Times** |
| Software Version1 | 0 | 0000 0000 (0x00) | Bits 9-8: Major (x.y.z format)  Bits 7-4: Minor  Bits 3-0: Build (see 2.1.1 below) | 3ms |
| Accessory ID1 | 1 | 1011 0001 (0xB1) | Accessory ID (see 2.1.2 below) | 3ms |
| Blade ID MDU Idle | 2 | 1101 0010 (0xD2) | Blade ID ( see 2.1.3 below) | 3ms |
| Blade ID MDU Running | 3 | 0110 0011 (0x63) | Blade ID ( see 2.1.3 below) | 3ms |
| Button State | 4 | 1110 0100 (0xE4) | Button State ( see 2.1.4 below) | 3ms |
| Not Supported2 | 5 | 0101 0101 (0x55) | Not Supported2 | 3ms |
| Not Supported2 | 6 | 0011 0110 (0x36) | Not Supported2 | 3ms |
| Not Supported2 | 7 | 1000 0111 (0x87) | Not Supported2 | 3ms |
| Not Supported2 | 8 | 0111 1000 (0x78) | Not Supported2 | 3ms |
| Not Supported2 | 9 | 1100 1001 (0xC9) | Not Supported2 | 3ms |
| Serial Number | 10 | 1010 1010 (0xAA) | Serial Number (see 2.1.7 below) | 10ms |
| Software Update Start1 | 11 | 0001 1011 (0x1B) | Software Update (see 2.1.5 below) | 3ms |
| Program Page1 | 12 | 1001 1100 (0x9C) | Bits 9-0:  Zero (see 2.1.5 below) | 500ms |
| Reset1 | 13 | 0010 1101 (0x2D) | Bits 9-0:  Zero (see 2.1.5 below) | 3ms |
| Motor Table | 14 | 0100 1110 (0x4E) | Motor Table (see 2.1.6 below) | 10ms |
| Not Supported2 | 15 | 1111 1111 (0xFF) | Not Supported2 | 3ms |

1Command Request defined in the 15000286 DII RS485 Accessory Protocol, device specific details provided in this document.

2Not Supported – The Reliant will respond with a NAK (Bits 15-0: Zero).

### Software Version

The Reliant MDU returns the current software version in response to the Software Version Command Request (Command Value 0).

### Accessory ID

The Reliant MDU returns either the value 3 (if there are hand controls) or the value 4 (if there are not any hand controls) in response to the Accessory ID Command Request (Command Value 1).

### Blade ID

The DYONICS POWER II will send two different commands to the Reliant MDU in to get the current Blade ID:

* The DYONCIS POWER II sends Accessory Specific Command 2 when the Reliant MDU is Idle.
* The DYONCIS POWER II sends Accessory Specific Command 3 when the Reliant MDU is Active.

This allows the Reliant MDU to keep track of the motor optional time while providing current Blade ID information to the DYONICS POWER II.

The Reliant MDU supports blades that have up two different magnets that can be either North or South facing. This allows up to nine possible Blade Codes as defined by the following table:

|  |  |  |
| --- | --- | --- |
| Blade Code | Magnet Code\* | Blade Max Speed  (RPM) |
| 0 | 00 | 5000 |
| 1 | S0 | 3000 |
| 2 | 0S | 8000 |
| 3 | SS | 10000 |
| 4 | 0N | Reserved |
| 5 | N0 | Reserved |
| 6 | NN | Reserved |
| 7 | NS | Reserved |
| 8 | SN | Reserved |

\* Magnet Code is the LR (Left-Right) magnet slot of the blade looking from the cord side of the MDU where:

* N - North facing magnet
* S - South facing magnet
* 0 – No magnet

### Button State

The Reliant MDU returns the current state of the three buttons in response to Accessory Specific Command 4. For Reliant MDUs that do not have hand control buttons the response is a zero. For Reliant MDUs that have hand control button the current button state is return as logical OR of each button according the following table:

|  |  |  |  |
| --- | --- | --- | --- |
| Button | | | |
| Bit | Value | Orientation\* | Function |
| 0 | 1 | Middle | Oscillate Pressed |
| 1 | 2 | Left | Reverse Pressed |
| 2 | 4 | Right | Forward Pressed |

\* Looking from the cord side of the Reliant MDU

### Software Update

The Reliant MDU supports Software Update Start (Command Value 11), Program Page (Command Value 12) and the Reset (Command Value 13) commands used for MDU Software Upgrades over the DYONICS II RS485 Accessory Protocol.

The Reliant MDU Software Upgrade FLASH area is 0x4000 to 0x6FFF.

### Motor Table

The Reliant MDU responds to the Motor Table Command Request (Command Value 14) by returning data required by the Motor Controller in order to drive the Reliant MDU motor:

|  |  |
| --- | --- |
| 34 Bytes of Reliant Motor Table Data | CRC Byte |

In order to keep the Reliant Motor Table data small, floating point values are represented in a 16 bit fixed format consisting of 12 bits (B0-B11) of base number (values of 0-4095) with 4 bits (B12-B15) of negative exponent (values of 0-15).

For example: The floating point value of 0.000456 or 4.56E-4 is represented by a base value 456 and a negative exponent of 6 which will appear as 0x61C8.

The Reliant Motor Table Data consists of the following:

|  |  |  |  |
| --- | --- | --- | --- |
| **Field Name** | **Bytes** | **Description** | **Detail** |
| wTacPerRevN | 2 | Numerator for TacsPerRev | B0:B15 **TacsPerRev Numerator** |
| bTacPerRevD | 1 | Denominator for TacsPerRev | B0:B7 **TacsPerRev Denominator** |
| bConfig | 1 | Configuration | B0 **FET Current Flow (Top\_Bottom)** 0 – [ A\_C, B\_A, B\_C, C\_B, A\_B, C\_A ], 1 – [ C\_A, A\_B, C\_B, B\_C, B\_A, A\_C ]  B1 **Hall Sequence** 0 – [ 5, 1, 3, 2, 6, 4 ], 1 – [ 4, 6, 2, 3, 1, 5 ]  B2 **Velocity Acceleration Coefficient** 0 – fKa set to 0.0f, 1 – fKa set to 1.0f  B3 **Stop Time** 0 – fStopTime set to 0.25f, 1 – fStopTime set to 0.5f  B4:B7 **Reserved (Set to Zero)** |
| wAccDecel | 2 | Output acceleration/deceleration in rpm/sec | B0:B15 **Acceleration / Deceleration** |
| wResistance | 2 | Total resistance (motor + cable) in ohms | B0:B11 **Float Value Base** B12:B15 **Float Value Negative Exponent** |
| wAccCvrt | 2 | Converts armature acceleration to amps (pi/30\*j\*grbx/kt) | B0:B11 **Float Value Base** B12:B15 **Float Value Negative Exponent** |
| wVelMax | 2 | Maximum allowable velocity command | B0:B15 **Maximum Velocity** |
| bLoopPeriod | 1 | PID timer interrupt interval in milliseconds | B0:B7 **PID Loop Period** |
| bPWMFreq | 1 | PWM frequency in kHz | B0:B7 **PWM frequency** |
| wVelKp | 2 | Velocity Proportional coefficient | B0:B11 **Float Value Base** B12:B15 **Float Value Negative Exponent** |
| wVelKi | 2 | Velocity Integral coefficient | B0:B11 **Float Value Base** B12:B15 **Float Value Negative Exponent** |
| wVelKd | 2 | Velocity Derivative coefficient | B0:B11 **Float Value Base** B12:B15 **Float Value Negative Exponent** |
| wPosKp | 2 | Position Proportional coefficient | B0:B11 **Float Value Base** B12:B15 **Float Value Negative Exponent** |
| wPosKi | 2 | Position Proportional coefficient | B0:B11 **Float Value Base** B12:B15 **Float Value Negative Exponent** |
| wPosKd | 2 | Position Derivative coefficient | B0:B11 **Float Value Base** B12:B15 **Float Value Negative Exponent** |
| wTlimA | 2 | Linear torque limit coefficient | B0:B11 **Float Value Base** B12:B15 **Float Value Negative Exponent** |
| wTlimB | 2 | Torque limit offset (PWM) | B0:B15 **Torque Limit Offset** |
| wIlim | 2 | Current limit (amp) | B0:B11 **Float Value Base** B12:B15 **Float Value Negative Exponent** |
| wIhigh | 2 | High current value (75% EIP measured stall current) | B0:B11 **Float Value Base** B12:B15 **Float Value Negative Exponent** |

The total size of the Reliant Motor Table Command Request is 34 bytes.

The CRC Byte is calculated as an 8 bit CRC of all the Motor Table Data. (See the CRC Byte section in the 15000286 DII RS485 Accessory Protocol for details on calculating the CRC Byte).

Once the Reliant Motor Table Data is received and verified by the Motor Controller it is then expanded internally to the Motor Controller BLDC data format used by the DYONICS POWER II:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Reliant Motor Table Data**  **(Sent from Reliant MDU)** | | | |  | **Motor Controller BLDC data**  **(Expanded from Reliant Motor Table Data)** | | | |
| **Field Name** | **Bytes** | **Value** | | **Field Name** | **Bytes** | **Value** | **Notes** |
| **Hex** | **Dec** |
| wTacPerRevN | 2 | 0x001e | 30 | wTacPerRevN | 2 | 30 |  |
| bTacPerRevD | 1 | 0x01 | 1 | wTacPerRevD | 2 | 1 |  |
| bConfig | 1 | 0x04 | 4 | wFCommTable[8] | 16 | [ A\_C, B\_A, B\_C, C\_B, A\_B, C\_A ] | bConfig:B0 |
| wRCommTable[8] | 16 | [ C\_A, A\_B, C\_B, B\_C, B\_A, A\_C ] | bConfig:B0 |
| wFDirTable[8] | 16 | [ 5, 1, 3, 2, 6, 4 ] | bConfig:B1 |
| wRDirTable[8] | 16 | [ 4, 6, 2, 3, 1, 5 ] | bConfigB1 |
| tKVel.fKa | 4 | 1.0 | bConfig:B2 |
| fStopTime | 4 | 0.25 | bConfig:B3 |
| wAccDecel | 2 | 0xea60 | 60000 | fAccel | 4 | 60000.0 | Same as wAccDecel |
| fDecel | 4 | -60000.0 | Negative of wAccDecel |
| wResistance | 2 | 0x2083 | 1.31 | fResistance | 4 | 1.31 |  |
| wAccCvrt | 2 | 0x7052 | 8.2E-6 | fAccCvrt | 4 | 8.2E-6 |  |
| wVelMax | 2 | 0x2710 | 10000 | sVelMax | 2 | 10000 |  |
| bLoopPeriod | 1 | 0x05 | 5 | fLoopRate | 4 | 5E-3f | bLoopPeriod \* 0.001 |
| bPWMFreq | 1 | 0x19 | 25 | fPWMFreq | 4 | 25.0 |  |
| wVelKp | 2 | 0x2005 | 0.05 | tKVel.fKp | 4 | 0.05 |  |
| wVelKi | 2 | 0x2005 | 0.05 | tKVel.fKi | 4 | 0.05 |  |
| wVelKd | 2 | 0x2005 | 0.05 | tKVel.fKd | 4 | 0.05 |  |
| wPosKp | 2 | 0x0019 | 25.0 | tKPos.fKp | 4 | 25.0 |  |
| wPosKi | 2 | 0x1019 | 2.5 | tKPos.fKi | 4 | 2.5 |  |
| wPosKd | 2 | 0x1005 | 0.5 | tKPos.fKd | 4 | 0.5 |  |
| wTlimA | 2 | 0x4271 | 6.25E-2 | fTlimA | 4 | 6.25E-2 |  |
| wTlimB | 2 | 0x0352 | 850 | wTlimB | 2 | 850 |  |
| wIlim | 2 | 0x0014 | 20.0 | fIlim | 4 | 20.0 |  |
| wIhigh | 2 | 0x104b | 7.5 | fIhigh | 4 | 7.5 |  |

As part of the expansion process, the following fields of the Motor Controller BLDC data are set to constant values:

|  |  |  |  |
| --- | --- | --- | --- |
| **Motor Controller BLDC data**  **(Set to constant values)** | | | |
| **Field Name** | **Bytes** | **Value** | **Notes** |
| tKVel.Kf | 4 | 0.0 | Coefficient not used |
| tKVel.fKl | 4 | 0.0 | Coefficient not used |
| tKPos.Kf | 4 | 0.0 | Coefficient not used |
| tKPos.fKa | 4 | 0.0 | Coefficient not used |
| tKPos.fKl | 4 | 0.0 | Coefficient not used |
| fFrpmA | 4 | 0.0 | Feed forward not used |
| wFrpmB | 2 | 0.0 | Feed forward not used |
| wMode | 2 | 0 | Always set to same initial value |
| sVelSet | 2 | 1000 | Always set to same initial value |
| wDwell | 2 | 80 | Always set to same initial value |
| fCycleTime | 4 | 0.1 | Always set to same initial value |
| wProfileCmd | 2 | 0x3000 | Always set to same initial value |
| wAssert | 2 | 0 | Always set to same initial value |
| wFault | 2 | 0 | Always set to same initial value |

### Serial Number

The Reliant MDU responds to a Serial Number Command Request (Command Value 10) by sending the handpiece serial number string, (10 character alphanumeric serial number followed by a null character for a total of 11 bytes) and a CRC Byte to the device to the controller.

|  |  |
| --- | --- |
| 11 Byte Serial Number String | CRC Byte |

The CRC Byte is calculated as an 8 bit CRC of the 11 Byte Serial Number String. (See the CRC Byte section in the 15000286 DII RS485 Accessory Protocol for details on calculating the CRC Byte).

The Reliant MDU will first attempt to return the Serial Number String stored by manufacturing in the Reliant internal FLASH area 0x7000 to 0x707F if it is valid. If a valid serial number string cannot be found in the FLASH the Reliant MDU will return the string “AAZ12345" in response instead.

NOTE: Future versions of the Reliant MDU will return an empty (zero filled) response rather than the string “AAZ12345", if a valid serial number string cannot be found in the FLASH.