Product Guide: PRDCTLMBxB

PRDCTLMB2B, PRDCTLMB6B

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Table of Contents

1 Introduction

The **PRDCTLMB2B and PRDCTLMB6B** from Protagd offer an alternative to the corresponding control modules from Texas Instruments. They are 100% drop-in compatible and deliver the same functions and performance:

Same mounting hole patterns and size
7 – 24V supply
Same controller card connectors
Same option jumpers are available

The control modules come in two variants:

PRDCTLMB2B is a control module with RS-232 interface
PRDCTLMB6B is a control module with RS-422/485 interface

Both modules contain firmware S2000, revision 1.5.

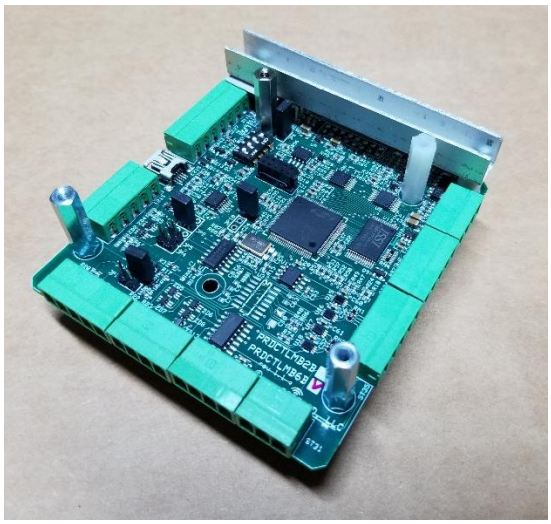

Figure 1.1 PRDCTLMB6B Control Module

1.1 Product Description

The control module acts as the interface between a Radio Frequency Module (RFM) and a controlling host. It controls the transmit and receive functions of the RFM according to the commands from the host to send signals and to receive data from a transponder. It decodes the received RFM signals, checks the validity, and handles the protocol conversion to a standard serial interface.

There are two communications protocols available:

- TIRIS Bus Protocol (TBP) that can be used with point-to-point or point-to-multipoint systems
- ASCII Protocol for use with point-to-point systems.

For details regarding the communications protocol (ASCII or TBP) please refer to the ASCII Protocol and TBP Reference Guides.

By programming the onboard EEPROM, the Control Module can be configured via the USB or standard serial interface according to applicable specific requirements.

The Control Module has eight configurable digital input/outputs that can be defined by the user, two input-only signals, and two open collector outputs. It also includes a wireless synchronization feature and a port to allow wired synchronization to avoid interference between readers located close to each other.

Four indication LEDs show the status of the module. Three of these can be extended external to the module.

The Control Modules work together with the RFMs listed below:

- PRDRFM007C from Protagd
- PRDRFM008B from Protagd
- RI-RFM-007B from Texas Instruments
- RI-RFM-008B from Texas Instruments

2 Abbreviations

BCC	Block Check Character
COM	Communication (port)
CRC	Cyclic Redundancy Check
DC	Direct Current
EEPROM	Electrically Erasable Programmable Read-Only Memory
FW	Firmware
HDX	Half Duplex
I/O	Input/Output
LED	Light Emitting Diode
LF	Low Frequency
N/A	Not Applicable
OOK	On-Off Keyed
PC	Personal Computer
PCB	Printed Circuit Board
PWE	Pulse Width Encoding
PWM	Pulse Width Modulator
Q	Quality Factor
RFID	Radio Frequency Identification
RFM	Radio Frequency Module
RFU	Reserved for Future Use
RO	ReadOnly
RS-232	Computer Serial Interface
RS-422/485	Computer Serial Interface
RW	ReadWrite
TI	Texas Instruments
UID	Unique Identification Number
USB	Universal Serial Bus

3 Conventions

Below conventions are used in this document to indicate vital information:

DANGER:

Care must be taken, or a certain procedure must be followed to prevent injury or harm to your health.

CAUTION:

Information on conditions that must be met, or a procedure must be followed to prevent permanent damage.

Note:

Condition, which must be met, or procedures, which must be followed to ensure proper functioning.

4 Installation

Mount the RFM on top of the Control Module by screwing four M3x10mm screws into the hexagon spacers provided, making sure that the 16-pin RFM connector J1 properly aligns with the Control Module's ST4 female connector.

Handle Control Module according to ESD handling requirements.
Do not touch any part/connector without taking appropriate precautions.
Do not hot-socket the Control Module: Power down before connecting or disconnecting any other module or cables.

The Control Module has 10 plug and screw connectors which provide all connections necessary for supply and control.

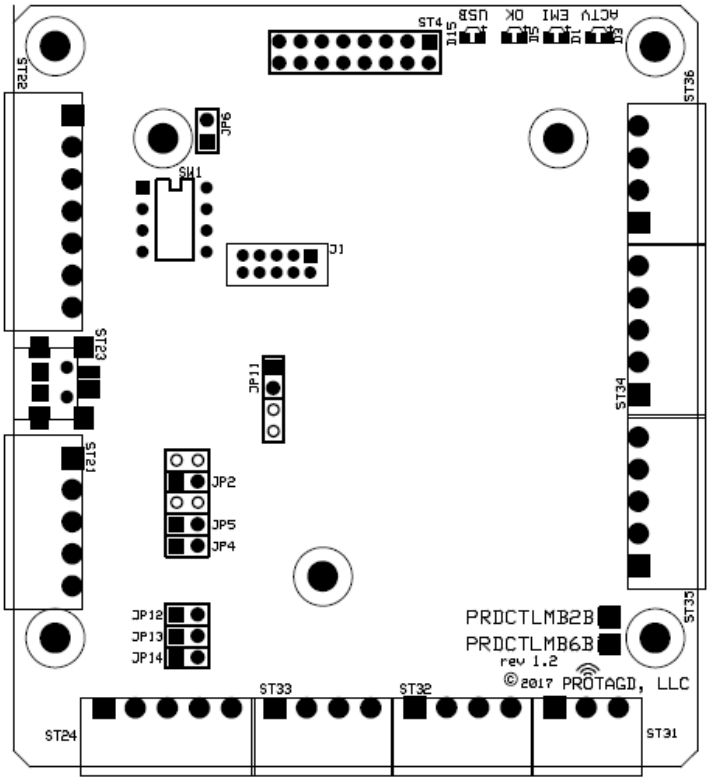

Figure 4.1 Bottom View

4.1 ST21: Serial Communication Interface – RS-232 (MB2B only)

For distances between the reader and the computer of less than 20m, the RS-232 version (PRDCTLMB2B) can be used.

Signal Name	Pin	Comment
RXD	1	RS-232-C Serial Data Input
DTR	2	RS-232-C Data Terminal Ready Input
GND	3	Signal Ground
TXD	4	RS-232-C Serial Data Output
DSR	5	RS-232-C Data Set Ready Output

Table 4.1: ST21 – RS-232 Communication Interface (MB2B)

Typically, the RS-232 interface is connected through a 9-pin Sub-D interface connector.

The Control Module firmware uses the following default configuration.

9600 baud, 8 data bits, 1 stop bit, software handshake enabled:

XON /XOFF XON = ASCII 17_{DEC}, XOFF = ASCII 19_{DEC}

The Data Rate, Parity, Data bits and Handshake can be configured using the Utility Tool.

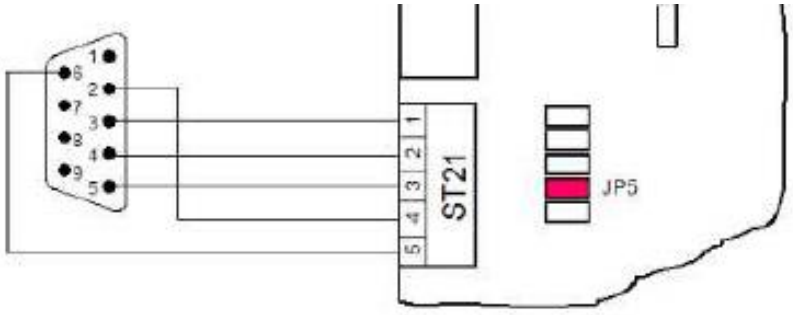

Figure 4.2 ST21 – RS-232 9-Pin Interface Connection (MB2B)

The Data Terminal Ready (DTR) signal is connected to the reset/watchdog circuit of the Control Module. This ensures a PC controlled microcomputer initialization before the default Read Mode is started. If you want to run the Control module in a 3-wire connection (RXD, TXD, and GND), without remote controlled activation, Jumper 5 (JP5) must be closed. This connects DSR and DTR together. When power is applied to the Control Module the Data Set Ready (DSR) of the RS-232 interface is activated.

4.2 ST21: Serial Communication Interface – RS-422/485 (MB6B only)

Signal Name	Pin	Comment
RX+	1	RS-422 Non-inverted Data Input
RX–	2	RS-422 Inverted Data Input
GND	3	Signal Ground
TX+	4	RS-422 Non-inverted Data Output
TX–	5	RS-422 Inverted Data Output

Table 4.2: ST21 – RS-422 Communication Interface (MB6B)

Signal Name	Pin	Comment
TX+/RX+	1	RS-485 Non-inverted Data Output/ Input
TX–/RX–	2	RS-485 Inverted Data Output/ Input
GND	3	Signal Ground

Table 4.3: ST21 – RS-485 Communication Interface (MB6B)

Figure 4.3 shows the circuitry of the RS-422/485 Interface. Jumper 2 (JP2) must be closed to provide line-to-line termination. If the PC is at one end of the line, it must be terminated at its R_X+/R_X- Inputs. The reader at the end of the line must be terminated. If the PC is connected somewhere in the middle of the line, then the readers at either end must be terminated.

Jumper JP4 and JP5 determine which of the two interface types is selected (RS-422 or RS-485). This is explained in detail below.

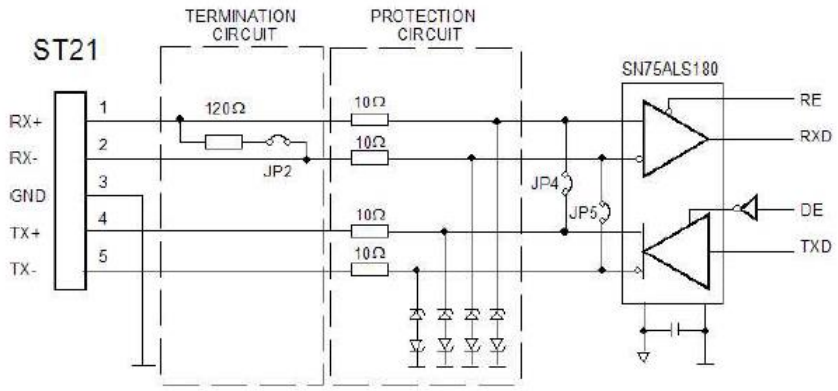

Figure 4.3 ST21 – RS-422/485 Interface Circuitry (MB6B)

Recommendations for point-to-point RS-422 interface connection are given in Figure 4.4. In this case, Jumper 2 (JP2) must be closed. Jumpers JP4 and JP5 must be open. For multi-point RS-422 communications, only the reader at the end of the line must be terminated.

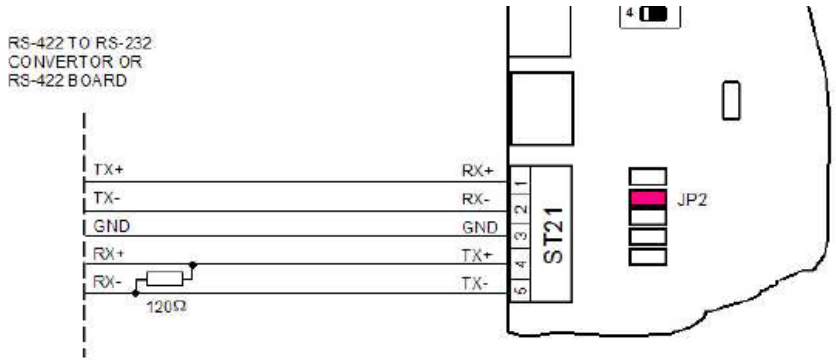

Figure 4.4 ST21 – RS-422 Interface Connection (MB6B)

When using the RS-485 interface, Jumper 4 and 5 (JP4, JP5) must be closed. Recommendations for an RS-485 interface connection to a twisted pair bus are given in Figure 2-12. The last reader on the line must be terminated by connecting Jumper 2 (JP2).

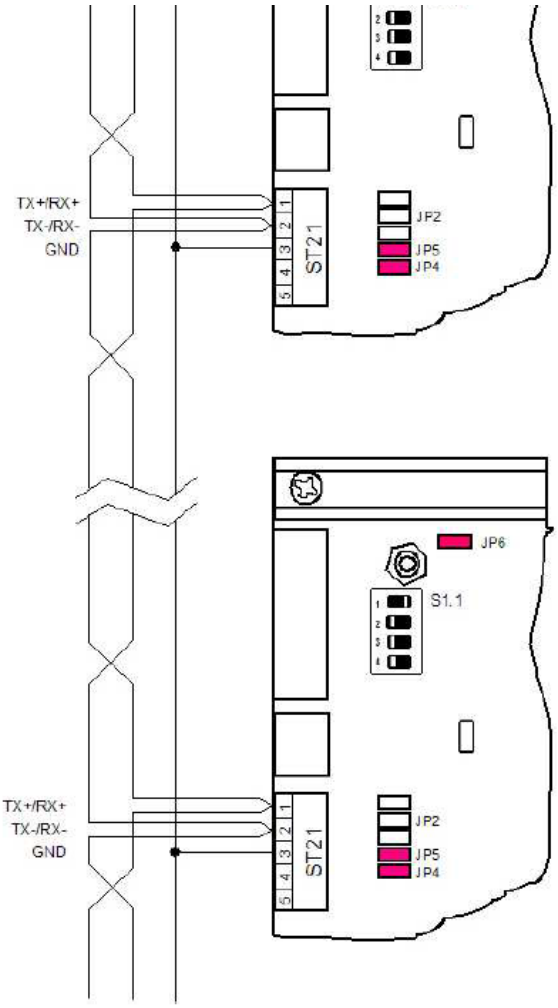

Figure 4.5 ST21 – RS-485 Interface Connection (MB6B)

4.3 ST22: Power Supply

This section describes the various Power Supply possibilities for the Control Module. These are:

- The Control Module and the RF Module are both powered by a regulated Power Supply (see Section 4.3.1).
- The Control Module and the RF Module logic circuitry are powered by a non-regulated Power Supply and the RF module power circuits are separately supplied by a regulated Power Supply (see Section 4.3.2).
- The Control Module and the RF Module logic circuitry are powered by a regulated (5 V) Power Supply and the RF Module power circuits are separately supplied by a regulated Power Supply (see Section 4.3.3).

When the Series 2000 Control Module control logic circuitry is powered by an external regulated (5 V) Power Supply, Jumper JP6 must be removed.

The supply voltage range that can be used depends on the RFM used, therefore in all cases, refer to the Recommended Operating Conditions and observe the electrical characteristics for minimum and maximum input supply levels.

Be very careful to ensure that you use the correct polarity in all of these methods as there is no reverse polarity protection built into the Control Module.

Signal Name	Pin	Comment
VSP	1	Supply voltage for the RF Module
GNDP	2	Ground line for the RF Module supply.
VDC	3	Non-regulated supply voltage for the control logic circuitry.
GND	4	Signal ground line for the control logic supply.
VCC2	5	Regulated supply voltage (5VDC) for the control logic circuitry.
VCC3	6	Memory data retention supply voltage
GND	7	Signal ground

Table 4.4: ST22 – Supply

4.3.1 Common DC Power Supply for both, the Control Module and the RFM

Figure 4.6 shows how to connect a regulated power supply for both, the Control Module and the RFM. Jumper JP6 must be closed.

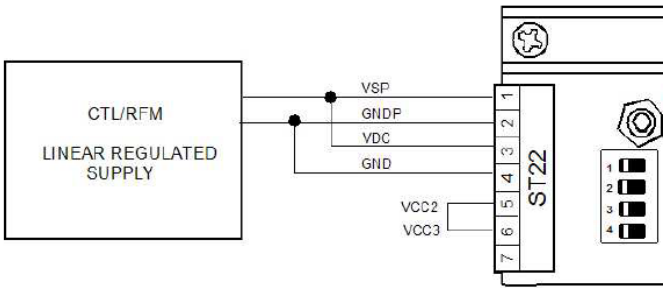

Figure 4.6 Single Power Supply for both, Control Module and RFM

4.3.2 Non-Regulated DC Power Supply (without memory backup)

If a non-regulated DC Power Supply is used to supply the Control Module logic circuits, it should be connected to the

reader as shown in Figure 4.7. Jumper JP6 must be closed.

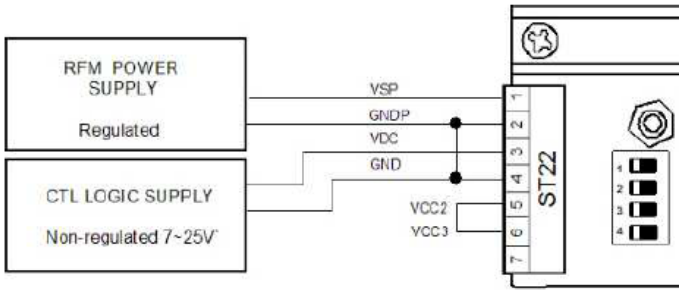

Figure 4.7 Non-Regulated Power Supply

4.3.3 Regulated DC Power Supply (without memory backup)

If you use a regulated (5 V) Power Supply for VCC2, it should be connected to the reader as shown in Figure 4.8. Jumper JP6 must be removed.

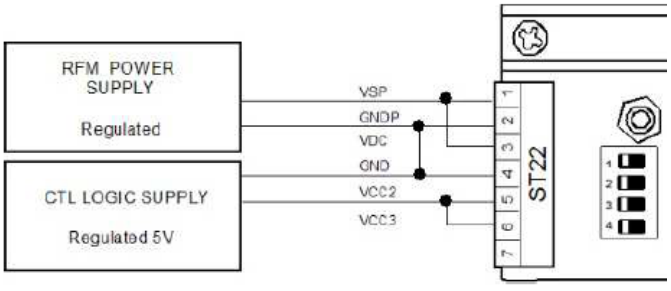

Figure 4.8 Regulated Control-Logic Power Supply

4.3.4 Battery Backup for Memory

Even though the Control Module remains powered, it is possible the memory contents are erased when the Control Module is reset. This occurs when power is temporarily removed from the RAM during reset.

A reset can be initiated in one of three ways:

- Internally by the reset/watchdog circuit
- Externally by using the reset input (pin 3 of ST33)
- Externally by the RS-232 DTR signal (RI-CTL-MB2B version only)

To prevent memory contents being lost during a reset, it is recommended that the following precautions are taken:

- Connect VCC2 (pin 5 of ST22) and VCC3 (pin 6 of ST22) to each other.

To prevent memory contents from being lost during a power-down, or during a reset, it is recommended that the following precautions are taken:

- Connect a battery (with VCC3 = 3.0 V) between pins 6 (+) and 7 (–) of ST22 as shown in Figure 4.9, instead of a bridge between VCC2 and VCC3. Tolerances for the battery are given in Table 4.4.

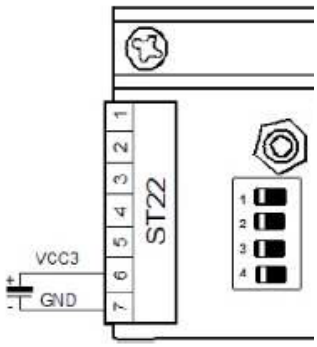

Figure 4.9 Regulated Control-Logic Power Supply

4.4 ST23: Mini USB B Interface

The Service/Configuration Interface allows both, PRDCTLMB2B and PRDCTLMB6B, to be configured via a USB serial port. A mini-USB B to USB A cable is required.

For USB operation jumper, JP11 must be inserted.

The red LED (furthest from the edge) will be lit to indicate that a USB Cable is connecting the Control Module to a host computer and that it is powered.

4.5 ST24: Synchronization Interface

Signal Name	Pin	Comment
SYNC. RX+	1	RS-422/485 Non-inverted Data Input
SYNC. RX–	2	RS-422/485 Inverted Data Input
GND	3	Signal Ground
SYNC. TX+	4	RS-422/485 Non-inverted Data Output
SYNC. TX–	5	RS-422/485 Inverted Data Output

Table 4.5: ST24 – Synchronization Interface

Figure 4.10shows the circuitry of the synchronization Interface, and Figure 4.11 shows the connector to the interface.

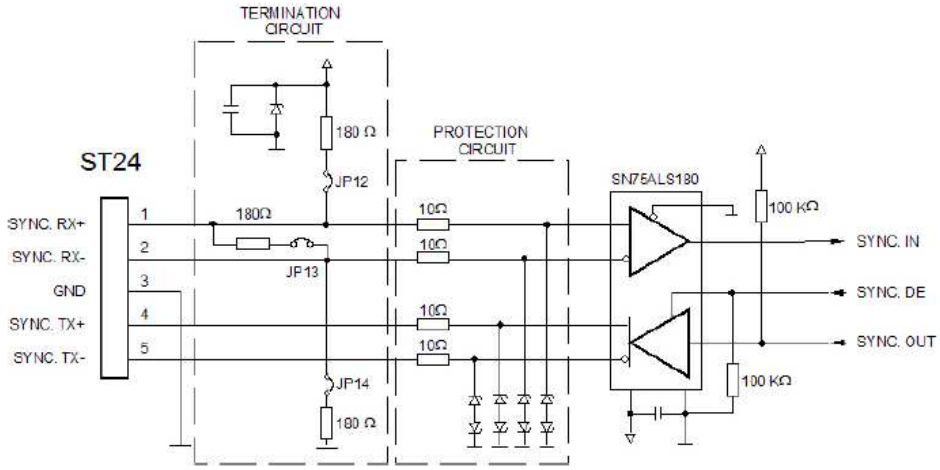

Figure 4.10 Synchronization Interface Circuit

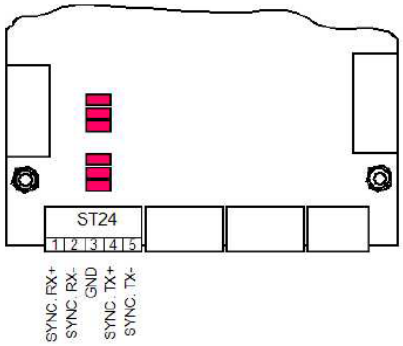

Figure 4.11 Synchronization Interface Connector

To allow the synchronization of up to 32 readers, the Series 2000 firmware provides six types of synchronization (or No Sync if you are not going to use synchronization):

- Wireless synchronization
- Wireless
- Wired
- Combined wireless/wired
- Master/slave (with or without acknowledgement)
- Triggered

This specification covers the way the readers must be connected for the wired, combined wireless/wired, Master/Slave and triggered synchronization.

When you have completed the hardware synchronization, you must run the configuration utility (S2_Util.exe) to tell the system which synchronization method you have installed, and then set the dipswitch S1.1 to the ON position.

4.5.1 Wired and Combined Wireless/Wired Synchronization

Figure 4.12 shows the way in which the Control Module must be connected for a wired and combined wireless and wired synchronization. The Control Module also must be software configured to the chosen synchronization method. Table 4.6 explains the setting of jumpers 12, 13 and 14 (JP12, JP13 and JP14

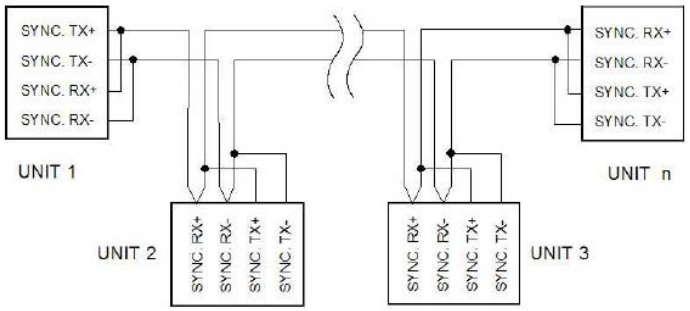

Figure 4.12 Wired and/or Combined Wired/Wireless Synchronization

	UNIT(1)	UNIT(2) to UNIT(n-1)	UNIT(n)
Jumper 12 (JP12)	Closed	Open	Closed
Jumper 13 (JP13)	Closed(1)	Open	Closed(1)
Jumper 14 (JP14)	Closed	Open	Closed

(1) If the distance between Unit 1 and Unit n is less than approximately 400m, JP13 can be left out to save power.

Table 4.6: Wired and Combined Wired/Wireless Synchronization

4.5.2 Master/Slave Synchronization without Acknowledgement; Triggered Synchronization without Acknowledgement

Figure 4.13 shows the way that the readers must be connected for Master/ Slave synchronization or Triggered synchronization, both without acknowledgement. In this figure, Unit 1 is the Master and all other units are Slaves. The individual SW configuration (Master or Slave) is shown in (1) If the distance between Unit 1 and Unit n is less than approximately 400m, JP13 can be left out.

Table 4.7 and Table 4.8. The tables also explain the setting of jumpers 12, 13 and 14 (JP12, JP13 and JP14).

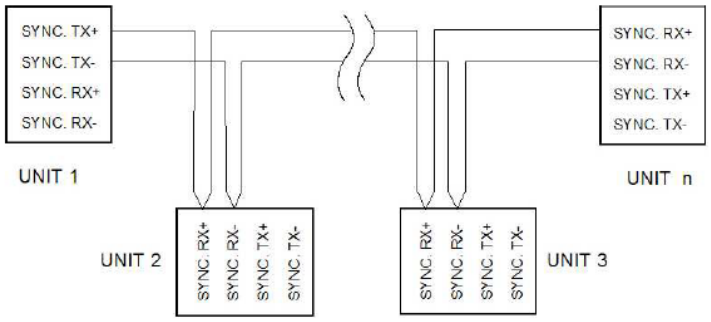

Figure 4.13 Synchronization Interface Connection

	UNIT(1) Control Module MASTER	UNIT(2) to UNIT(n-1) Control Module SLAVES	UNIT(n) Control Module SLAVE
Jumper 12 (JP12)	Closed	Open	Closed
Jumper 13 (JP13)	Open	Open	Closed(1)
Jumper 14 (JP14)	Closed	Open	Closed

(1) If the distance between Unit 1 and Unit n is less than approximately 400m, JP13 can be left out.

Table 4.7: Master/Slave Synchronization without Acknowledgement

	UNIT(1) Trigger Unit	UNIT(2) to UNIT(n-1) Control Module MASTERS	UNIT(n) Control Module MASTER
Jumper 12 (JP12)	Termination not required	Open	Closed
Jumper 13 (JP13)	Termination not required	Open	Closed(1)
Jumper 14 (JP14)	Termination not required	Open	Closed

(1) If the distance between Unit 1 and Unit n is less than approximately 400m, JP13 can be left out.

Table 4.8: Triggered Synchronization without Acknowledgement

4.5.3 Master/Slave Synchronization with Acknowledgement

Figure 4.14 shows the way that the Control Module must be connected for Master/Slave synchronization with acknowledgement. The individual SW

configuration (Master or Slave) is shown in Table 4.9, which also explains the setting of jumpers 12, 13 and 14 (JP12, JP13 and JP14).).

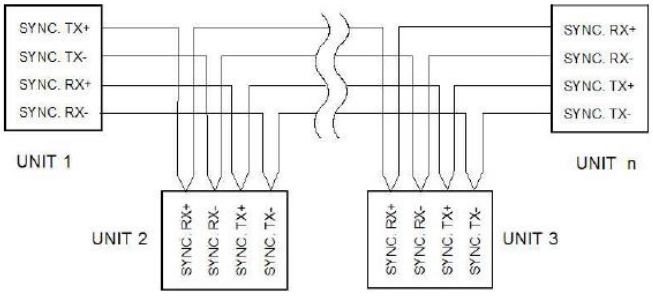

Figure 4.14 Master/Slave Synchronization with Acknowledgement

	UNIT(1)	UNIT(2) to UNIT(n-1)	UNIT(n)
	Control Module MASTER	Control Module SLAVES	Control Module
			SLAVE
Jumper 12 (JP12)	Closed	Open	Closed
Jumper 13 (JP13)	Closed(1)	Open	Closed(1)
Jumper 14 (JP14)	Closed	Open	Closed

(1) If the distance between Unit 1 and Unit n is less than approximately 400m, JP13 can be left out.

Table 4.9: Master/Slave Synchronization with Acknowledgement

4.6 ST31: RXSS Tuning Inputs

Signal Name	Pin	Comment
RSCA/RXSA1	1	RSCA/RXSA1 Receiver Signal Strength Control A Receiver Signal Strength Adjust refer to RFM Manual
RSCB	2	Receiver Signal Strength Control B (not used)
GND	3	Signal Ground

Table 4.10: ST31 – RXSS Inputs

The signal RXSA is made available at ST31 terminal 1 to allow adjustment of the signal strength threshold level for the RFM. To adjust the signal strength threshold level please refer to the RFM manual (RSCA and RSCB are not used).

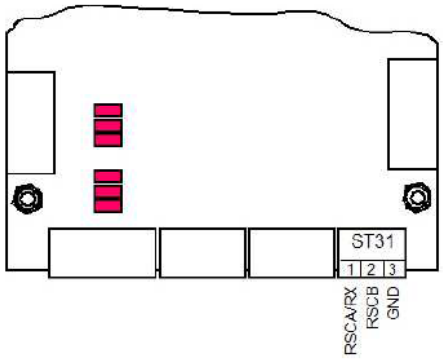

Figure 4.15 RFM Tuning Inputs

4.7 ST32: Indicator Outputs

Signal Name	Pin	Comment
VCC2	1	Regulated 5 VDC supply output
ACTIVE–	2	Open Collector Output: RF Module Transmitter Signal
OK–	3	Open Collector Output: OK Signal
EMI–	4	Open Collector Output: EMI Signal

Table 4.11: ST32 – Indicator Outputs

The signals of the indicator LEDs are available at ST32. They can be used to drive external LEDs which can be mounted on a front Panel. A current limiting resistor is required for each LED. An example is shown in Figure 4.16

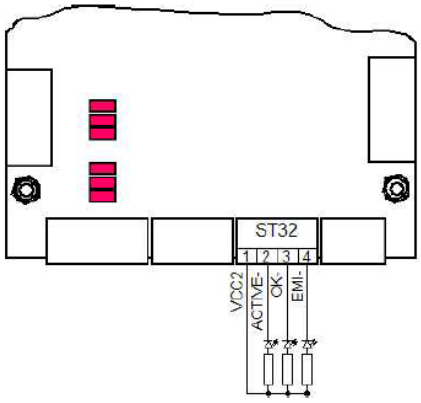

Figure 4.16 Indicator Outputs

4.8 ST33: Input/Reset

Signal Name	Pin	Comment
IN0	1	General Purpose Input 0
IN1	2	General Purpose Input 1
RESET	3	RESET Input/Output
GND	4	Signal Ground

Table 4.12: ST33 – Input/Reset

The Control Module provides two general purpose input lines. Each of these input lines is pulled up to VCC2 (+ 5V) by a 100kW resistor. The Reset-terminal at this connector can be used to reset external circuitry or to reset the Control Module externally. Figure 4.17 shows an example to reset the Control Module with an external push button

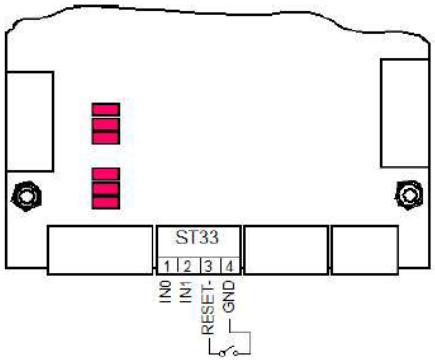

Figure 4.17 Input/Reset Connection

4.9 ST34/ST35: General Purpose I/O

Signal Name	Pin	Comment
I/O 4	1	General Purpose Input/Output 4
I/O 5	2	General Purpose Input/Output 5
I/O 6	3	General Purpose Input/Output 6
I/O 7	4	General Purpose Input/Output 7
GND	5	Signal Ground

Table 4.13: ST34 – Input/Output Port 4-7

Signal Name	Pin	Comment
I/O 0	1	General Purpose Input/Output 0
I/O 1	2	General Purpose Input/Output 1
I/O 2	3	General Purpose Input/Output 2
I/O 3	4	General Purpose Input/Output 3
GND	5	Signal Ground

Table 4.14: ST35 – RXSS Inputs

The Control Module provides two I/O ports, which can be configured in the following way:

I/O[1]				I/O			
0	1	2	3	4	5	6	7
I	I	I	I	I	I	I	I
I	I	I	I	O	O	O	O
O	O	O	O	I	I	I	I
O	O	O	O	O	O	O	O

(1) I = Input, O = Output

The Control Module firmware configures I/O ports 0 – 3 as Inputs and I/O ports 4 – 7 as Outputs by default. S2_Util.exe can be used the reconfigure the system as required. Please do not exceed the values given under Electrical Characteristics in this guide. The pin assignments for the I/O are shown in Figure 4.18.

These I/O lines are TTL compatible and are connected via 220Ohm series resistors to internal I/O drivers.

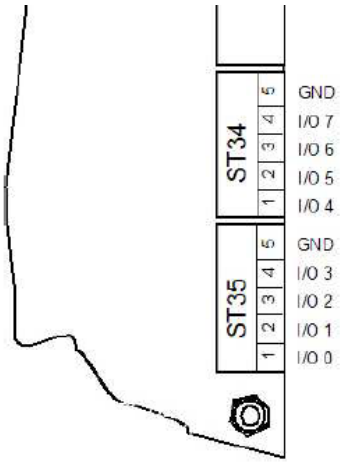

Figure 4.18 General Purpose I/O Port Pin Assignment

4.10 ST36: Open Collector Outputs

Signal Name	Pin	Comment
VCC2	1	Regulated 5 VDC Supply Output
OC0	2	Open Collector Output 0
OC1	3	Open Collector Output 1
GND	4	Signal Ground

Table 4.15: ST36 – Open Collector Outputs

The Control Module provides two general purpose open collector output lines. They can be used for a Wiegand interface or to drive relays.

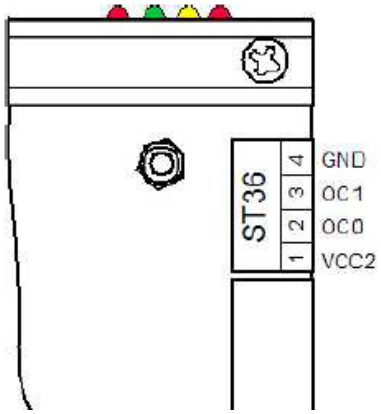

Figure 4.19 Open Collector Outputs

5 Software Configuration

The Texas Instruments utility "S2_Util.exe" can be used to configure the Control Module according to the customer's application specific requirements concerning:

- Communication protocol
- Communication parameters
- Default read mode
- RF Module parameters
- Synchronization type
- Default I/O settings

Dip-switch S1 (S1.1) determines the mode of operation of the Control Module. If Dip-switch S1.1 is in the OFF position, standard default parameters are used. These are:

- RI-CTL-MB2B
  - ASCII protocol
  - 9600 baud, eight databits, no parity, one stop bit, Xon/Xoff enabled
  - Normal mode
  - RF module power RFM-007 (also valid for RFM-008)
  - Wireless synchronization
  - I/O 0 to 3 defined as input
  - I/O 4 to 7 defined as output and logic high
  - Hardware interface RS-232

- · RI-CTL-MB6B
  - ASCII protocol
  - 9600 baud, eight databits, no parity, one stop bit, Xon/Xoff enabled
  - Normal mode
  - RF module power RFM-007 (also valid for RFM-008)
  - Wireless synchronization
  - I/O 0 to 3 defined as input
  - I/O 4 to 7 defined as output and logic high
  - Hardware interface RS-422

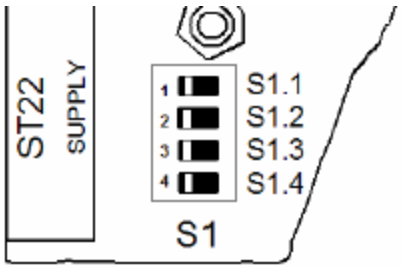

Figure 5.1 Detailed View of Dip-Switch S1

If Dip-switch S1.1 is in the ON position, customer specific default parameters are used to operate the Control Module. These application specific parameters are stored in a serial EEPROM on the Control Module.

Note: Dip-Switch S1.1 is checked at power-up, after a software RESET and during operation; however, in some cases (such as M/S sync, Slave mode) switching back to default parameters may require a board reset.

Configuration changes will become active as soon as the switch is moved. To enable the customer specific parameters to be changed the Control Module can be configured either via a communications port or via the USB service port. Connect one of these ports to the Host and get connection using the standard reader settings by switching S1.1 to the OFF position. Change the default parameters to customer parameters and save them. Then after moving Dip-switch S1.1 to the ON position, the Control Module will work with the customer specific parameters.

For details regarding the communication protocol (ASCII or TBP), please refer to the ASCII Protocol or TIRIS Bus Protocol Reference Guides.

6 Characteristics

6.1 Mechanical Dimensions

Length: 93mm (3.66 inches)
Width: 82mm (3.23 inches)
Height: 33mm (1.14 inches)
Weight: 78g (2.76 oz)

The dimensions for the holes are given in Figure 6.1. All dimensions are in mm and are given for the Printed Circuit Board (PCB) without the heat sink.

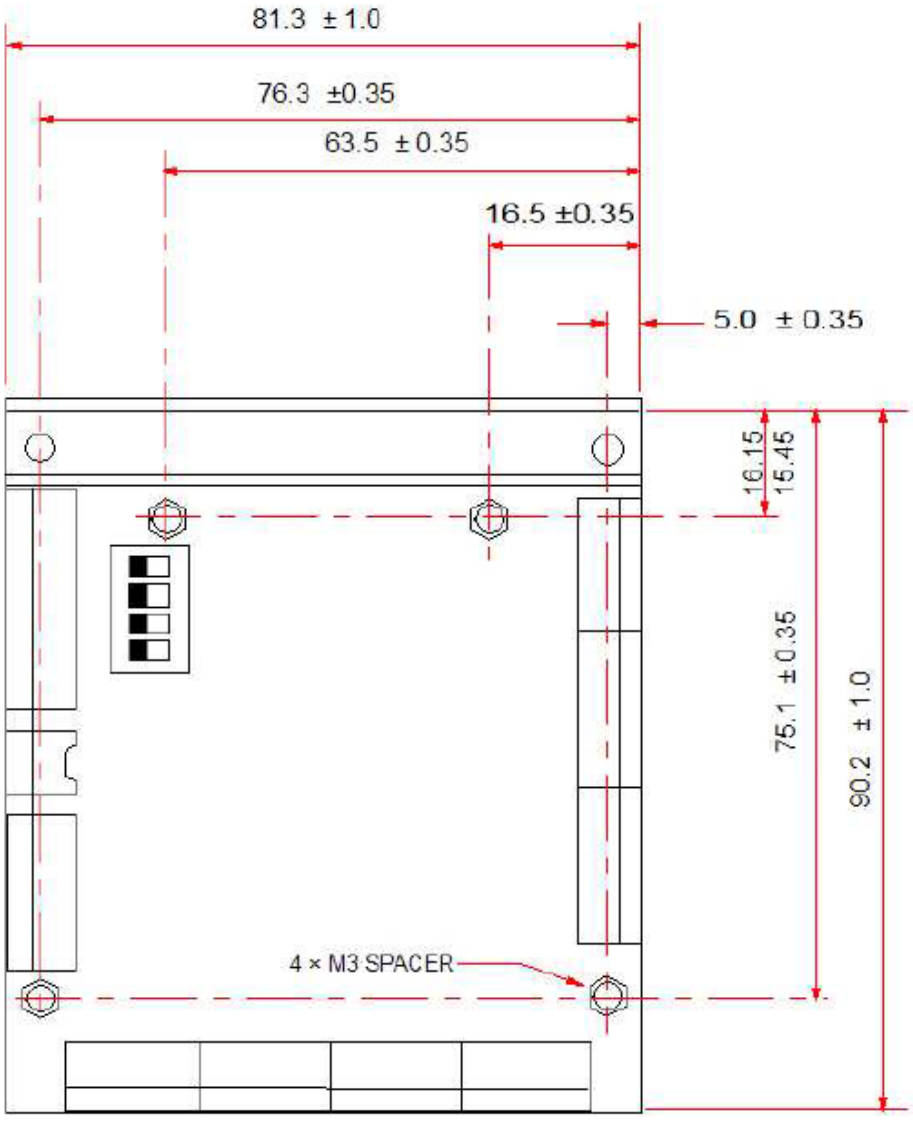

Figure 6.1 Mechanical Dimensions

6.2 Temperature Range

Operating Temperature Range: 0°C to +70°C
Storage Temperature Range: -40°C to +85°C

6.3 Recommended Operating Conditions – Electrical Characteristics

6.3.1 RS-232 (ST21)

PARAMETER		DESCRIPTION	CONDITIONS	MIN	TYP.	MAX	UNIT
V_{TXD}		Output Voltage Swing	TXD loaded 3 kΩ to Ground	= 5		= 9	V
V_{RXD}		Input voltage range		–30		30	V
V_{DTR}		DTR input voltage		–30		30	V
V_{DSR}		DSR Output voltage	DSR loaded 3 kΩ to Ground	3.5	4.1	V_{CC2}	V
V_{RXD_TRES}	Low	RXD input threshold	V_{CC2} = 5 V			0.8	V
	High			2.4			
VDTR_TRES	Low	DTR input threshold	V_{CC2} = 5 V				V
	High			1.6 2.25		3.15 3.85	
ITXD		Short circuit current	TXD connected to ground, infinite duration		±18		mA
RRXD				3	5	7	kΩ
IDTR		DTR current	V_{DTR} = 12 V	3.6	3.8	4.1	mA

6.3.2 RS-422/485 (ST21)

PARAMETER	DESCRIPTION	CONDITIONS		MIN	TYP	MAX	UNIT
V_I, V_{IC}	Voltage at any bus terminal (separately or common mode)			–7		+12	V
V_{IC}	Differential input voltage(1)					±12	V
V_O	Output voltage	I_O = 0		0		V_{CC2}	V
I_O	Output current	Output disabled, V_O = 12 V				1	mA
I_{OH}	High-level output current	TX+, TX–				–60	mA
		RX+, RX–				–400	
I_{OL}	Low-level output current	TX+, TX–				60	mA
		RX+, RX–				8	
I_{OS}	Short circuit current	Duration should not exceed 1 second	V_O = 0 V			–150	mA
			V_O = V_{CC2}			–250	
$\|V_{OD1}\|$	Differential output voltage	I_O = 0		1.5		V_{CC2}	V
$\|V_{OD2}\|$	Differential output voltage	R_L = 54 Ω		1.5	2.5	V_{CC2}	V
V_{TH}	Differential input high threshold voltage	V_O = 2.7 V, I_O = 0.4 mA		+0.3			V
V_{TL}	Differential input low threshold voltage	V_O = 0.5 V, I_O = 8 mA				–0.3	V
R_I	Input resistance			12			kΩ

(1) Differential input/output voltage is measured at the one-inverting terminals RX+/TX+ with respect to the inverting terminals RX–/TX–.

6.3.3 Supply (ST22)

PARAMETER	DESCRIPTION	CONDITIONS	MIN	TYP	MAX	UNIT
V_{DC}			7		25	V
V_{CC2}	Logic Supply Voltage	Connector ST22 pin 5 is used as logic supply output. V_{DC} = 7 to 25 V. Jumper JP6 must be closed.	4.75	5.0	5.25	V
P_{DIS}	Power dissipated by the voltage regulator	No external loads. Indicator LEDs are on.			4	W
I_{DC}, I_{CC2}	Supply Current	No external loads. Indicator LEDs are on.		120	200	mA
I_{CC2}		Output current if ST22 pin 5 is used as external logic supply output. The maximum power dissipation must not be exceeded!			1	A
V_{CC2}	Data retention input voltage		2.7	3.0	V_{CC2}	V
I_{CC2}	Data retention current	RESET = V_{RESOL} (Reset active)(1)		2	50	µA

(1) A reset can be initiated in one of three ways:
- Internally by the reset/watchdog circuit
- Externally by using the reset input (pin 3 of ST33)
- Externally by the RS-232 DTR signal (RI-CTL-MB2B only)

6.3.4 Synchronization Interface (ST24)

PARAMETER	DESCRIPTION	CONDITIONS		MIN	TYP	MAX	UNIT
V_{SYNC_I}, V_{SYNC_IC}	Voltage at any bus terminal (separately or common mode)			–7		+12	V
V_{SYNC_ID}	Differentila input voltage					(1)±12	V
V_{SYNC_O}	Output voltage	I_O = 0				V_{CC2}	V
I_{SYNC_O}	Output current	Output disabled, V_O = 12 V				1	mA
I_{SYNC_OH}	High-level output current	TX+, TX–				–60	mA
		RX+, RX–				–400	
I_{SYNC_OL}	Low-level output current	TX+, TX–				60	mA
		RX+, RX–				8	
I_{SYNC_OS}	Short circuit current	Duration should not exceed 1 second	V_O = 0 V			–150	mA
			V_O = V_{CC2}			–250	
$\|V_{SYNC\_OD1}\|$	Differential output voltage	I_O = 0		1.5		V_{CC2}	V
$\|V_{SYNC\_OD2}\|$	Differential output voltage	R_L = 54 Ω		1.5	2.5	V_{CC2}	V
V_{SYNC_TH}	Differential input high threshold voltage	V_O = 2.7 V, I_O = 0.4 mA		+0.3			V
V_{SYNC_TL}	Differential input low threshold voltage	V_O = 0.5 V, I_O = 8 mA				–0.3	V
R_{SYNC_I}	Input resistance			12			kΩ

(1) Differential input/output voltage is measured at the non-inverting terminals RX+/TX+ with respect to the inverting terminals RX-/TX-.

6.3.5 RXSS Tuning Inputs (ST31)

For the electrical characteristics of the RXSA input please refer to the relevant RFM manual.

6.3.6 Indicator Outputs (ST32)

PARAMETER	DESCRIPTION	CONDITIONS	MIN	TYP	MAX	UNIT
V_{OH}	High level output voltage				10	V
V_{OL}	Low level output voltage	I_{OL} = 100 mA			1	V
V_{IL}	Low level output current				290	mA
t_{OK_TRG}	Low level trigger signal pulse width		(1)40	50		µs
t_{OK_DELAY}	Delay to the low-to-high transition of the trigger signal		(2)50	70	90	ms

(1) The OK_LED (ON) and the OK_LED(OFF) functions of the S2000 software library can be used to generate a trigger signal.
(2) The pulse extension circuit is only added for the OK-signal.

6.3.7 Input/Reset (ST33)

PARAMETER	DESCRIPTION	CONDITIONS	MIN	TYP	MAX	UNIT
V_{RESOH}	Reset high level output voltage, ST33 pin 3	I_{OH} = 20 µA	3.8	4.1	V_{CC2}	V
		Reset/watchdog circuit inactive. See and DTR=VDTRL (RS-232 version)(1)				
V_{RESOL}	Reset low level output voltage, ST33 pin 3	I_{OL} = 10 µA			0.8	V
		Reset/watchdog circuit inactive. See DTR=V_{DTRL} (RS-232 version)(2)				
V_{RESIL}	Reset low level input voltage, ST33 pin 3	Output disabled; V_O = 12 V			0.8	V
V_{IN0L}, V_{IN1L}	Low level input voltage for input 0 and input 1				0.8	V
V_{IN0H}, V_{IN1H}	High level input voltage for input 0 and input 1		2.2		V_{CC2} – 0.3	V
I_{ILL}	Input leak current	0 ≤ V_{IN} < +V_{CC2}	–1		1	µA
t_{RESOL}	Reset output low-level pulse duration		10	16		ms
t_{RESIL}	Reset input low-level pulse duration		10	16		ms

(1) Differential input/output voltage is measured at the non-inverting terminals RX+/TX+ with respect to the inverting terminals RX-/TX-.
(2) A reset of the Rest/watchdog circuit is initiated if:
- The logic supply voltage (V_{CC2}) is below 4.65 Volt
- The watchdog is not periodically retriggered within 50 ms

6.3.8 General Purpose I/O (ST34/35)

PARAMETER	DESCRIPTION	CONDITIONS	MIN	TYP.	MAX	UNIT
V_{OH}	High level output voltage	I_{OH} = –40 mA	4.2			V
		I_{OH} = –1.6 mA	3.4			
V_{OL}	Low level output voltage	I_{OL} = 1.6 mA			0.8	V
V_{IL}	Low level input voltage				0.8	V
V_{IH}	High level input voltage		2.2		V_{cc2} + 0.3	V
I_{LI}	Input leak current	0 ≤ V_{IN} ≤ V_{CC2}	–1		1	µA

6.3.9 Open Collector Outputs (ST36)

PARAMETER	DESCRIPTION	CONDITIONS	MIN	TYP	MAX	UNIT
V_{CC2}	+5 V Output	The total consumption of the two VCC outputs (GEN I/O pin 13 and OC pin 1) must not exceed 500 mA	4.75	5	5.25	V
V_{OH}	High level output voltage				80	V
V_{OL}	Low level output voltage	I_{OL} = 500 mA			1.3	V
I_{OL}	Low level output current				500	mA

7 Regulatory Notes

Prior to operating the CTL, the required relevant government agency approvals must be obtained. Sale, lease or operation in some countries may be subject to prior approval by government or other organizations.

7.1 Europe

The equipment complies with the Radio Equipment Directive (RED) 2014/53/EU. when used for its intended purpose.

A CE Declaration of Conformity for the CTL is available from Protagd.

Any device or system incorporating this module in any other than the originally tested configuration needs to be verified against the requirements of the Radio Equipment Directive (RED) 2014/53/EU. A separate Declaration of Conformity must be issued by the system integrator or user of such a system prior to marketing it and operating it in the European Community.

It is the responsibility of the system integrators to get their complete system tested and obtain approvals from the appropriate local authorities before operating or selling the system.

7.2 USA

The CTL is considered by the Federal Communications Commission (FCC) to be a "subassembly". As such, no prior approval is required to import, sell or otherwise market them in the United States. To form a functioning radio frequency system, the Reader must be connected to a suitable antenna and power supply.

Such a system containing the CTL may have to comply with the limits pursuant to part 15 of the FCC rules. It is the responsibility of the system integrators to get their complete system tested and to obtain approvals from the appropriate local authorities before operating or selling this system.

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