



HF Reader System Series 6000
S6500 Long Range Reader Module RI-STU-650A

Reference Guide

Edition One - May 2001

This is the first edition of this manual. It describes the following equipment:

S6500 Long Range Reader Module RI-STU-650A

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Read This First

About This Manual

This reference guide for the S6500 Long Range Reader Module is designed for use by TI partners who are engineers experienced with Radio Frequency Identification Devices (RFID).

Regulatory, safety and warranty notices that must be followed are given in Chapter 5.

Conventions



WARNING:

A WARNING IS USED WHERE CARE MUST BE TAKEN, OR A CERTAIN PROCEDURE MUST BE FOLLOWED IN ORDER TO PREVENT INJURY OR HARM TO YOUR HEALTH.



CAUTION:

This indicates information on conditions which must be met, or a procedure which must be followed, which if not heeded could cause permanent damage to the equipment or software.



Note:

Indicates conditions which must be met, or procedures which must be followed, to ensure proper functioning of the equipment or software.



Information:

Indicates information which makes usage of the equipment or software easier

If You Need Assistance

For more information, please contact the sales office or distributor nearest you. This contact information can be found on our web site at:

<http://www.ti-rfid.com>

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Introduction

This chapter introduces you to the S6500 Long Range Reader Module.

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1.1 General

This document provides information about the S6500 Long Range Reader Module. It describes the reader and how to install it.

1.2 System Description

The HF Reader System Series 6000 works at a frequency of 13.56 MHz. It comprises a reader, antenna and transponder (for example: smart label) and is used for wireless identification of a variety of objects.

The system works according to the “reader talks first” principle which means that the transponder keeps quiet until the reader sends a request to it. The reader can rapidly and simultaneously identify numerous transponders in the antenna’s field. It can write data to and read data from the transponders; either in addressed mode by using the factory programmed read only number, or in general mode to all of the transponders in its field. The read/write capability of the transponder allows users to update the data stored in the transponders memory anywhere along its movements.

1.3 Product Description

The S6500 Long Range Reader Module handles all RF and digital functions required in order to communicate with Tag-it HF, Tag-it HF-I (ISO 15693 compliant) and all other ISO 15693 compliant transponder from various suppliers.

The Reader Module is mounted onto a rigid, 6 mm thick aluminium base plate. The module has two digital inputs, two digital outputs, a relay output and an asynchronous interface which can be configured as RS232 or RS485.

The configurability of the interfaces also allows the module to be operated on an RS485 data bus. The address can be assigned either through software or hardware (3 DIP switches).

Figure 1: S6500 Long Range Reader Module (RI-STU-650A)



1.1 General

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1.2 System Description

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Figure 1: S6500 Long Range Reader Module (RI-STU-650A)



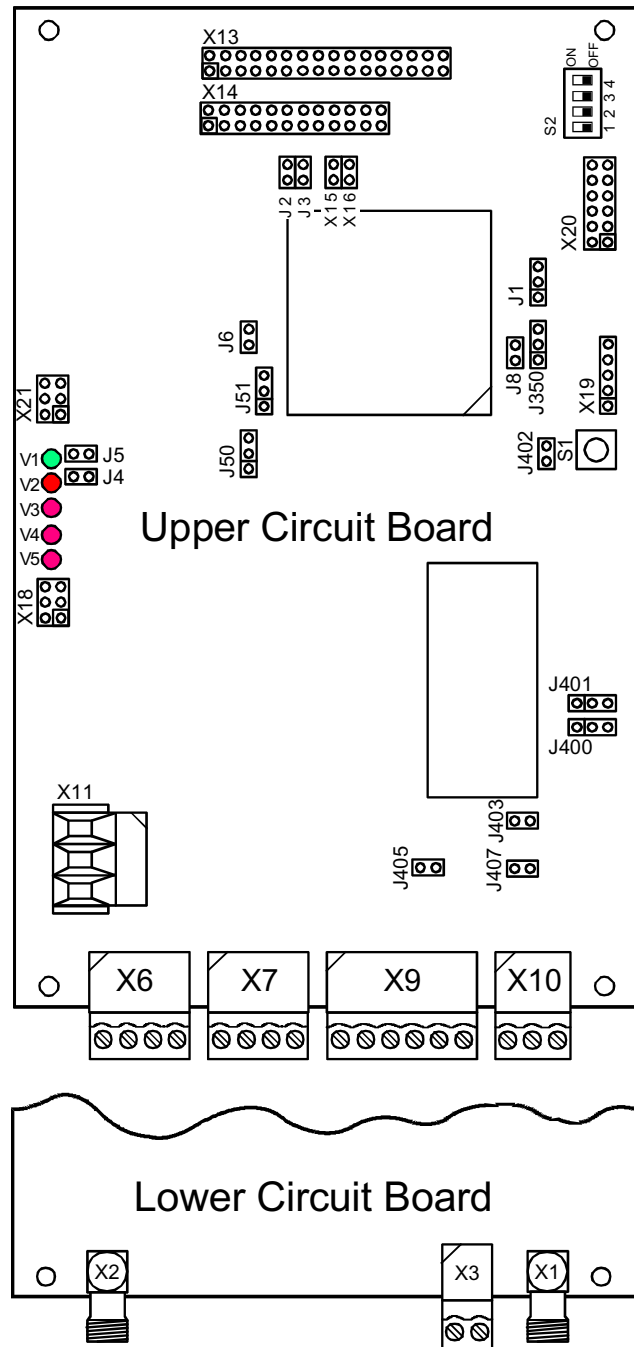
2.1 General

This chapter provides a description of the S6500 Long Range Reader Module hardware. It also provides the electrical specifications of the inputs and outputs.

2.2 Mechanical Information

Figure 2 shows the location of the connectors, jumpers and LEDs on the S6500 Reader.

Figure 2: Top View Upper and (part of) Lower pcb



2.3 Connectors

Three connectors are located on the lower pcb and 5 connectors are on the upper pcb. The connectors are all shown on Figure 2. Table 1 provides an overview of all the connectors and lists the section that describes them.

Table 1: List of Connectors

Identifying Letter	Function	Section
X1	Rx Only Antenna Connection	2.3.1
X2	Tx/Rx Antenna Connection	2.3.1
X3	Voltage Supply	2.3.2
X6	Isolated Optocoupler Outputs	2.3.4
X7	Isolated Optocoupler Inputs	2.3.3
X9	RS485 Interface	2.3.6
X10	RS232 Interface	2.3.7
X11	Relay Outputs	2.3.5

2.3.1 Antenna Connectors

There are two antenna connectors on the reader module. They are listed in Table 2.

Table 2: Antenna Connectors

Pin	Signal	Description
X1	ANT	Receive Only Antenna
X2	ANT	Transmit/Receive Antenna

Table 3: Antenna - Specifications

Parameter	Minimum	Maximum
Antenna Q-factor	10	30
Antenna Impedance	$50 \Omega \pm (3 \Omega \angle 3^\circ)$	
Tightening Torque	-	0.45 Nm

2.3.2 Supply Connector (X3)

The supply voltage is connected to connector X3 on the lower circuit board.

Table 4: Supply Connector

Pin	Name	Description
1	+ 24 V	Positive supply
2	GND	Ground

Table 5: Supply Connector - Specifications

Parameter	Minimum	Maximum
Logic Supply Voltage VSL	23.75 V	25.2 V
Logic Supply current ISL	-	2.5 A
Connecting Cable Length	-	3 m
Ripple (acceptable level)	-	20 mV

2.3.3 Isolated Optocoupler Inputs (X7)

The optocoupler inputs on Terminal X7 are galvanically isolated from the reader electronics and must therefore be powered by a separate external DC supply. For supply voltages above 10 V, the input current must be limited to a maximum of 20 mA by an additional external dropping resistor (see section 3.4.3).

Table 6: Optocoupler Inputs Connector

Pin	Name	Description
1	IN1+	+ Input 1
2	IN1-	- Input 1
3	IN2+	+ Input 2
4	IN2-	- Input 2

Table 7: Optocoupler Inputs Connector - Specifications

Parameter	Minimum	Maximum
External Supply Voltage	5 VDC	24 VDC
External Supply Current	-	20 mA

2.3.6 RS485 Interface (X9)

Depending on the configuration, the reader module will communicate either via the RS232 or RS485 interface (see Section 3.5).

The RS485 interface is connected to X9.

The transmission parameters can be software configured.

Table 12: RS485 Interface Connector

Pin	Name	Description	Direction
1	Rx+/Tx+	RS485 Non-inverted data	Input/Output
2	Rx+/Tx+	RS485 Inverted data	Input/Output
3	GND	Signal ground	-
4	-	n.c.	
5	-	n.c.	
6	-	n.c.	

All interface parameters are according to RS485 specifications and are not given in detail in this manual.

2.3.7 RS232 Interface (X10)

Depending on the configuration, the reader module will communicate either via the RS232 or RS485 interface (see Section 3.5).

The RS232 interface is connected to X10.

The transmission parameters can be software configured.

Table 13: RS232 Interface Connector

Pin	Name	Description	Direction
1	GND	Signal ground	-
2	RxD	Receive data	Input
3	TxD	Transmit data	Output

All interface parameters are according to RS232 specifications and are not given in detail in this manual.

2.4 Reader Module LEDs

There are five (one green and four red) LEDs on the reader. Their location is shown in Figure 2 and their function is described in Table 14.

Table 14: Description of LEDs

Name	Description
LED V1 (green)	<p>“RUN-LED”</p> <ul style="list-style-type: none"> - If all checks are OK this LED comes on (flashes) when V5 goes out. It indicates that the reader's internal software is running properly. - Flashing rate approximately 1 Hz. - After a firmware change this LED flashes alternately with V5 until a second reset is performed.
LED V2 (red)	<p>Diagnostic 1: RF communication / EEPROM status</p> <ul style="list-style-type: none"> - Short flashing indicates error-free communication with a transponder on the RF interface. - Flashes alternating with V1 after a Reset following a software update. - Flashes alternating with V1 in case a data error while reading the parameters occurred following a Reset.
LED V3 (red)	<p>Diagnostic 2: Host communication</p> <ul style="list-style-type: none"> - Short flashing indicates a protocol is being sent to the host on the RS232/RS485 interface.
LED V4 (red)	Diagnostic 3: Reserved
LED V5 (red)	<p>Diagnostic 4: Reader initialization / RF error</p> <ul style="list-style-type: none"> - Comes on during Reader initialization after power-up or after a reset, and goes out if everything is OK. - Comes on to indicate an error in the RF section of the Reader. The error type can be read out via software on the RS232/RS485 interface. - After a firmware change this LED flashes alternately with V1 until a second reset is performed.

2.5 Switches

There are two switches on the reader. Their location is shown in Figure 2 and their function is described in Table 15.

Table 15: Description of Switches

Name	Description
S1	Reset button
S2	1 - Setting data bus addresses (0 ... 7) 2 - Setting data bus addresses (0 ... 7) 3 - Setting data bus addresses (0 ... 7) 4 - not used



Note:

In order to set the bus address using S2, the reader must be set to software address "0" (default factory setting).

3.1 Introduction

**Note:**

Always ensure that the reader is switched off when making or breaking connections to it.

3.2 General

The S6500 Reader Module has been designed with easy installation in mind. The following information provides you with any details that you will need to know.

3.2.1 Default Configuration

The S6500 Reader is delivered with the default configuration as follows:

- Communication Interface: 38400 Baud,
8 data bits,
1 stop bit, even parity
- Antenna Connection: Only TX/RX Antenna active
- Anticollision procedure: active
- Supported Transponder Types: Tag-it HF,
Tag-it HF-I (and other ISO 15693 compliant transponders)

**Note:**

If you are only using one transponder Type in the application, the reaction time of the reader for transponder read/write operations can be optimized as long as only one transponder driver (not both of them) is activated.

However, if your system requires that you use the reader with a different configuration, you can use the S6 Reader Utility program which is available at our internet site <http://www.ti-rfid.com> (S/W Tools & Download) to re-configure the reader to your system's requirements.

3.3 Mechanical Mounting

Mounting is accomplished using the 4.5 mm diameter holes located in each corner of the base plate (see Figure 3). If the antenna is properly tuned and there is sufficient air convection along the mounting plate, the reader can be operated without an additional heat sink at up to 4 W of RF power.

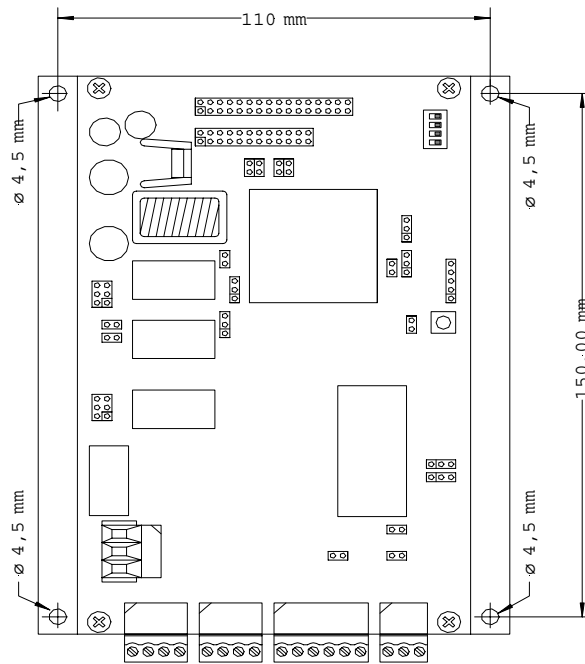
If you are going to operate the reader module above 4 W (to fully exploit the reader's performance) it must be mounted on an additional heat sink. The heat sink should have a thermal resistance R_{ThK} of maximum 0.8 K/W. When attaching the Reader Module to the heat sink you should strive for as little heat transfer resistance between the base plate and the heat sink as possible. We recommend that you use a heat sink compound.



Note:

Detuning of the antenna can result in additional heat being generated in the reader. If this happens the reader regulates its output power down until the final stage is once again within its upper temperature limit.

Figure 3: Reader Mounting Holes



The tolerances for the position of the mounting holes is ± 0.5 mm.

3.4 Connectors

3.4.1 Power Supply Connector

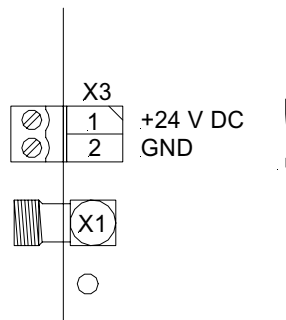
The supply voltage is connected to connector X3 on the lower circuit board.



CAUTIONS:

1. Reversing the power supply wires may destroy the device.
2. If you are using a switched power supply you must ensure that the switching frequency is below 300 kHz.

Figure 4: Supply Voltage Connector X3



Notes:



1. In order to conform to national requirements for radio devices, the power supply line must incorporate one of the \varnothing 28 mm x 20 mm ring cores mentioned in section 1.5. The cable must be wound around the core at least eight times (as shown in Figure 11). The distance between the ring core and the reader connection must not be more than 10 cm.
2. In order to avoid interference, the length of the cable between the power supply and the reader must not exceed 3 m.

3.4.2 Antenna Connectors (X1 & X2)

The transmit/receive antenna must be connected to the reader via the antenna SMA socket (X2). The maximum tightening torque for the SMA socket is 0.45 Nm.

If you are using a receive only antenna (together with the read write antenna) it must be connected to the reader via the antenna SMA socket (X1). The maximum tightening torque for the SMA socket is 0.45 Nm.

Notes:



1. In order to conform to national requirements for radio devices, each antenna line must incorporate one of the \varnothing 28 mm x 20 mm ring cores mentioned in section 1.5. The cable must be wound around the core at least four times (as shown in Figure 5). The distance between the ring core and the reader connection must not be more than 10 cm.
2. When connecting an antenna, ensure that it does not exceed the permissible limits as prescribed by the national regulations for radio frequency devices.

Figure 5: Antenna Line on a Ring Core



3.4.3 Isolated Optocouplers Input Connector

The input LED's on the optocouplers have an internal input series resistor of 500 Ω. For supply voltages above 10V the input current must be limited to a maximum of 20 mA by an additional external dropping resistor (see Figure 6 and Table 16).



CAUTION:

Reversing the polarity or overloading the inputs will destroy the reader.



Notes:

1. If the connecting cable is longer than 3 m you must use a shielded cable.
2. You must NOT use the reader's supply voltage to drive these inputs as the added noise may reduce the effective reading range.

Figure 6: Optocoupler Input - Internal and External Wiring

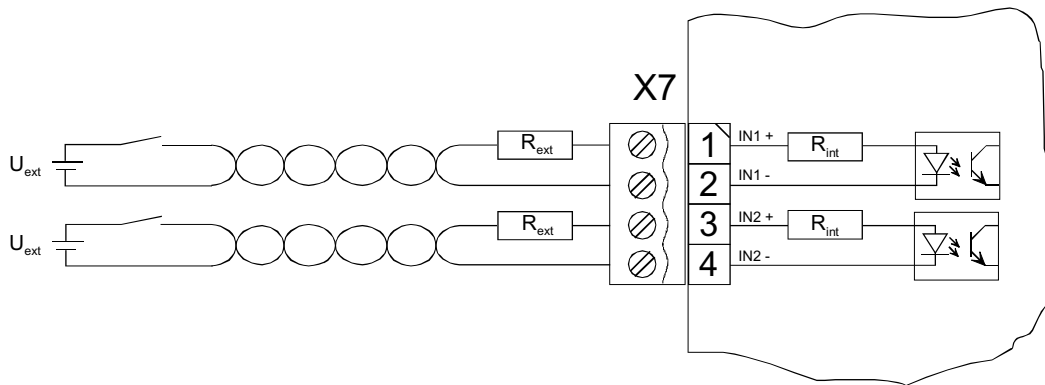


Table 16: Required External Dropping Resistor

External voltage V_{ext}	Required External Dropping Resistor R_{ext}
5 V ... 10 V	---
11 V ... 15 V	270 Ω
16 V ... 20 V	560 Ω
21 V ... 24 V	820 Ω

3.4.4 Isolated Optocoupler Outputs Connector

The transistor connections, collector and emitter, of the two optocoupler outputs are galvanically isolated from the reader electronics and brought out on connector X6 without any additional circuitry. The outputs must therefore be powered by external supplies.

The outputs are designed to switch resistive loads only.

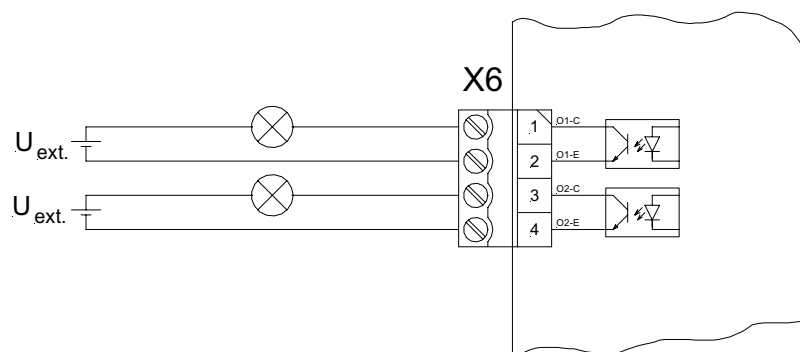
**Note:**

If the connecting cable is longer than 3 m you must use shielded cable.

**CAUTIONS:**

Reversing the power supply wires may destroy the device.

Figure 7: Optocoupler Outputs



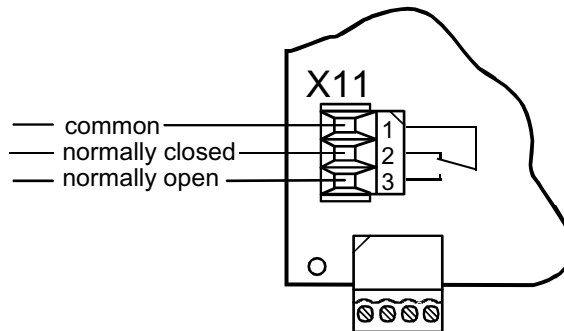
3.4.5 Relay Connector



CAUTIONS:

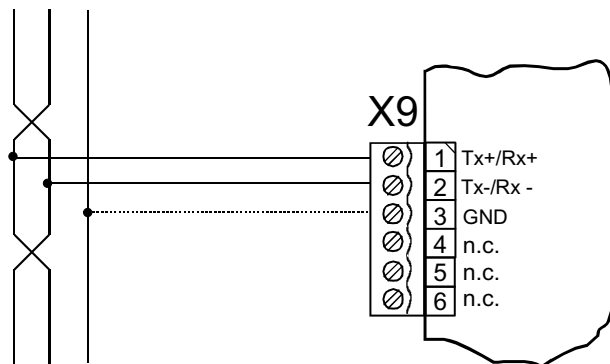
The two relay change-over contacts are designed to switch resistive loads only. If you are using an inductive load, the relay contacts must be protected by means of an external protection circuit.

Figure 8: Relay Connector



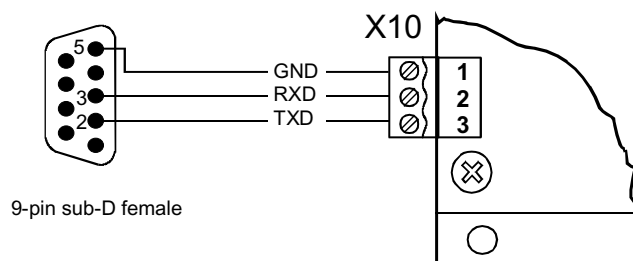
3.4.6 RS485 Connection

Figure 9: RS485 Interface



3.4.7 RS232 Connection

Figure 10: RS232 Interface



In order to conform to national requirements for radio devices, the interface connector line must incorporate one of the ring cores mention in section 1.5. The cable must be wound around the core at least eight times as shown in Figure 11. The distance between the ring core and the reader connection must not be more than 10 cm.

Figure 11: RS232 Interface Line on a Ring Core



3.5 Interface Configuration Jumper Settings

There are five jumpers used on the reader. They are Jumpers J400 - J401 which are used to configure the asynchronous interface for RS232 or RS485 described in Table 17, and Jumpers J403, J405 and J407 are used to insert the termination resistors which may be required for the RS485 interface, described in Table 18 and shown in Figure 14.

Table 17: Jumper Setting - J400 and J401

Jumper	RS232	RS485
400	1 - 2 connected	2 - 3 connected
401	1 - 2 connected	2 - 3 connected

Figure 12: Jumper Settings for RS232

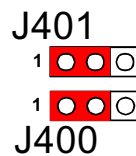


Figure 13: Jumper Settings for RS485

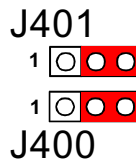
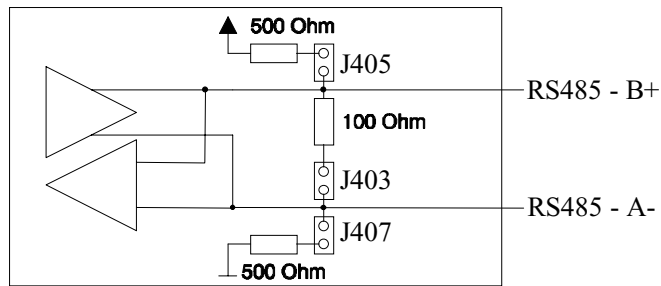


Table 18: Jumper Setting - J403, J405 and J407

Jumper	In	Out
403	Termination resistor between RS485 - A and RS485 - B	No termination resistor between RS485 - A and RS485 - B
405	Pull-Up on RS485 - B	No Pull-Up on RS485 - B
407	Pull-Down on RS485 - A	No Pull-Down on RS485 - A

Figure 14: Jumper Settings for RS485 Line Termination



3.6 Setting Bus Addresses

If you are going to use the reader connected to a bus you will have to give each reader an individual address. You can do that either by setting switch S2 on the reader or by software from the controlling computer.

3.6.1 Using S2 to Set the Address

You can use switch S2 to set the reader address between "0" and "7".

To set the bus address using S2, the Reader must be set to software address "0" (factory setting).

Address	S2-1	S2-2	S2-3
0	OFF	OFF	OFF
1	OFF	OFF	ON
2	OFF	ON	OFF
3	OFF	ON	ON
4	ON	OFF	OFF
5	ON	OFF	ON
6	ON	ON	OFF
7	ON	ON	ON



Note:

When you are using the reader modules in a multi-drop configuration you must power the readers up one-by-one, giving each reader its unique address before progressing to the next reader.

3.6.2 Setting the Reader's Bus Address through Software

Addresses "0" to 253" can be set by the host computer software, using the S6 Reader Utility program.

Technical Data

This chapter provides the technical specifications of the S6500 Reader Module. It also provides information about packing and storage.

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4.1 Specification Summary

Table 19: Ambient Conditions

Operating Temperature	-20°C to +65°C
Storage Temperature	-40°C to +85°C
Vibration	According to EN60068-2-6, 10 Hz to 200 Hz: 0.15 mm / 2 g
Shock	According to EN60068-2-27, acceleration 30 g

Table 20: Electrical Data

Supply Voltage	24 VDC +5%/-1% Ripple: maximum 20 mV
Power Consumption	maximum 60 W
Operating Frequency	13.56 MHz \pm 7 kHz
Transmitter Power	0.5 to 10 W* (set by software in steps of 0.25W)
Transmitter Modulation	(10% to 30%) \pm 6% and 100% (adjustable by software)
Antenna Connection - Tx/Rx Antenna - Rx Only Antenna	1 x SMA socket (50W) 1 x SMA socket (50W)
Optocoupler Outputs	24 V DC / 30 mA (galvanically isolated)
Relay (1 x change-over) Outputs	24 V DC / 60 W
Optocoupler Inputs	maximum 24 V DC / 20 mA
Interfaces	RS232 and RS485 (internally selectable)
Memory	EEPROM 1 kByte (for parameters; up to 10,000 write cycles) RAM 256 kByte (for data) Flash 512 kByte (for firmware; update via communication interface)

* If the configured output power is above 4 W, an additional 0.8 K/W heat sink is necessary

4.2 Mechanical Information

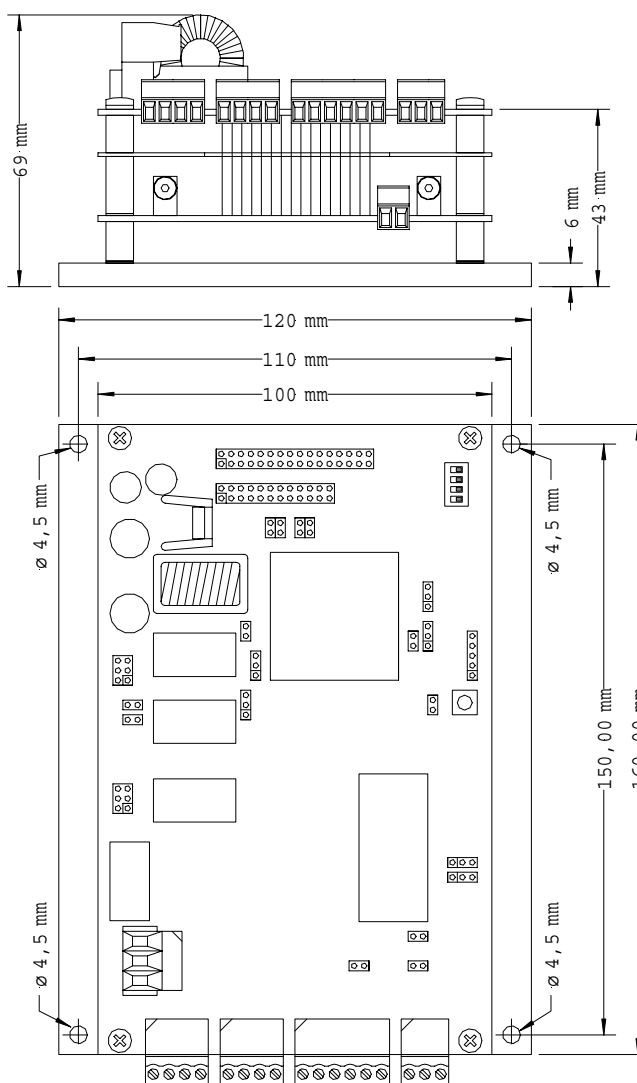
- **Dimensions (W x L x H)** 120 x 160 x 69 mm
- **Weight** 650 g

Figure 15 shows the dimensions of the S6500 Reader. The tolerances are:

Length and Width: ± 0.5 mm

Height: ± 2.0 mm

Figure 15: Reader Dimensions and Mounting Holes



Regulatory, Safety and Warranty Notices

This chapter provides important information about regulatory constraints and safety precautions.

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5.1 Regulatory Notes

An RFID system comprises an RF transmission device, and is therefore subject to national and international regulations.

Prior to operating the S6500 Long Range Reader Module together with antenna(s) and power supply, the required FCC, PTT or relevant government agency approval must be obtained. Sale, lease or operation in some countries may be subject to prior approval by the government or other organization.

5.1.1 FCC Notices (U.S.A.)

A typical system configuration containing the S6500 Long Range Reader Module has been tested and found to comply with the limits for a Class A digital device, 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.

5.1.2 R&TTE Conformity (Europe)

A R&TTE Declaration of Conformity is available for the S6500 Long Range Reader Module at TI*RFID Sales Offices.

The equipment complies with the essential requirements of the Telecommunication Terminal Equipment Act (FTEG) and the R&TTE Directive 1999/5/EC when used for its intended purpose.



Any device or system incorporating the S6500 Long Range Reader Module in any other than the originally tested configuration needs to be verified against the requirements of the Telecommunication Terminal Equipment Act (FTEG) and the R&TTE Directive 1999/5/EC. A separate Declaration of Conformity must be issued by the System Integrator or user of such a system prior to marketing and operating it in European Community.

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 the system.

5.2 Safety Precautions

5.2.1 Human Safety

**WARNING:**

CUSTOMERS USING THE S6500 READER MODULE ARE RESPONSIBLE FOR OPERATING THEIR SYSTEM UNDER IMPLEMENTED POWER LEVELS AND ANTENNA CONFIGURATIONS AGAINST RELEVANT STANDARDS FOR HUMAN SAFETY IN ELECTRONIC FIELDS.

5.2.2 Application Restrictions

**CAUTIONS:**

When integrating these boards into housings appropriate means of cooling may be necessary in order to prevent that the combination of environmental temperature and heat generated by the reader board will not exceed the specified operating temperature.

5.2.3 ESD Safety Information

The Reader Module is packed in special anti-static envelopes, which protect against electrostatic charge that could cause damage.

- Handle the Reader Module carefully and keep it in the protective envelope until you are ready to install it.
- Whenever possible, handle the Reader Module by its edges or frame.

5.3 Warranty and Liability

The “General Conditions of Sale and Delivery” of Texas Instruments Incorporated or a TI subsidiary apply. Warranty and liability claims for defect products, injuries to persons and property damages are void if they are the result of one or more of the following causes:

- improper use of the Reader Modules
- unauthorized assembly, operation and maintenance of the Reader Modules
- operation of the Reader Modules with defective and/or non-functioning safety and protective equipment
- failure to observe the instructions during transport, storage, assembly, operation, maintenance and setting up of the Reader Modules
- unauthorized changes to the Reader Modules
- insufficient monitoring of the Reader Modules' operation or environmental conditions
- improperly conducted repairs
- catastrophes caused by foreign bodies and acts of God.

Terms & Abbreviations

The terms and abbreviations used in this manual can be found in the TIRIS Terms and Abbreviations Manual - document number 11-03-21-002. This manual can be found in the document center on our home page:

<http://www.ti-rfid.com>