# Manual

## SHL-2100 v3.0


| Product name | Version | |
|---|---|---|
| SHL-2100 | 3.0 | |
| Last change | Author | Document revision |
| 31.08.17 | J.Kalbitzer | 1.0 |

# Contents

# 1 Safety Informations

**As with all electronic systems, the system described hereafter may not be used for any applications critical for maintaining safety. This means, the products may not used in life support applications or any other life critical applications that could involve potential risk of death, personal injury or severe property or environmental damage.**

**The user/operator is solely responsible for any damages resulting from an improper or unintended utilization of the system.**

# 2 General

scemtec Transponder Technology GmbH (sttID) reserves the right to make changes or to discontinue its products or services at any time without notice. sttID takes no responsibility for customer applications, products, or performance relating to systems or applications incorporating with sttID products.

sttID assumes no liability and is not responsible for infringement of patents and/or any other intellectual or industrial property rights of third parties, which may result from assistance provided by sttID.

Please note, that the user is responsible for conformity with regulation issues (e.g. radio approval), when using antennas not provided by sttID or using the system in countries, where the conformity with local regulations is not tested by sttID. All other products mentioned in this document might be brands or brand names of the different suppliers.



## 2.1 RoHS and WEEE Directives

### *2.1.1 RoHS*

sttID certifies that this product is compliant with the European Directive 2011/65/EU (RoHS II)

for the restriction in Electrical and Electronic Equipment's (RoHS) of the use of the following

hazardous substances:

- Cadmium
- Hexavalent Chromium
- Lead
- Polybrominated biphenyl flame retardants
- Polybrominated diphenyl ether flame retardants
- Mercury

This declaration is based on information provided by our suppliers and subcontractors.

### *2.1.2 WEEE (Waste Electrical and Electronic Equipment)*

This product bears the selective sorting symbol for waste electrical and electronic equipment

(WEEE). This means that this product must be handled pursuant to European Directive 2011/65/EU in order to be recycled or dismantled to minimize its impact on the environment. For further information, please contact your local or regional authorities.

# 3 RFID Systems

As this technology is based on radio frequency, one must exercise the following operational and mounting instructions to achieve best performance:

- Metal affects radio signals. Normally the antenna has to be as far away as possible from any metal object and it's damping influence on the magnetic field. Only this leads to the best distribution of the magnetic field in the reading range. Very important as well is not to have "short circuits", in the vicinity of the antenna, damping the magnetic field. A "short circuit" is any metal near the antenna, building a "metallic ring", so that currents introduced by the RF-field can flow, absorbing the energy needed for the tag to operate.
- Care must be taken to reduce or eliminate unwanted signals (so called interference or noise) from external sources. The reading range may be reduced by following noise sources:
  - portable two way radio
  - cellular phones
  - switching power supplies
  - computer monitors
  - frequency converters (e.g. motor control systems)
- The read range is depending upon
  - performance of the Reader
  - size of the antenna
  - size of the tag (the bigger the better)
  - orientation of the tag antenna plane to the Reader antenna plane
  - quality of the tag
  - matching of Reader antenna size and tag (-antenna) size
  - environmental, electrical noise
  - If influence of metal can not be fully avoided a tuning of the antenna is required and will improve reading range

# 4 System Description

This manual describes the 13,56 MHz Long Rang Reader System „SHL-2100“, hereafter referred to as "Reader".

The 13,56 MHz Long Range Reader system „SHL-2100“ is designed as a multi-tag system for reading and writing information stored on transponders (TAGs).

Beside the standard version with one single antenna port, there is also a MUX version with integrated antenna multiplexer is available. This version offers 4 antenna ports with BNC connectors for attaching external antennas.

The Reader is designed for indoor and outdoor usage.

Transfer of data between the Reader and a host computer is possible via Ethernet, USB and an asynchronous RS232 interface. Furthermore a configurable “stand-alone” operation via so called Smart Read Feature is possible.

The Reader is compatible with the ISO/IEC 15693-2 and ISO 18000/3 “A” and “C” standards.

# 5 Quick Start

First Connect the Reader as shown below:

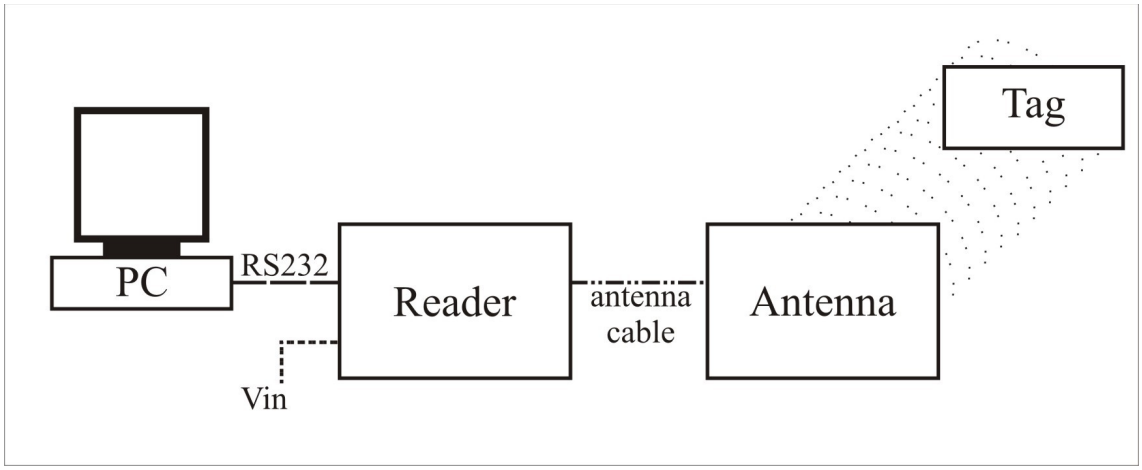


*figure 1: Reader connection example*

As example you can use the sttID antenna “SAT-A40-LR-O-13MHz” [400.4020].

Now you can use a Software like “Uni - Demo” to control the Reader. For more details please refer to “Quick Start Guide read”. This Guide is available for download on www.stt-rfid.com.

# 6 Hardware

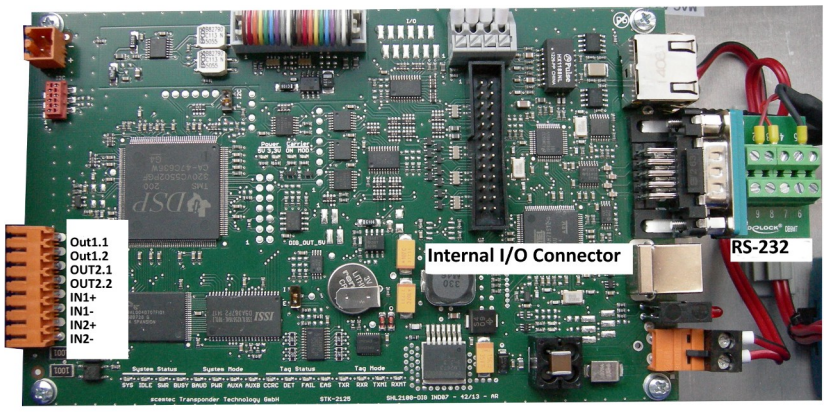


*figure 2: Digital board*

## 6.1 Voltage Supply

The Reader is designed for a voltage supply direct by the grid connectable via an Schuko plug (two-pin grounded plug).

## 6.2 Interfaces

For communication with a host device (e.g. PC), the Reader provides three interfaces (RS232, USB, Ethernet). The interfaces are handled by an separate, built-in interface unit with an ARM7 microprocessor. This interface-unit can also be configured to operate the Reader in stand-alone mode (Smart Read feature).

The interfaces are intended to be used only with connection cables not longer than 3m.

### *6.2.1 Ethernet*

The Reader is equipped with a 10/100 T-Ethernet interface.

By default the Reader gets his IP Address via DHCP. Nevertheless the Reader can also be configured with a static IP Address. Configuration can be done via a simple integrated web server, which can be reached by typing the actual IP Address in the address line of browser. After Login, configuration page for Network settings is available.

Default Login Settings:

Username: admin

Password: scemtec

The actual assigned IP address of the reader can be determined using sttID Demo Software (e.g. Unidemo). Clicking the “Search” Button in Ethernet connection window of the STX/ETX connector will show the actual IP address as well as MAC address of all sttID devices available in the local network.

Network settings may also be configured by using STX-ETX commands. For details please refer to STX-ETX protocol description.

### 6.2.2 USB

The Reader is equipped with a USB 2.0 full speed (12 Mbits/sec) port. The connection is made via a standard USB-B connector.

| | |
|---|---|
| **Supported profiles** | CDC-ACM (virtual COM-Port), HID (Keyboard emulation) |

Appropriate drivers for Windows are available for download on www.stt-rfid.com.

### 6.2.3 RS 232 Interface

The Reader is equipped with a RS232 interface. The connection is made via a 6 pole plug with Push-in spring connection. The connection is made via a standard 9 pin D-Sub connector .

| Terminal designation: | SUB-D Connector Pin | Terminal Function |
|---|---|---|
| TxD | 2 | Transmit Data |
| RxD | 3 | Receive Data |
| GND | 5 | Ground |

The data transfer rate is adjustable via STX-ETX commands.

| | |
|---|---|
| **Configuration** | 8 Data Bits, 1 Stop Bit, no Parity, no flow control |
| **Supported Data Rates [baud]** | 1200, 2400, 4800, 9600 (default), 19200, 38400 57600, 115200, 230400 |

In addition to the primary RS232 Interface described above, the Reader provides a secondary RS232 Interface, intended to be used in stand alone mode as interface for connecting auxiliary equipment (e.g. additional RFID reader, bar code scanner, …). The connection to the secondary RS232 is also made via the 9 pin SUB D connector. Please contact sttID for further Information regarding usage of the second RS232 in your application.

| Terminal designation: | SUB-D Connector Pin | Terminal Function |
|---|---|---|
| TxD2 | 8 | Transmit Data Secondary RS232 |
| RxD2 | 7 | Receive Data Secondary RS232 |
| GND | 5 | Ground |

Special Adapters cables for connecting external devices to the secondary RS232 are available from sttID.

On the SHL-2100 Rev3 an adapter board for easy connecting lose wires is supplied. The Pin numbers are equal to the 9 pin SUB D connector.

## 6.3 HF Unit

The carrier frequency of 13.56 MHz is generated in the HF unit. The final stage generates a maximum output on nominal $Z_F = 50$ Ohm.

## 6.4 External Antenna

The Reader is only operational with external antenna(s).

Some key parameters of the Reader such as reading range for example depends on the used antenna, the used transponder type,size and quality, and the resulting magnetic coupling between the transponder resonant circuit and the transmission/receiver antenna.

The connected antenna(s) should be configured for the optimal resonance frequency of 13.56MHz with ohm adjustment (nominal $Z_F = 50$ Ohm) to ensure the best possible system performance.

When using antennas not provided by sttID, please make sure that the antenna quality factor is in the range between 20 and 50 and the antenna is optimally tuned. The resulting SWR value should be well below 2.

Antenna tuning should be checked at the final installation. Furthermore antenna detuning caused by heating of the antenna matching unit should also be observed

## 6.5 Reader Versions

The Reader is available in two versions. The standard version is equipped with a single antenna port. Beside this a version with integrated antenna Multiplexer (MUX) is available, which switches the output power to one of up to 4 antenna ports, for sequential operating of attached antennas. This Version can also configured in a Split – Mode.

### *6.5.1 Single Port (standard)*

The standard version of the Reader is equipped with one antenna port, which provides the maximal output power. The output power can be reduced by software commands.

### *6.5.2 Internal Multiplexer (can also be configured as Splitter)*

In this version up to 4 antennas can be connected to the Reader. The user can select each connected antennas with software commands. In this version only a slightly reduced HF power on nominal $Z_F = 50$ Ohm is available on the selected antenna port at any one time. Furthermore the output power can be reduced by software command.

## 6.6 Internal Inputs and Outputs (using not recommended)

The Reader has an internal 26 pole connection for different features which are shown in this table:

| Pin assignment of the internal 26 pol connector | |
|---|---|
| **pin** | **function** |
| 1 | Binary Input I1 + (A) (see section “Binary Inputs) |
| 2 | Binary Input I1 – (K) (see section “Binary Inputs) |
| 3 | Binary Input I2 + (A) (see section “Binary Inputs) |
| 4 | Binary Input I2 – (K) (see section “Binary Inputs) |
| 5 | reserved |
| 6 | reserved |
| 7 | reserved |
| 8 | reserved |
| 9 | Ground (GND) |
| 10 | + 5 V (50mA max) |
| 11 | Ground (GND) |
| 12 | +15V (250mA max) |
| 13 | Digital Output “OUT_TAG” (open collector, see section “Digital Output”) |
| 14 | Digital Output “OUT_EAS” (open collector, see section “Digital Output”) |
| 15 | Digital Output “OUTPUT 1” (open collector, see section “Digital Output”) |
| 16 | Digital Output “OUTPUT 2” (open collector, see section “Digital Output”) |
| 17 | Digital Output “OUTPUT 3” (open collector, see section “Digital Output”) |
| 18 | Digital Output “OUTPUT 4” (open collector, see section “Digital Output”) |
| 19 | Digital Output “OUTPUT 5” (open collector, see section “Digital Output”) |
| 20 | Digital Output “OUTPUT 6” (open collector, see section “Digital Output”) |
| 21 | Digital Output “OUTPUT 7” (open collector, see section “Digital Output”) |
| 22 | Digital Output “OUTPUT 8” (open collector, see section “Digital Output”) |
| 23 | R_NO (two-way relay, normally open contact, see section “Relay”) |
| 24 | R_COM (two-way relay, common contact, see section “Relay”) |
| 25 | R_NC (two-way relay, normally closed contact, see section “Relay”) |
| 26 | +3.3V (250mA max) |

### 6.6.1 Binary Inputs (Pin 1- 4)

Two binary inputs are available for customer-specific tasks. Both inputs are accessible with indirect-connected opto-couplers .

The state of both binary inputs must be imported unambiguously via software command.

In stand alone mode (SMART Read) the behavior of the Inputs can be configured freely (e.g. trigger Read event).

| Input designation: | Terminal designation: | Internal opto-coupler assignment: |
|---|---|---|
| Input 1 | I1 + (A) | Anode of the opto-coupler input 1 |
| | I1 – (K) | Cathode of the opto-coupler input 1 |
| Input 2 | I2 + (A) | Anode of the opto-coupler input 2 |
| | I2 – (K) | Cathode of the opto-coupler input 2 |

The electrical data can be found in the table 'electrical specification'.

### 6.6.2 Binary Outputs

Two binary outputs in the form of potential-free contacts are available for customer-specific tasks. Both outputs are accessible with indirect-connected relays and screw terminals (see terminal description below). They are freely configurable via software commands.

In stand alone mode (SMART Read) the behavior of the Outputs can be configured freely (e.g. change state when TAG is read).

Terminal assignment:

| Input designation: | Terminal designation: | Internal assignment: |
|---|---|---|
| Output 1 (normally open) | O1.1 | Contact 1 of the potential-free Output-port 1 |
| | O1.2 | Contact 2 of the potential-free Output-port 1 |
| Output 2 (normally open) | O2.1 | Contact 1 of the potential-free Output-port 2 |
| | O2.2 | Contact 2 of the potential-free Output-port 2 |

All screw terminals are clearly marked with their specific designation at the terminal. The screw terminals accepts wires of maximum conductor cross-section of 2.5mm².

The electrical data can be found in the table 'electrical specification'.

### 6.6.3 I/O connection example

The following schematic is an example how to connect the Inputs and Outputs.

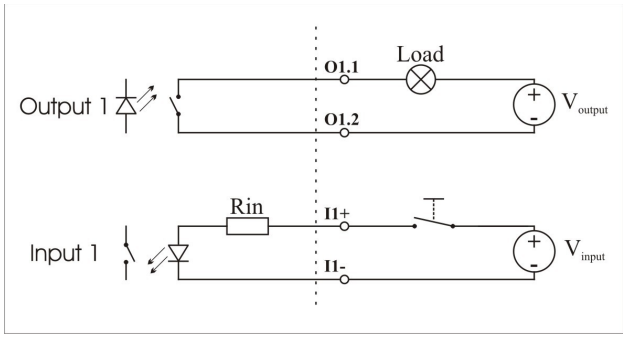


*figure 3: IO connection example*

## 6.7 Diagnosis LEDs

### *6.7.1 Internal LEDs*

There are some internal LEDs for diagnostics.

SHL-2100 Diagnosis LEDs

Firmware v0.91

| *Group* | *LED* | *C* | *Description* | *Off* | *Blink (n times)*[1] | *On* | *Error* |
|---|---|---|---|---|---|---|---|
| System Status | SYS | R | Global system status display. | Normal system operation. | a) $n$=3 at boot time: Firmware is being restored from backup. | a) Error display[2]; a second LED classifies the error (see "Error" column). | Always on.<br>See blinking LED for error classification. |
| | | | | | b) During operation: System overheat by ($n$-1)*10 to $n$*10 degrees. | b) EEPROM Loader is active; only SYS and IDLE LEDs are available. | |
| | IDLE | Y | Idle status display | System is processing a command. | - | System is accepting commands | No valid firmware backup available to be restored. |
| | SWR | R | SWR (standing wave ratio) display. | SWR is below the lower threshold or has not been measured. | SWR value with integer precision: $n$=1 means 1.x, $n$=2 means 2.x and so on. | SWR is beyond the upper threshold specified in the global settings. | Firmware restore failed. |
| | BUSY | Y | Busy status display. | System is accepting commands. | - | System is processing a command. | SRAM error. |
| System Mode | BAUD | G | Baud rate display. | - | Currently active baud rate step (1-9)[3]. | - | Flash access violation. |
| | PWR | G | Power display. | - | Currently active power step (1-4)[4]. | - | Fash write/verify error. |
| | AUXA | G | Auxiliary display A. | No auxiliary information. | Auxiliary information. | Auxiliary information, e. g. SYNC Listen Mode active. | EEPROM not found. |
| | AUXB | G | Auxiliary display B. | No auxiliary information. | Auxiliary information, e. g. SYNC group number. | Auxiliary information, e. g. ungrouped SYNC mode active. | EEPROM write/verify error. |
| Tag Status[5] | CCRC | R | Collision/CRC display. | Neither collision nor CRC error has been detected. | - | Collision and/or CRC error during the most recent tag operation. | Data stack overflow. |
| | DET | Y | Tag detection display. | No (valid) tag response detected. | - | Valid tag response detected during the most recent tag operation. | System stack overflow. |
| | FAIL | R | Tag operation failure display. | No failure (or no valid tag response). | - | Execution error though valid tag response (e. g. write protection) during the most recent tag operation. | SRAM access violation. |
| | EAS | Y | EAS alarm display. | No EAS alarm. | - | EAS alarm activated during the most recent tag operation. | DMA overload. |
| Tag Mode[6] | TXR | G | TX data rate. | Low data rate from reader to tag. | - | High data rate from reader to tag. | - |
| | RXR | G | RX data rate. | Low data rate from tag to reader. | - | High data rate from tag to reader. | - |
| | TXMI | G | TX modulation index display. | Reader's modulation index is 20%. | Reader's modulation index is a combination of 20% and 100%. | Reader's modulation index is 100%. | - |
| | RXMT | G | RX modulation type display. | Tag's modulation type is ASK (amplitude shift keying). | - | Tag's modulation type is FSK (frequency shift keying). | - |

[1] Blinking equals a numeric display; the number of flashes between pauses represent a numeric value.
[2] Once an error condition is displayed, only a cold reboot will return the system to normal operation.
[3] Baud rate steps: 1=1.2K; 2=2.4K; 3=4.8K; 4=9.6K (default); 5= 19.2K; 6=38.4K; 7=57.6K; 8=115.2K; 9=230.4K.
[4] Power steps: 1=0.7W; 2=1.0W; 3=2.0W; 4=4.0W (default).
[5] Tag status will only be displayed as long as the carrier remains on.
[6] Tag mode display will always refer to the most recent tag transaction.

*figure 4: internal LEDs*

Shortcuts in column C (Color): R = red, Y = yellow, g = green.

### *6.7.2 External LEDs*

Two external LEDs provide users with a diagnosis of the most important monitoring functions "Power" and "Tag Detect".

| Led | Color | Designation | Description |
|---|---|---|---|
| 1 | green | Power | The voltage supply for the CPU is ensured |
| 2 | yellow | Tag Detect | A read or write process for the transponders has concluded successfully |

## 6.8 Processors

The Reader incorporates two Microprocessor. One handles the interface communications with the connected host systems as well as stand alone operations (interface processor).
The second processor (main processor) handles all actions related to Communication with Transponders

## 6.9 Memory

The firmware of the incorporated microprocessors is stored in a flash memory. It can be updated at any time via the USB or RS232 interface.
A serial EEPROM to store configuration and user data is also available.

## 6.10 Real time clock (RTC)

The reader has an integrated RTC – Unit. It can be read out by STX/ETX commands.

## 6.11 Temperature Sensor

The reader has an integrated Temperature Sensor. It can be read out by STX/ETX commands.

# 7 Operating Modes

## 7.1 Standard (Host) Mode

In standard mode the Reader is completely controlled by a Host system connected to one of the available Interfaces via STX-ETX commands. For further information, please refer to the STX-ETX protocol description, which can be downloaded from www.stt-rfid.com.

## 7.2 Stand alone Mode (SMART Read)

In addition to controlling the Reader with a host system via one of the interfaces, it can also be configured for stand alone operation. Therefore the “Smart Read” feature is implemented.

For further Information about Smart Read please refer to the correspondent Smart Read manual, which can be downloaded from www.stt-rfid.com.

# 8 Software

## 8.1 Software utilities

Various software utilities for Windows for the Reader are available for download on www.stt-rfid.com. Linux Versions are available on request.

Available Software utilities:

- UniDemo: Universal Demo Software for easily controlling the Reader with a Host system.
- STXTerm: Terminal program for controlling the Reader with a Host system by directly submitting STX-ETX commands. For submitting multiple STX-ETX commands a comprehensive Script utility is implemented
- Flasher: Utility for updating firmware on the incorporated Microprocessors
- SmartManager: Utility for configuration and using the Reader in Standalone mode (Smart Read).

## 8.2 Firmware

The firmware of the Reader contains all basic functions for reading and writing tags of different manufacturers (air protocol), numerous control and configuration functions, as well as different diagnosis routines. Firmware can be updated by the user via USB or RS232 Interface. Therefore the latest Firmware files are available for download on www.stt-rfid.com.

## 8.3 STX-ETX Interface Protocol

For communication with the Reader sttID STX-ETX protocol is used. The required STX/ETX protocol description can be downloaded from www.stt-rfid.com. A list of supported STX-ETX commands can be read out from the Reader via the STX-ETX command ‘100E’ or via STX-ETX script ‘Get Fn List.stx’ (which will be installed together STXTerm software ).

# 9 Electrical specification

| Electrical specification (Ambient temperature: 25°C) | | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **Test condition** | **Symbol** | **Min.** | **Typ.** | **Max.** | **Unit** |
| AC input voltage | - | $V_{IN}$ | 100 | 230 | 240 | Volt |
| Current consumption | - | $I_{IN}$ | - | - | 1 | A |
| Operating frequency | - | $F_{RF}$ | - | 13,56 | - | MHz |
| RF power (internal) | - | $P_{internal}$ | - 1db | 4 | + 1db | W |
| Input voltage binary inputs I1/I2 | - | $V_{input}$ | - | 24 | - | Volt DC |
| Input current binary inputs I1/I2 | $V_{input}$ = 24V/DC | $I_{input}$ | - | 22 | - | mA |
| Series resistors binary inputs I1/I2 | - | $R_{IN}$ | - | 1000 | - | Ohm |
| Output switching voltage binary outputs O 1 / O 2 | | $V_{output}$ (AC/DC) | - | - | 30 | Volt AC/DC |
| Output switching current binary outputs O1 / O 2 | | $I_{out}$ | - | - | 1 | A |
| Output power dissipation binary outputs O 1 / O 2 | | $P_{out}$ | - | - | 500 | mW |
| On resistance binary outputs O 1 / O 2 | | $R_{on}$ | - | 0,25 | 0,50 | Ohm |
| Operating (ambient) temperature range | - | $T_{amb}$ | 0 | - | 50 | °C |
| Storage temperature range | - | $T_{stg}$ | -20 | - | 70 | °C |

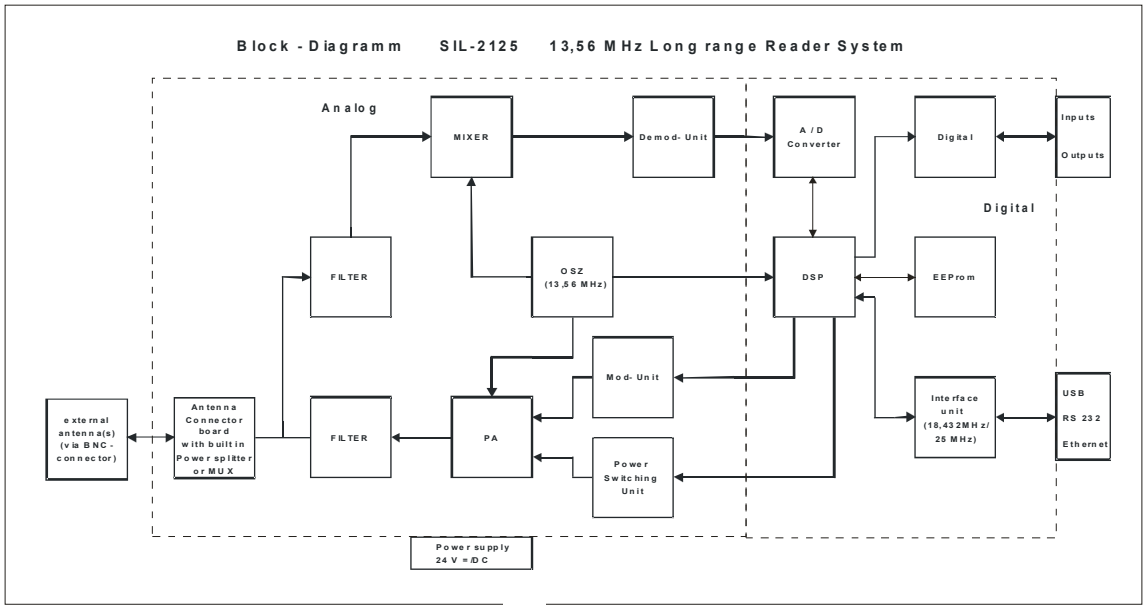


*figure 5: Block diagram*

# 10 Mechanical Specification & Mounting

## 10.1 Dimensions

An steal housing protection type IP 66 (in acc. with DIN EN 60529) is used. This housing is equipped with four mounting holes. For mounting the Reader only use the delivered mounting brackets. To safe the protection type mount the brackets in the way it is described in the included mounting manual.

| **Housing dimensions** | |
|---|---|
| Length | 400mm (without connectors/ with: +30mm) |
| Width | 200 mm |
| High | 120 mm |
| Color | Blue (RAL 5002) |

## 10.2 Mounting

When mounting the Reader on a wall or ceiling, only the provided screw-holes has to be used. Fixing to the wall/ceiling has to be done with appropriate installation material (not included) using all of the foreseen mounting points.

When installing the Reader, please make sure that the maximum ambient temperature is not exceeded at any time. Therefore the Reader should only be installed in places where sufficient ventilation is assured. Any kind of possible heat accumulation should be avoided (e.g. the Reader should not be mounted in an additional housing or cabinet).

# 11 Delivery Scope / Optional Equipment and Accessories

## 11.1 Delivery Scope

- SHL-2100 Reader system
- USB cable

# 12 Related Documents

- QuickStart Guide read
  - Short introduction for using the Reader with UniDemo
- Quick guide to STXETX-protocol
  - Short introduction of basic structure of STX-ETX protocol
- STX/ETX Protocol description
  - Detailed Description of command structure and available commands for controlling the Reader with a Host system
- SmartRead Manual
  - Description of functionality for stand alone operation
- SmartManager Manual
  - Description for using the SmartManager to configure a Reader for stand alone operation
- C# Demo with source code
  - Example code for integrating the Reader in your own application software

All documents are available for download on www.stt-rfid.com.

# 13 Contact sttID

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If you have any questions about our products, please do not hesitate to call us. Our specialists are always available for you and will provide professional support to find a solution to your specific problem.

# 14 Document History

| Version | Date | Changed by | Description |
|---|---|---|---|
| 2.0 | 25.10.2006 | G.Cichon | Corrections in the old German document |
| 2.1 | 10.1.2007 & 6.2.2007 | G.Cichon | Corrections in the old German document |
| 2.2 | 22.1.2015 | A.Auras | Fit to new general English template |
| 2.3 | 02.06.15 | B.Bröhl | Minor coorections |
| 3.0 | 31.08.17 | J.Kalbitzer | Adapted to Hardware Rev.3 |