SYMEO LPR®

SYMEO
ABSOLUTE POSITIONING

Protocol Description Binary XP (1D messages)

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1 Protocol Description Binary XP (1D messages)

1.1 General Description

This protocol describes the interface between a LPR®-B station and the user. The binary protocol XP protocol provides information in high density. Its structure ensures a simple implementation. The transfer is done in single data frames.

The interface for the binary protocol XP can either be a serial (RS232) interface or a TCP/IP or UDP interface. The baudrate of the serial interface must be set to 115200 baud.

1.1.1 Direction of Data

The interface can be applied bidirectional. However certain data types are defined for one direction. Furthermore it is only allowed to send data to a LPR®-B station after the LPR®-B station has sent a send request (type 0x02). Table 1 shows an overview which data packets can be applied in which direction.

Data Type	direction	
	from LPR®-B	to LPR®-B
0x00 Distance Data	+	
0x01 User Data	+	+
0x02 Send Request	+	
0x03 Relay Switching Command		+

Tab. 1: direction of data

Sending data to the LPR®-B station is only possible after receiving a send request (Type `0x02`). The send request type guarantees the “ready-to-receive” status of the LPR®-B station. The LPR®-B can only handle one data packet from one user.

If nevertheless data is sent to the LPR®-B station without a previous send request, it can result in a reboot of the LPR®-B station.

Per one send request the user can send only one data set to the LPR®-B station.

1.1.2 Structure of Data Packet

To apply the protocol on a RS232 interface each data packet starts and ends with a reserved symbol. This reserved symbol cannot appear in the data stream.

Figure 1 shows the general structure of the data packet.

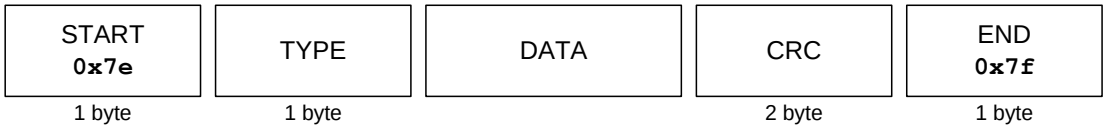


Figure 1: Structure of data the packet

The START and the STOP-field is in each data packet the reserved symbol `0x7e` and `0x7f`. TYPE indicates the type of the data packet. There can be defined up to 256 different types.

The TYPE-field is following the DATA-field. The DATA field contains the real data of the packet of the type TYPE. The CRC-field contains a check sum. The check sum is applied to all previous data fields except the START data field.

All multi byte integers (e.g. CRC field) are encoded in Network-Byte-Order (Big Endian). All signed integers are encoded in two's complement representation.

1.1.3 Byte Stuffing

The two symbols 0x7E and 0x7F are unique for START and STOP-fields. If those symbols occurs within any other field (TYPE, DATA or CRC), they must be replaced by the following order:

original symbol	replaced by
0x7D	0x7D 0x5D
0x7E	0x7D 0x5E
0x7F	0x7D 0x5F

This byte stuffing scheme ensures that the receiver of the protocol can identify definitely the START-field within a flow of data, even if the symbol of the start field occurs within the DATA-field.

Example: If the symbol 0x7d is read, it must be cancelled. The following symbol must be XOR combined with 0x20 to recreate the original symbol.

Remark: Byte stuffing is deactivated for the fixed frame protocol (compare chapter 1.3).

1.1.4 CRC

The CRC-16-IBM with polynomial $x^{16}+x^{15}+x^2+1$ is used for the CRC. The CRC is calculated over all data fields (TYPE and DATA), but not for the START and END field.

The CRC-calculation is only applied to the original symbols. The appropriate calculation for coding must applied **before** byte stuffing. If receiving the data from the LPR®-B system the byte stuffing must be reserved to get the original symbol. Then the CRC is updated with the original symbol.

1.2 Data Types

The second byte in each data packet specifies the data type.

1.2.1 Type 0x00 – Distance Data

Direction: LPR®-B → User

Content	Length	Data type	Value
START	1	unsigned integer	0x7E
TYPE	1	unsigned integer	0x00
Source[1] (LPR® address)	2	see chapter 1.4.1	0x####
Destination[1] (LPR® address)	2	see chapter 1.4.1	0x####
Antenna number[2]	1	unsigned integer	0x##
Distance [mm]	4	signed integer	0x#### ####
Velocity [mm/s]	4	signed integer	0x#### ####
Level [dB]	1	signed integer	0x##
Distance Error	1	see chapter 1.4.2	0x##
Status[3]	1	unsigned integer	0x00
CRC	2	unsigned integer	0x####
END	1	unsigned integer	0x7F

Total length without byte stuffing: 21 byte

[1]) Any measurement is always executed by a LPR®-B base station, this means, the base station measures its distance etc. towards a transponder unit. The source field always contains the address of the LPR®-B base station. The destination field contains the address of the measured transponder. Even if the data set is transferred further on to another unit (e.g. another transponder), the value of the source and destination field is maintained.

[2]) The field antenna contains the antenna number of the base station as well as the antenna number of the measured transponder. The 4 lower bits represent the antenna number of the base station (values 1…4) and the higher ones the antenna number of the transponder (values 1…4).

3) reserved for future application. Currently set to 0.

Example of Distance Data

```
7E 02 C1 81 7F
7E 00 08 03 08 02 11 00 00 10 62 00 00 00 7A E6 00 00 AF C4 7F
```

Figure 1 - Protocol for a single 1D measurement: request data and following distance data

This protocol shows a simple example for 1D measurement. A distance data set (or also 2 distance data sets) alternate with a send request. The Send Request indicates that the LPR® unit is listening to a data set from the user (for example relays external commands). The Distance Data sends the data to the user (i.e. to a PLC or to a PC/software).

Send request:

7E 02 C1 81 7F

7E hex	START byte
02 hex	TYPE (02; Send Request)
C1 81 hex	CRC
7F hex	END byte

Distance data:

7E 00 08 03 08 02 11 00 00 10 62 00 00 00 7A E6 00 00 AF C4 7F

7E hex	START byte
00 hex	TYPE (00: Distance Data)
08 03 hex = 00001|0000000001|1 bin	Source LPR®-B address: SID: 1; GID: 1; BBt: 1 (base station)
08 02 hex = 00001|0000000001|0 bin	Destination LPR®-B address: SID: 1; GID: 1; BBt: 0 (transponder)
11 hex = 0001|0001 bin	Antenna port base station: 1 antenna port transponder: 1
00 00 10 62 hex = 4194 dec	Distance: 4194 mm
00 00 00 7A hex = 122 dec	Velocity: 122 mm/s
E6 hex = 230 dec	Level: 230 – 256 = -26 dB
00 hex	Error status: 0 means no error; unequal 0 means error (see chapter 1.4.2)
00 hex	Status
AF C4 hex	CRC
7F hex	END byte

1.2.2 Type 0x01 – User Data

User Data can be integrated at a LPR®-B station via the serial interface and then transmitted to another LPR®-B station via the frequency channel. There the user data can be readout.

Direction: LPR®-B → User

Content	Length	Data type	Value
START	1	unsigned integer	0x7E
TYPE	1	unsigned integer	0x01
Source (LPR®-B address)	2	see chapter 1.4.1	0x####
User Data	8	depends on application	0x#### #### #### ####
CRC	2	unsigned integer	0x####

END	1	unsigned integer	0x7F

Total length without byte stuffing: 15 byte

1.2.3 Type 0x02 – Send Request

Direction: LPR®-B → User

Content	Length	Data type	Value
START	1	unsigned integer	0x7E
TYPE	1	unsigned integer	0x02
CRC	2	unsigned integer	0xC181
END	1	unsigned integer	0x7F

Total length without byte stuffing: 5 byte

This packet is sent from the LPR®-B station continuously. It informs the user that the LPR®-B station is able to receive data from the user. The user may only send one single data frame after receiving a send request.

1.2.4 Type 0x03 – Relays Switching Command

Direction: User → LPR®-B

Content	Length	Data type	Value
START	1	unsigned integer	0x7E
TYPE	1	unsigned integer	0x03
Destination (LPR®-B address)	2	see chapter 1.4.1	0x####
Relay Selection (Bitmask) (bit 1..7 → relay 1..7)	1	unsigned integer	0x##
Relay Switch (Bitmask)	1	unsigned integer	0x##
CRC	2	unsigned integer	0x####
END	1	unsigned integer	0x7F

Total length without byte stuffing: 9 byte

With the relay selection (bitmask) relays are selected which can be controlled. The relays that are chosen within the Relay Selection bitmask will be switched according to the Relay Switch bitmask Example: A Relay Selection value = $0x14_{hex}$ = 00010100_{bin} and a Relay Switch value = $0xFF_{hex}$ = 11111111_{bin} will switch relays 2 and 4 ON - the state of the other relays remains unchanged.

No acknowledgment of the relay switch command will be sent because this data frame can be forwarded to other LPR®-B stations and thus no reception on the destination station is guaranteed. In case of faulty data frame (e.g. invalid relays chosen or unknown destination address) the LPR®-B station will print an error message.

1.3 TCP/IP option: Fixed Frame Protocol

If the LPR® station has a TCP/IP interface two options are available for the protocol. Either you use the protocol as it is sent from the serial interface (with different data type lengths, byte stuffing) or you use a fixed frame protocol.

In the first case the data symbols `0x7e` und `0x7f` (which are reserved for the START and END field) are replaced (see chapter 1.1.3). Byte stuffing causes a different protocol length.

For the fixed frame protocol each LPR® data packet is filled up with zero bytes to a fixed length of bytes (i.e. 87 bytes) before the data packet is sent. Byte stuffing does not occur. The START and the END byte are still used but not clear anymore due to not applying byte stuffing. The fixed length of the data packets can be set on the web-interface of the LPR® unit.

For the fixed frame protocol the data packets which are sent to a LPR® unit has to be filled up to a fixed length (i.e. 15 bytes). The START- and the END byte have to be occurred as well and byte stuffing does not occur anymore. It is recommended to fill up the data packet with zero bytes to facilitate a troubleshooting.

If TCP/IP is used the transmitted data have already a checksum. Therefore the checksum in the protocol is not as important as for the serial interface. Two options for the fixed frame are allowed by the protocol inverter for receiving data in a fixed frame. Either 0x0000 is sent as the check sum to the LPR® unit. Then the protocol inverter is calculating the check sum itself. Or another value (differing to 0x0000) is sent as the check sum. Then this check sum is assumed to be the correct check sum. Otherwise the data packet is rejected.

1.3.1 Detailed description TCP Fixed-Frame Protocol

If a TCP fixed-frame protocol is used, a working TCP connection between the PC and the LPR® unit has to be guaranteed. Depending on the configuration of the LPR® protocol inverter either the connection to a port on the LPR® has to be initialized from the PC or the LPR® unit is establishing a connection to a PC.

If the connection is established, the PC has to read the data from the LPR® in fixed data length (i.e. 87 bytes). The first byte is always the START-byte and the second byte is always the TYPE-byte. The relevance of the following data is depending on the data type. Because no byte stuffing occurs the content for a special data type is always constant. For example the measured velocity of the distance data (type 0x00) is always written in the 12.-15 data byte.

Sending data from the PC to LPR® station, a fixed data length has to be chosen (i.e. 15 byte). The first byte (START byte: 0x7e) follow the TYPE-byte. The following data depends on the chosen type, following by the CRC (correct CRC or 0x0000), following by the STOP byte (0x7f). The data packed has to be filled up with zeros.

1.3.2 Detailed description UDP Fixed-Frame Protocol

If a UDP fixed frame protocol is used, the IP and the UDP port of the PC has to be configured in the LPR® protocol inverter. The converter sends each data packet as a UDP packet of a fixed length (87 byte) to the PC. Compared to the TCP fixed frame option the UDP fixed frame does not verify if the data packed arrived.

The content is the same as for the TCP fixed frame protocol.

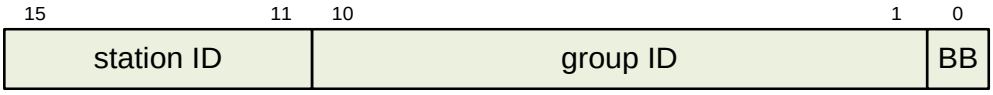
If data is sent to the LPR® unit the data has to be packed in a fixed data length (i.e. 15 bytes as for TCP fixed frame option). This data packet is sent as UDP packet to the LPR® unit. The port number of the receiver is the same as for the PC.

In general bidirectional data communication is not recommended for UDP due to loosing singular data packets.

1.4 Remarks

1.4.1 LPR®-B Address

LPR®-B station addresses are completely defined by a 16 bit value:



BB – Base station Bit:	Indicates, if the LPR®-B station is defined as a base station or as a transponder (1=base station, 0=transponder)
group ID:	group ID of the station (1..1022)
station ID:	station ID of the station (0..30)

In multi cell applications, group ID is the cell ID of the cell.

1.4.2 Distance Error codes

The distance data contains an error field which indicates the status of the distance measurement. The following errors can occur:

Value	Content	Source	Description
0x00	no error		Measurement valid
0x01	no peak detected	Base Station	No measurement signal
0x02	peak too low	Base Station	Measurement signal is imprecise
0x03	nothing received	Transponder	No measurement data received
0x04	implausible speed	Base Station	Velocity is to high
0x05	measurement botched	Base Station	Measurement is not feasible.
0x06	no occupying received	Master Transponder	Measurement channel is not reserved
0x07	no results received	Master Transponder	No measurement data received
0x08	trigger	Transponder	Unit did not attend the measurement