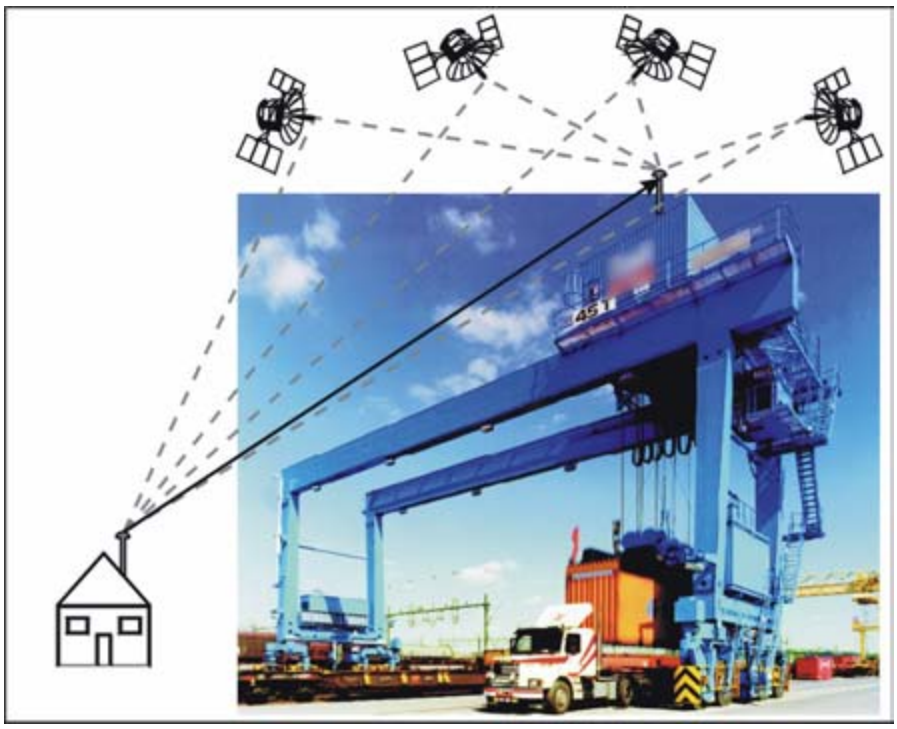

# DGPS Positioning of Gantry Cranes (RTGs)

## DGPS Positioning for Automatic Container Tracking

# S_G57630-A

| | |
|---|---|
| English, Revision 01 | Developed by: M.L. / T.N. / T.C. |
| Date: 15.08.2001 | Author: RAD / SIS / A.F. |
| Götting KG, Celler Str. 5, D-31275 Lehrte - Röddensen (Germany), Tel.: +49 (0) 51 36 / 80 96 -0, Fax: +49 (0) 51 36 / 80 96 -80, eMail: techdoc@goetting.de, Internet: www.goetting.de | |
|  | |

# Contents

# Contents

# 1 Introduction

## 1.1 Systems Function

With the, in general use, Global Positioning System (GPS) it is possible to determine a geographical position. The commonly used standard GPS provide an accuracy of approx. 10 m.

With the aid of additional equipment and under certain area conditions it is possible to achieve a geographic position with an accuracy of up to ±3 cm.

### Container Tracking

The temporary storage of containers by use of visual means with manual confirmation leads to an error rate in the storage handling, which disrupts the efficient turn over time of the container ships. Therefore it is better to use GPS to control the positioning and documentation of containers within the container port environment.

It has been possible for years for Rubber Tired Gantry Cranes (RTG), working on container transport within a seaport, to communicate with the controlling container management system, via a data Radio Transceiver, when it picks up or sets down a container at a predesignated position within the container yard. This takes some of the load off of the driver as well as reduce the error rate, which a complicated and time exhaustive container search entails.

## 1.2 Employed Technologies: PDGPS Positioning

**GPS** offers every one the chance to find out their Geographical position by use of a special GPS receiver. To do this the signals from the GPS satellites are decoded. For normal civilian uses, only a signal that gives an accuracy of approx. 10 m is available.

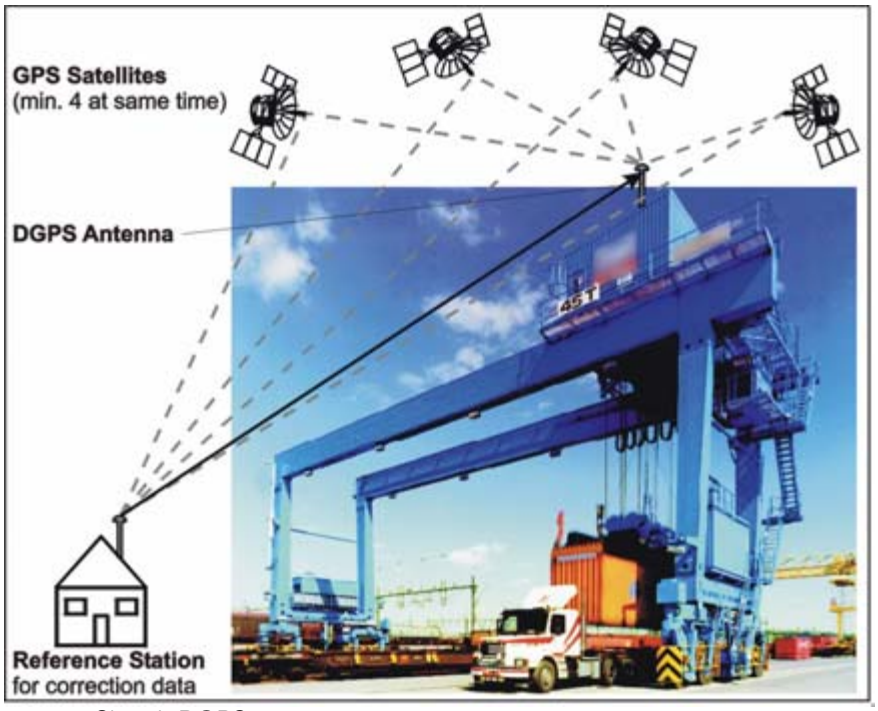


**Figure 1** Sketch DGPS

This accuracy is not enough for the presented system. Therefore alongside the GPS system fitted to the Crane (mobile unit) a further stationary GPS system (Base station) is set up, the base stations position can be exactly calculated, it can then compare it's actual position with that of the GPS, and Transmits this error factor via a Data radio Transceiver to the mobile systems. These can then calculate there positions with an accuracy of up to 3 m (differential GPS; **DGPS**).

Via the determination of the carrier wave of the GPS signal it is possible to increase this accuracy level to ±3 cm (Precision DGPS; **PDGPS**).

**NOTE!** The system requires approx. 15 minutes after a new start to effectively calculate the carrier wave!

The GPS system seen over a long period of time offers a very stable service but can due to shadowing, or reflection become temporary unstable.

## 1.3 Operational overview

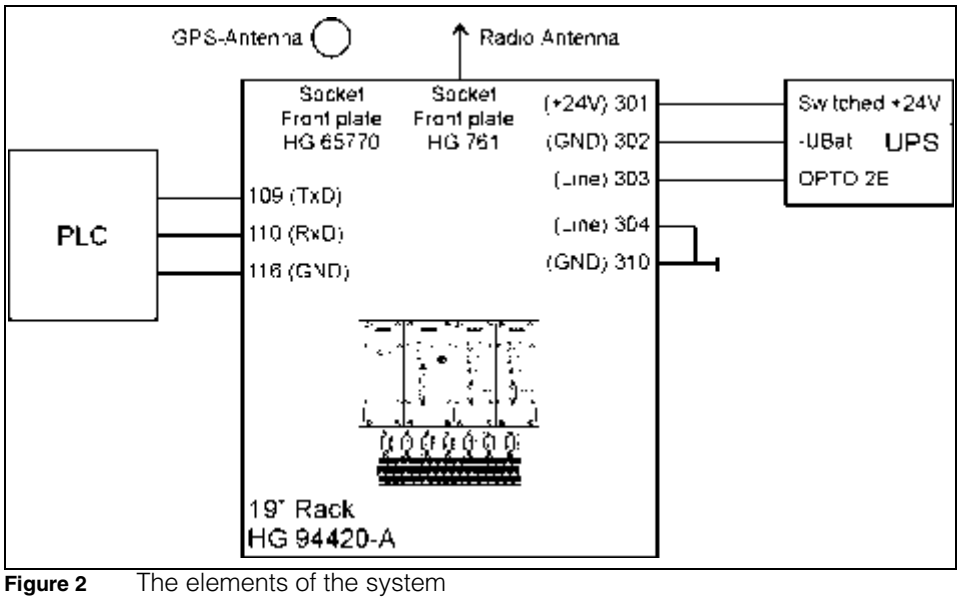


**Figure 2** The elements of the system

The rack consists of, a GPS receiver HG 65770, a radio modem HG 76100 to enable the receipt of the correction data from the base station, a GPS controller HG 61417, which prepares the GPS signal and passes it on to the Crane Control unit (PLC).

Connected to the rack are the GPS antenna and the radio antenna. Apart from this a UPS is fitted to the system, which can in the invent of a power failure provide enough power to keep the system operable for approx. 75 min's. Over output ports the data is transferred to the PLC.

During the initial set up, all necessary parameters, which the crane requires, can with use of the software incorporated within the controller be incorporated into the system. These highly explicit software menu's are described in more detail in the included Controller Manuals. It is to be noted that any changes within the parameters can only be carried out by schooled personnel. An overview of the relevant values for the cranes parameters or shown in Figure 3 on page 7.

It is important to know that for service reasons it is possible to store all relevant values, set during the initial set up, onto a hard disk via a laptop, they can then be re-entered if necessary. You can find more information over this subject in paragraph 2.2 „Re-Start“ on page 9 and C.2 „Minimum Requirements for a Laptop for configuring and monitoring the System“ on page 26.

### 1.3.1 Determining important values for the Crane

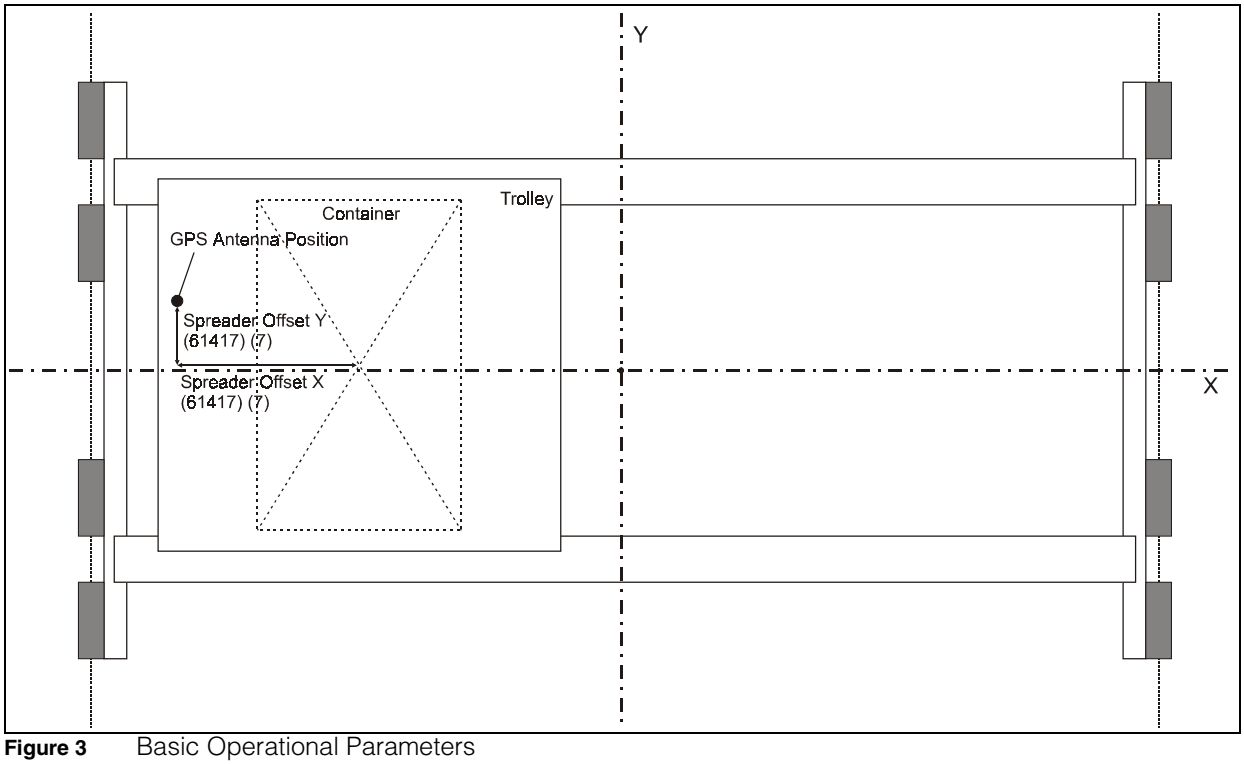


**Figure 3** Basic Operational Parameters

Figure 3 shows the distances that the system needs to know in order to calculate, using the GPS antenna on the Trolley, the spreader's geometrical centre point.

### 1.3.2 Determining important values for a stack

When defining a Stack or route which a Crane should take, the following values are important:

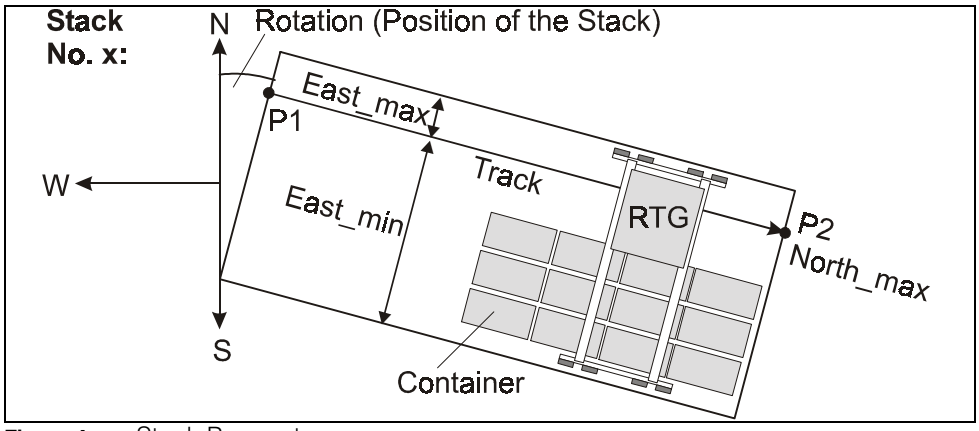


**Figure 4** Stack Parameters

For every stack the following values have to be set, the stacks inclination over the geographical North pole (rotation), P1 is the cranes starting point in this stack, via East_min and East_max informs the crane of the stacks sideward expansion in relation to the position of the GPS antenna. P2 is the end point of the crane. The connection between P1 and P2 give the stacks direction.

# 2 Start-up

## 2.1 Initial Start-up

**ATTENTION!** Only specialized personnel of Goetting is allowed to do the initial start-up of the system!

The parameters of every crane are saved on disk after the commissioning.

**NOTE!** These disks have to be archived by the yard operator for possible re-starts.

## 2.2 Re-Start

For a re-start it is assumed, that all system components have been installed and connected by qualified personnel. Since all system parameters are permanently stored within the system, the system will be fully operationable after a power breakdown and re-connection to power supply (however, the re-start will take a few minutes, since the system has be re-initialized).

In case it is necessary to exchange the controller (all other components are pre-configured and will be delivered in the same pre-configured manner), it is simply necessary to download the parameters set during the initial start-up which are stored on a disk. Use the corresponding parameter disk for the crane which was produced during the initial start- up (s. a.).

**ATTENTION!** Make sure you only use the suitable parameter disk for each crane, since there may be differences in parameter settings between the different cranes!

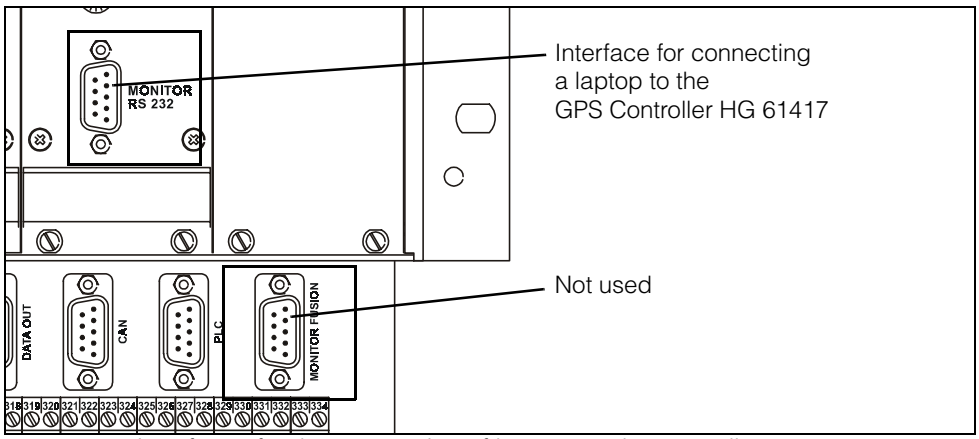


**Figure 5** Interfaces for the connection of laptops to the controller

Connect a laptop (as described in section C.2 on page 26) using a serial cable to the monitor port of the controller (Monitor/RS 232 port) located on its front panel.

Start a terminal program with ANSI terminal emulation (e.g. Hyperterminal of Microsoft® Windows®) on the laptop. Set the following interface parameters:

- Interface parameters: 19200, 8, N, 1

In case the baud rate was set to the wrong value, non-readable characters will appear on the display. Provided that all parameters were set correctly, press the space bar and the main menu will appear.

```
   HG 61417GG1.03         Copyright (C) 1997-1999 Goetting KG, Germany

      Installation                              Reports from Receiver

  1 - Set Positions and Time                 R - Receiver Status
  2 - Set Vehicle Parameters                 N - Navigation UTM
  3 - Set Stacks                             S - Receiver Summary
  4 - Supervisory Parameters                 K - RTK Kalman Status
  5 - Output Port Setup




      Other Functions

  H - History
  O - Firmware/Parameter Options
```

**Figure 6** Screenshot: Main menu GPS Controller HG 61417

Press [O] in order to enter the parameter menu. Then the following menu will appear:

```
                    FIRMWARE/PARAMETER OPTIONS

  1 - Firmware Update
  2 - Firmware Download

  3 - Parameter Update
  4 - Parameter Download

  5 - Stack Export


  X - Exit
```

**Figure 7** Screenshot: Firmware/Parameter Options of the GPS Controller HG 61417

Selecting the function `Parameter Update` ([3]) sets the controller to the waiting function. It will then wait for the transfer of a valid parameter file from a laptop.

Start the transmission of a text file from the terminal program on the laptop. Now select the correct parameter file for the corresponding crane and controller from the parameter disk. Once the update has been completed, the parameter menu of the controller reappears on the display.

Now press [X] in order to return to the main menu. The controller will then automatically start using these transferred parameters. The detailed description of the controller software is included in the controller description available with this service manual.

# 3 Trouble Shooting

The PDGPS Vehicle Navigation System G 57650 is designed to independently operate after the initial start-up (only to be effected by specialized Goetting personnel) without any intervention. The system is so complex, that only especially trained engineers are allowed to open it. Its perfect operation highly depends on the correct operation of all other involved electrical equipment – e. g. the crane control.

This section shall enable the reader in case of a system failure, to determine whether this failure was caused by System G 57650 and if so, which system component is responsible. Please always draw up a detailed description of the failure before contacting Goetting.

## 3.1 Maintenance

The design of the system only requires a minimum of maintenance. The maintenance is limited to

- the regular visual inspection of the equipment in general and
- the regular inspection of the connections and the terminals

approx. every four weeks.

## 3.2 Function Tests

The GPS Controller HG 61417 is equipped with a serial service interface (monitor) located directly on the front panel (also refer to Figure 5 on page 10).

This interface enables connecting the controller to a PC (or laptop; also refer to section C.2 on page 26). The interface operates with the following settings: 19200, 8, N, 1 (if the baudrate of the PC is incorrect, the display will only show cryptical strings). A Terminal Program with ANSI Terminal Emulation enables checking all system functions as well as adjusting parameters. For further information, please refer to section 2.2 on page 9 and the also supplied system description of the controller.

This way you are able to determine whether the controller is operating correctly or whether it outputs faulty data or none at all. Thus it is possible to restrict possible malfunctions to the controller or even to the components in front of them. It is also possible to check whether the controller is using the parameter values set for the respective RTG during the initial start-up.

## 3.3 Normal Operation

### 3.3.1 Radio Modem HG 76100

#### 3.3.1.1 Reference Station

In normal operation, the Power LED is permanently on, while the Tx LED of the HG 76100 slip-in card blinks once per second. The Rx LED is always off.

| **LEDs** | LED +12V (red) **O** POWER<br>LED AKTIV (yellow) **O**<br>LED RX (green) **O O** LED TX (green) | | |
|---|---|---|---|
| ● = LED permanently on, O = LED off, ⊕ = LED blinking, X = LED status of no interest for this issue | | | |
| **LED Power** | **LED TX** | **LED RX** | **Function** |
| ● | O | O | Modem in reception mode and waiting for data transmission |
| ● | ⊕ | O | Modem transmits data |

**Table 1** Reference Station Radio Modem LEDs in normal operation

#### 3.3.1.2 Mobile Station

In normal operation, the Power LED is permanently on, while the Rx LED of the HG 761 slip-in card blinks once per second. The Tx LED is always off.

| **LEDs** | LED +12V (red) **O** POWER<br>LED AKTIV (yellow) **O**<br>LED RX (green) **O O** LED TX (green) | | |
|---|---|---|---|
| ● = LED permanently on, O = LED off, ⊕ = LED blinking, X = LED status of no interest for this issue | | | |
| **LED Power** | **LED TX** | **LED RX** | **Function** |
| ● | O | O | Modem is in reception mode and waiting for data transmission |
| ● | O | ⊕ | Modem receives data |

**Table 2** Mobile Station Radio Modem LEDs in normal operation

### 3.3.2 GPS Controller HG 61417

The GPS Controller HG 61417 is only part of the Mobile Station.

- LED Power permanently on.
- LED 4 blinking at 10 Hz.
- During the power-up period, first LED 1 + LED 3 and LED 2 + LED 4 are blinking during the ROM test, and then LED 1 + LED 2 and LED 3 + LED 4 are blinking during the.
- All other LEDs are off!

| **LEDs** | LED PWR **O**<br>LD2 **O O** LD1<br>LD4 **O O** LD3 | | | | |
|---|---|---|---|---|---|
| ● = LED permanently on, O = LED off, ⊕ = LED blinking, X = LED status of no interest for this issue | | | | | |
| **Mode** | **LED 1** | **LED 2** | **LED 3** | **LED 4** | **Function** |
| Standard | ● | ● | ● | ⊕ | normal positioning-mode |
| System start | ● | O | ● | O | ROM test (blinking at 1 Hz) |
| | O | ● | O | ● | |
| System start | O | O | ● | ● | RAM test (blinking at 1 Hz) |
| | ● | ● | O | O | |
| Firmware Update | ● | X | ● | O | Intel-hex file being received (blinking at 10 Hz) |
| | O | X | ● | ● | |

**Table 3** GPS Controller LEDs in normal operation

## 3.4 Identifying Malfunctions

### 3.4.1 Radio Modem HG 761

#### 3.4.1.1 Reference Station

| **LEDs** | LED +12V (red) **O** POWER<br>LED AKTIV (yellow) **O**<br>LED RX (green) **O O** LED TX (green) | | |
|---|---|---|---|
| ● = LED permanently on, O = LED off, ⊕ = LED blinking, X = LED status of no interest for this issue | | | |
| **LED Power** | **LED TX** | **LED RX** | **Function** |
| O | O | O | check power supply or exchange HG 76100 |
| ● | ● | X | Indication for malfunction of Radio Modem. It may happen, that the Rx LEDs of the mobile Radio Modems are also permanently on. Exchange HG 76100. |
| ● | O | O | Reference Station does not transmit correction data. Check GPS Receiver, GPS Antenna and corresponding Antenna Cable. Switch the Reference Station off and then on again. Make sure the accumulator is also disconnected and the UPS switched off, in order to effect a reset of the receiver. If, after 10 minutes, the Tx LED is still off, it is necessary to check with the Sharpe-CDU Program, whether the Reference Station receives more than 4 satellites and is defined as Reference Station. In case it is not possible to locate a defect, first the GPS Receiver has to be exchanged by an other GPS Receiver (also defined as Reference Station). In case 15 minutes later the malfunction is still there, exchange the Radio Modem HG 76100. In case this neither clears the fault, check whether the RTCM Port of the GPS Receiver is correctly configured. |
| ● | X | ● | This indicates a defect Radio Modem in a Mobile Station or an external jammer. It is also possible that the Rx LEDs of all mobile Radio Modems are on. Exchange the mobile Radio Modem with the Tx LED permanently on or eliminate the external jammer. |
| ● | ● | ● | Modem control defective, exchange HG 76100. |

**Table 4** Radio Modem LEDs of the Reference Station in case of indicating a malfunction

### 3.4.1.2 Mobile Station

| **LEDs** | LED +12V (red) **O** POWER<br>LED AKTIV (yellow) **O**<br>LED RX (green) **O O** LED TX (green) | | |
|---|---|---|---|
| ● = LED permanently on, O = LED off, ⊕ = LED blinking, X = LED status of no interest for this issue | | | |
| **LED Power** | **LED TX** | **LED RX** | **Function** |
| O | O | O | Check power supply; if the Power LEDs of the other components are of, the radio modem is defective –> exchange HG 76100 |
| ● | ● | X | HG 76100 is defective and has to be exchanged, since it blocks the whole system. |
| ● | O | O | The Reference Station does not transmit correction data. Check the GPS Antenna and the GPS Antenna Cable. Switch Reference Station off and then on again. Make sure the accumulator is also disconnected and the UPS switched off, in order to effect a reset of the receiver. If, after 10 minutes, the Tx LED is still off, it is necessary to check with the Sharpe-CDU Program, whether the Reference Station receives more than 4 satellites and is defined as Reference Station. In case it is not possible to locate a defect, first the GPS Receiver has to be exchanged by an other GPS Receiver (also defined as Reference Station). In case 15 minutes later the malfunction is still there, check the Radio Modem HG 76100. Check the RF Antenna and the corresponding cables. If the Rx LEDs of the other mobile units are blinking, the distance between the Mobile Station and the Reference Station may be too far. If the Tx LED of the Reference Station is not blinking, it is necessary to check the Reference Station. In case none of the above helped, check whether the RTCM port of the GPS Receiver is correctly set. |
| ● | X | ● | If the Rx LED is permanently on, an other mobile participant or the Reference Station is permanently transmitting data or a jammer is interfering. Eliminate the permanently jamming transmitter. |
| ● | ● | ● | Modem control defective, exchange HG 76100. |

**Table 5** Radio Modem LEDs of the Mobile Station indicating malfunction

### 3.4.2 GPS Controller

| LEDs | LED PWR O<br>LD2 O O LD1<br>LD4 O O LD3 | | | | |
|---|---|---|---|---|---|
| ● = LED permanently on, O = LED off, ⊕ = LED blinking, X = LED status of no interest for this issue | | | | | |
| **LED Power** | **LED 1** | **LED 2** | **LED 3** | **LED 4** | **Function** |
| O | O | O | O | O | Power supply failed. If the power LEDs of the other modules are on, the corresponding module is defective and has to be exchanged. |
| ● | ● | X | X | X | Status 2 bit 7 (hardware error with GPS Receiver) or Status 3 Bit 6 (UTM zone does not comply with reference station) |
| ● | X | ● | X | X | Power supply is below lower limit. There is a failure in the UPS. This may have been caused by faulty accumulators or a faulty charging unit. Check the UPS fuses. Measure the UPS voltage, it must be at least 24 Volts. Exchange the UPS if the voltage is too low. If the low voltage occurs only in autonomous operation without line voltage, the accumulators have to be exchanged. |
| ● | X | X | ● | X | Lock status is not 3D RTK Fix.<br>The GPS Receiver does not supply the highly accurate position signal. If this status remains even after a restart of the GPS Receiver for more than 30 minutes, check whether the other Mobile Stations, too, do not supply accurate positions. Is this the case, the problem is based on the current satellite constellation, or there is a malfunction of the Reference Station or the correction data transmission. Check whether the Reference Station is transmitting correction data. Also refer to the status description for the Radio Modem HG 76100. Via the monitor interface of the GPS Controller HG 61417 it is possible to check on the current satellite constellation. Also refer to the System Description of the GPS Controller HG 61417. |
| ● | ⊕ (1s● / 1sO) | X | ⊕ (1s● / 1sO) | ⊕ (1s● / 1sO) | LEDs 1, 3 and 4 blinking at 0,5 Hz (on for one second, off for one second):<br>The communication with the GPS Receiver failed. The GPS Receiver is probably defective and has to be exchanged. |

**Table 6** GPS Controller LEDs indicating malfunction

## 3.5 Exchanging Spare Parts

If one of the modules of System G 57650 should be defective, it can only be exchanged completely. For example, exchange the Radio Modem HG 76100 as follows:

1. Disconnect the System Rack HG 94420-A from power.
2. Unscrew the four screws on the front panel of the Radio Modem (since they are secured, it is not possible to remove them completely).
3. Use the handle on the front panel to remove (pull) the Radio Modem from the system rack.
4. Insert the spare part Radio Modem in the guide rail of the system rack and push the card in until it is correctly latched. Only then the contacts will be correctly connected.
5. Use the four screws to rescrew the front panel of the Radio Modem to the system rack.
6. Reconnect the system rack to the power supply. The system will then start-up and be ready for operation.

Follow this routine also for the other modules. Radio Modems and GPS Receivers are always supplied correctly pre-configured. Therefore it is not necessary to do any adjustments when exchanging one of these modules. In case it should be necessary to exchange the Controller HG 61417, make sure that the parameters saved on disk for the corresponding crane are downloaded into it. For further information refer to section 2.2 „Re-Start“ on page 9.

# 4 The System in Detail

## 4.1 System Components

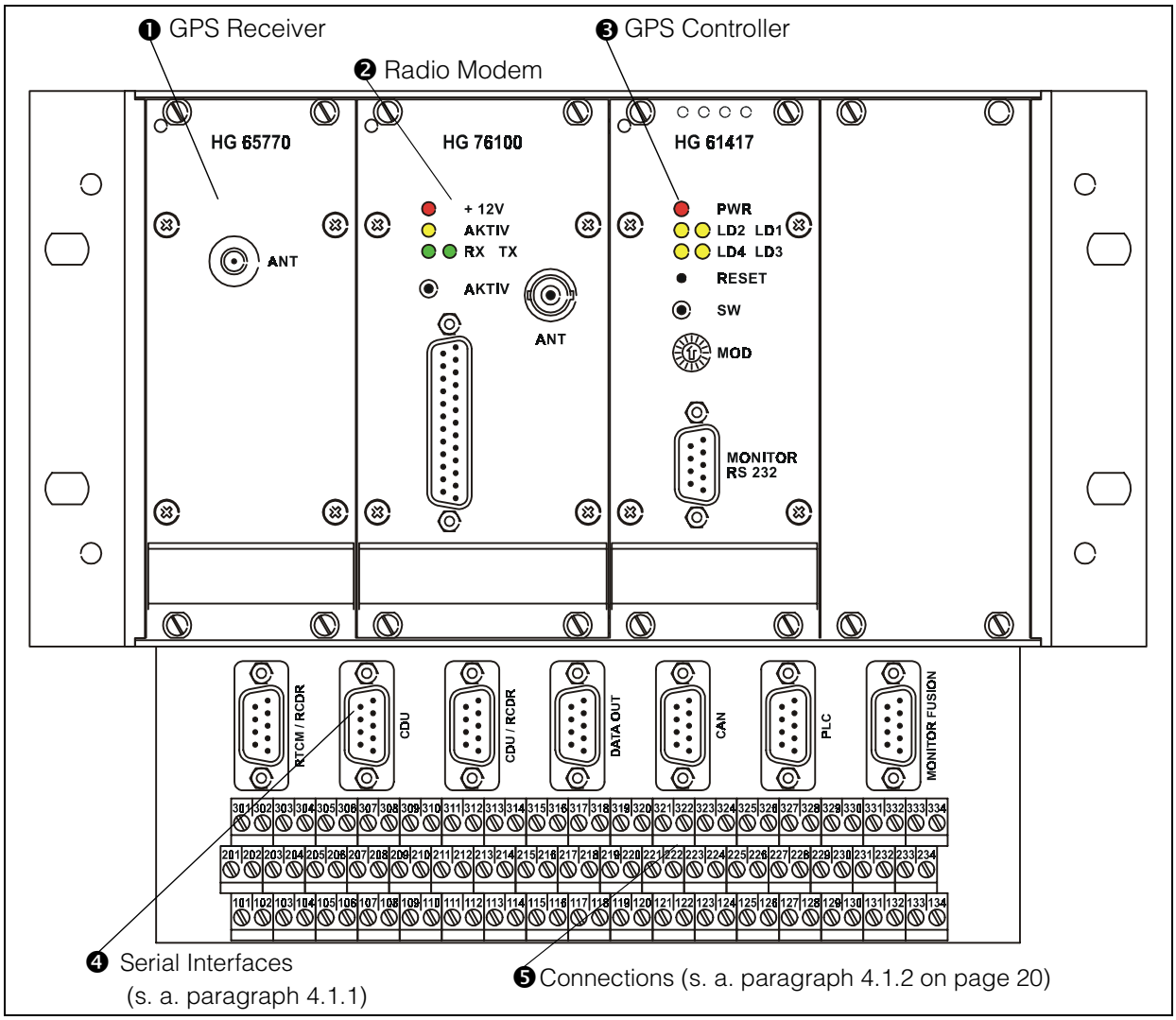


**Figure 8** System components S_G57630-A (19“ rack HG 94420-A)

### 4.1.1 Serial Interfaces

Table 7 shows, which function each individual interface has.

**ATTENTION!** These interfaces are only for use within the configuration of the individual components and can not be occupied for other uses when the system is operating, otherwise the signal could be blocked!

| Description | Function |
|---|---|
| RTCM/RCDR | RTCM correction data (receipt data from the radio transceiver) |
| CDU | Control and Display Unit (connection to the GPS receiver) |
| CDU/RCDR | GPS data from GPS receiver |
| DATA OUT | Data from GPS controller to sensor fusion controller |
| CAN | Data from sensor fusion controller CAN |
| PLC | Data from sensor fusion controller RS 232 |
| MONITOR FUSION | Not used |

**Table 7** Serial interfaces in the 19“ rack

### 4.1.2 Connection Plan

The following table shows the connection plan for which connection can be used to connect the system to the vehicle.

| Connector No. | Signal Description | External Connection to Vehicle |
|---|---|---|
| 109 | PLC data 61418 TxD + | Data output to PLC RS 232 TxD |
| 110 | PLC data 61418 RxD + | Data input from PLC RS 232 RxD |
| 116 | Signal - GND | Signal ground for PLC |
| 301 | +24V input | +24 V power supply from UPS |
| 302 | GND | Power supply GND |
| 303 | Input + | Control of voltage breakdown HG 61417 |
| 304 | Input - | Control of voltage breakdown HG 61417 |
| 310 | GND | Power supply GND |

**Table 8** Connections used for connection with the vehicle

## 4.2 Availability and Restrictions

- Availability of the PDGPS: approx. 95 % with an **accuracy of ±3 cm**
  approx. 99,7 % with an **accuracy of ±5 cm**.
- Prerequisites: Line of sight visibility to the satellites, opening angle from approx. 170°; elevation 5°.
- Maximum distance from the base station should not exceed approx. 1 to 2 km (restricted via HF components for the transmission of the correction data).
- The GPS antenna has to be solidly fixed to either the main frame of the crane or the trolley. Ideally on one of the bridge sides in the centre directly over the wheels.
- The base station should be set up as a redundant system, because the availability of its correction data is a requirement for the functionability of the complete terminal.
- The positional output data is available over RS 232 interface. The position is given as a distance (e. g. in mm) from an original reference coordinate system. It is possible to define up to 100 reference coordinate systems per terminal.

## 4.3 UPS supervision HG 20330 (in comb. with UPS APU 24-2)

The UPS supervision controls the function of the UPS and switches the system off after a set time when system is running on battery power (UPS), due to a power failure, to avoid the batteries being completely discharged. All conditions are indicated via LEDs (see Table 9 on page 23). Furthermore there are two optically decoupled outputs available, in order to trigger external events.

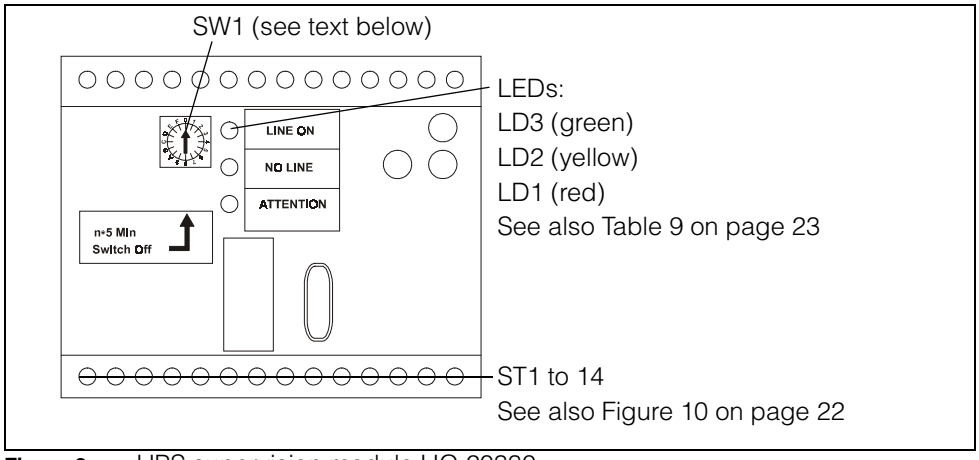


**Figure 9** UPS supervision module HG 20330

The duration of the UPS running time is setable via positionable switch (see Figure 9 on page 22). To obtain the time set multiply the switch's position by 5 mins (e. g. SW1 set on 8 –> 8 x 5 minutes = 40 minutes). Changes to SW1 are only transferred to the UPS supervision when the it is switched on and off again.

### 4.3.1 Connection plan

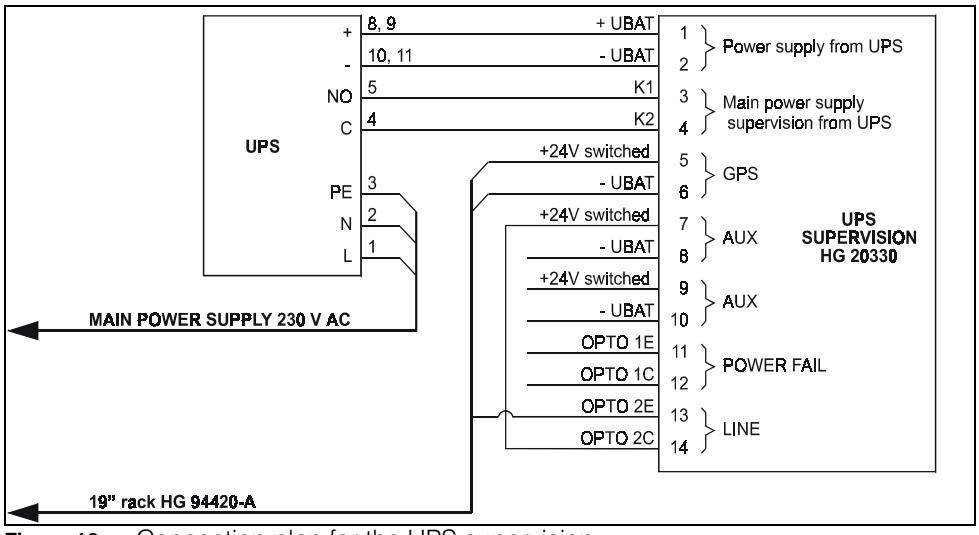


**Figure 10** Connection plan for the UPS supervision

### 4.3.2 Status display

| LED Display | Status | Opto Coupler |
|---|---|---|
| all LEDs off | No main power supply, load turned off | Power fail not active<br>line not active |
| LD3 green blinks | Main power supply on, batteries being charged, UPS is in charging | Power fail active<br>line active |
| LD3 green on | Main power supply on, batteries charged, UPS is ready | Power fail not active<br>line active |
| LD2 yellow on | Main power failure, working on battery power for set time | Power fail active<br>line not active |
| LD1 red on | Main power failure, battery power for one minute | Power fail active<br>line not active |
| all LEDs blink | Battery power low, main power supply present | Power fail active<br>line not active |

**Table 9** Interpretation of the status displays on the UPS

For a preset charging time of 30 mins LED 3 (green) blinks. If during this time the main power fails then the load will be separated from the UPS after one minute. This prevents a complete discharge of the batteries caused by a short connection to the main power supply.

LED 3 (green) is constantly on after the charging time – this signals that the UPS is ready. Should the main power supply now fail then the system's load is supplied by the batteries for the set time, this is indicated by LED 2 (yellow) being on. After the per SW1 preset time has past, the system is provided with power for one more minute; this is indicated when LED 1 (red) is lit. At the end of this time period then the load is completely separated from the UPS. If the main power supply is reinstated before the system is shut down then the charging time starts again.

If the battery voltage drops below a defined limit (approx. 12 V) then the system is immediately shut down.

# 5 Appendix

## A Scope of Supply (Part List)

The following components are part of System G 57650:

| Item | Description | Model | Ordering Information |
|---|---|---|---|
| 1. | Mobile Station, Subrack completely assembled | Includes items 5, 6, 7, 8, 9, 10, 11, 13, 15, 17, 19 | SG57650 Mobile Station |
| 2. | Base Station, Subrack completely assembled | Includes items 5, 6, 7, 10, 11, 12, 13, 15, 17, 19 | SG57650 Base Station |
| 3. | Mobile Station, Subrack completely assembled, without Antennas and UPS | Includes items 5, 6, 7, 8, 9 | SG57650 Mobile Station w/o Antenna and UPS |
| 4. | Base Station, Subrack completely assembled, without Antennas and UPS | Includes items 5, 6, 7 | SG57650 Base Station w/o Antenna and UPS |
| 5. | Subrack with Backplane, without Insert Modules | G 94420 | G 94420 - A |
| 6. | GPS - Receiver Insert Module | Sharp Card | HG65770-A / 10TE_HB / SW2.2 |
| 7. | Radio - Transceiver Insert Module | HG 76100 | HG76100-B / 24V / 12TE_HB / C64 / 445,425 9600 / RS-232 9600 8N1/ HG39720AA3.09 |
| 8. | GPS - Controller Insert Module | HG 61417 | HG61417 / 24V / 10TE_HB / C64 / 1*RS-422, 3*RS-232 / HG61417GG |
| 9. | Uninterruptable Power Supply (UPS) without UPS Supervisor (see Pos. 11 and 12) | Thiele APU24-2 w/o Accus | APU 24-2 / XX Ah / 115 / 230 |
| 10. | Accumulator Set for UPS (2 Accumulators included) | 12 V / 7,2 Ah | 2 pieces Panasonic LC-R127R2P |
| 11. | UPS Supervisor | HG20330 | HG20330 / N=15 / HG20330AA2.00 |
| 12. | Base Station GPS - Antenna | CR - Antenna | GPS - CR - Antenna with Nut and Bolt |
| 13. | Mobile Station GPS - Antenna with orig. Mounting Flange | LWS - Antenna | GPS - LWS - Antenna with Nut and Bolt and Mounting-Flange |

**Table 10** Part List (Part 1 of 2)

| Item | Description | Model | Ordering Information |
|---|---|---|---|
| 14. | Base Station Radio - Antenna | Kathrein Omni 450 | K75 11 21 |
| 15. | Mobile Station Radio - Antenna | Kathrein Gainflex | K71 53 23 6 |
| 16. | Base Station GPS - Antenna cable | RG-58, 18m, SMA elbow / TNC even | G09234-A / 18m |
| 17. | Mobile Station GPS - Antenna cable | RG-58, 2m, SMA elbow / TNC even | G09232-A / 2m |
| 18. | Base Station Radio - Antenna cable | RG-58, 9m, BNC elbow / N even | G09233-A / 9m |
| 19. | Mobile Station Radio - Antenna cable | RG-58, 2m, BNC elbow / TNC FlaBu (flat socket) | G09231-A / 2m |
| 20. | Heat Shrink with Glue, 4/1 for Type TNC Plug with RG-58 cable | IAKT 16/4 Bürklin | 91 F 3756 / L, (L = required Length in Meter) |
| 21. | Heat Shrink with Glue, 4/1 for Type N Plug with RG-58 cable | IAKT 24/6 Bürklin | 91 F 3758 / L, (L = required Length in Meter) |

**Table 10** Part List (Part 2 of 2)

## B Cable Specifications

| | Correction Data Transmission | GPS Mobile (Rover) | GPS Reference Station |
|---|---|---|---|
| RG58 | l <= 10 m | 9 < l < 18 | 15 < l < 20 |
| RG213 | l <= 20 m | 10 < l < 30 | 20 < l < 30 |

**Table 11** Cable specifications

- Temperature range permanently installed: -40 to +90 $^{o}$C
- Minimum bending radius permanently installed: 6 x cable diameter
- Sea-proof

# C General Specifications

## C.1 Basic technical Data

| Valid for system configurations: | |
|---|---|
| Operating temperature of electronic components | 0 to +50 °C |
| Operating temperature of antennas | -20 to +65 °C |
| Update rate of position output with Sensor-Fusion | up to 20 Hz |
| Power supply | 130 V AC or<br>240 V AC |
| Minimum 5 minutes start-up time for self-calibration essential | |

**Table 12** Basic technical data

## C.2 Minimum Requirements for a Laptop for configuring and monitoring the System

The laptop has to be connectable to the serial interfaces of the system and has to be able to run a terminal program with ANSI terminal emulation. Therefore almost every available laptop is suitable.

We recommend using a laptop with Microsoft® Windows 95® or higher with the (included in Windows 9x/NT) terminal program HyperTerminal®, since this is the program the Götting engineers use. The laptop has to have a free serial interface. In addition, a serial cable (9pol. Sub-D) is necessary for connecting the system.

## C.3 RTG/RMG Specifications

- Sideways sway of less than 5 cm allowed, in any other case is the use of a slope controller necessary.

# D List of Abbreviations

| | |
|---|---|
| **DGPS** | Differential GPS |
| **GPS** | Global Positioning System |
| **PDGPS** | Precision DGPS |
| **RTG** | Rubber Tired Gantry Crane |
| **UPS** | Uninterruptable Power Supply |

**Table 13** Abbreviations

# 6 Notices

## 6.1 Proper Use of Equipment

The system S_G57630-A is used to determine the position of Rubber Tired Gantry Cranes (RTGs). A pure positional determination is carried out. The determined position is made available to interconnected superordinate systems.

The installation, technical maintenance and service is only allowed to be carried out by authorised trained personnel.

## 6.2 Copyright



## 6.3 Exclusion of Liability

Any information given is to be understood as system description only, but is not to be taken as guaranteed features. Any values are reference values. The product characteristics are only valid if the systems are used according to the description.

This instruction manual has been drawn up to the best of our knowledge. Installation, setup and operation of the device will be on the customer's own risk. Liability for consequential defects is excluded. We reserve the right for changes encouraging technical improvements. We also reserve the right to change the contents of this manual without having to give notice to any third party.

# 7 List of Pictures

# 8 List of Tables

# 9 Index