FCC requirements § 2.1033 (b)(3)

## INSTALLATION INSTRUCTIONS

Installation Instructions (Instruction Manual) furnished to the user of the Hi-G-Seal system hand held terminal follow this page

Hi-G-TEK

Hi-G-Tek Ltd. Microelectronics & Asset Tracking Technology

**Hi-G-Seal**

(IG-SA-21 and IG-MA-22)

# Electronic Seals and Hand Held Terminals for Sealing Assets

## INSTRUCTION MANUAL

***Nov. 1998***

Rev. C

UM3158

Note: This equipment has been tested and found to comply with the limits for a class B digital device, pursuant to the part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in the residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
-Reorient or relocate the receiving antenna.
-Increase the separation between the equipment and receiver.
-Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
-Consult the dealer or an experienced radio/TV technician for help.

Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

## Congratulations!

You have chosen Hi-G-Tek's products that are state-of-the-art in their technology and properties.

The Hi-G-Seal will lead you to a new dimension in the **field of security**.

The electronic miniaturized seals are more **reliable** and more **secure** than their mechanical counterparts.

They are cost-effective. They are reusable, save paperwork and workers time.

You can know not only if the asset was opened on its way but also when it was opened.

It is all carried out remotely.

Contents page



# 1. Hi-G-Seal Components

## 1.1 The Seal

- **Seal Electronics**
  This unit contains the electronic circuitry of the seal. It contains the transmitter, the receiver, the computer and the memory to store the events.
- **Seal Wire**
  The Seal Wire with the Connectors at the end is used to seal the object.
- **Key**
  To release the connectors after sealing, use the Key for convenience.

## 1.2 The Hand Held Terminal-HHT

- **Display**
  The Hand Held Terminal displays all the information on this LCD display.

- **Indicators**
  **On**. When power is on and the system functions O.K this indicator lights up **GREEN** color.
  When it lights up **RED**, there is a problem with the unit.
  When it blinks up **RED**, the batteries are low, please replace them.

- **Key Pad**
  The keypad is used to operate the unit in its different modes of operation, to enter data as required.

- **Batteries.**
  This is the battery compartment. Use a flat screwdriver to open it.

# 2. Preparation for Use – How to Use the Seal

## 2.1 Hand Held Terminal-HHT

### 2.2.1 Placing/Replacing Batteries.

One) Open the battery compartment using a screwdriver.
Two) Use "AA" size 1.5 V batteries only!
Three) Take out the old batteries if there are any.
Four) Insert 4 new batteries into the battery compartment, **verify polarity** of the batteries to match the indications inside the battery compartment!
Five) Close the cover and secure it with the screw.

## 2.2 How to Seal an Asset

Thread the sealing wire through the locking ring of the asset.
Inserting seal wire connectors into the seal's sockets.

## 2.2 How to Release the Seal

Pull out the connectors using
the Key.

1. Insert the Key into the recess on the connector.
2. Rotate the Key upward and pull the connector from the socket.

## 3. Basic Operation – Understanding the System

The basic operation of the system includes three simple stages:

The first two stages are performed at the origin site while the third stage is carried out at the destination site.

Stage I: Sealing the asset.

At this stage you seal the asset by threading the sealing wire through the locking ring of the asset, and then insertion of the seal wire connectors in the seal's sockets.

Stage II: SET the Seal

Press the ON key and verify that the green light illuminates. Place the HHT within 60 cm. from the seal and then press the SET key on the HHT.

Notes:There is an available option to write down the ID Number of the seal and the sealing stamp on the bill of lading (you may want to FAX or E-Mail the result to the destination site).

Stage III: READ the Seal.

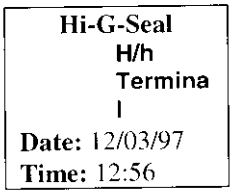
Place the HHT within 60 cm. from the seal and then press the READ key on the HHT. If the OK notation appears on the HHT's display, you hear 2 beeps, and you know the asset was not opened on the way from the last SET site to the Reading site. If a Tampered notation appears and you hear a long beep, you know that the seal was tampered on the way.
You can know when it occurred (see details below).

Note: If you chose to write down the ID Number, you can compare the ID and the sealing stamp to the written numbers you have on the bill of lading (or on the FAX copy).

# 4. Operating Instructions

## 4.1 Initialization

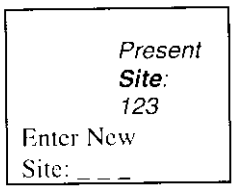
Turn the HHT on by pressing the **ON** key and verify that the green light illuminates.
After a few seconds the main screen appears:




While the main screen is shown, you may change the screen **contrast** using the up (^) and down (V) keys.

**NOTE:** If no keys are touched for 5 minutes, the HHT will automatically shut- off, in order to save batteries.

In case you want to see the site, you are located at, which is stored in the HHT's memory, or you want to update the site to your present location, press the **SITE** key. The following screen appears:




Enter 3 digits (from 000 to 255) encoding your site. After each digit you enter, the cursor will move to the next digit location. Pressing the **ENTER** key will store the new site. In case the code has less than 3 digits you must enter leading zeroes (e.g. if your site code is 1, you must enter 001). The new site will be stored along with all the other sealing data till the next change of the site.

You may, of course, change the site at every stage during the operation of the HHT.

## 4.2 Reading a Seal

Press the **READ** key. There are 3 possible events:

One. The seal was not tampered on the way. The screen will be as follows

**Seal #:1234567890**
**Stamp**:11231231
OK. **Set** at:
12/04/97 12:45

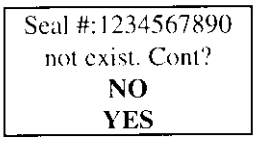
And you will hear 2 beeps.

Two. The seal was tampered on the way. The screen will be as follows:

**Seal #:1234557890**
**Stamp**:12312311
Tamp. **Set** at:
12/04/97 12:45

And you will hear a long beep.

Three. The seal is new to the terminal. The screen will be as follows:

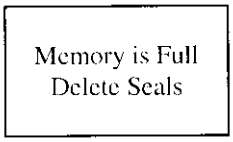



And you would hear a long beep.

In this case if you want to read the seal, choose **YES**, and you will complete the READ procedure.

In case you want to SET the seal, choose **NO**, and you will have to press the SET button.

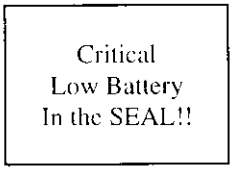
In case memory is full, the following display appears:




In this case you have to delete unused seals using the Clear Data option from the Menu. If you do not delete a seal, the READ process will not be completed.

**NOTES:**

- While reading, make sure there is no other seal in the vicinity of the seal you want to read and of the HHT. Other seals must be at least 60 cm. away.
- While reading, if the seal's battery is low the following message appears.



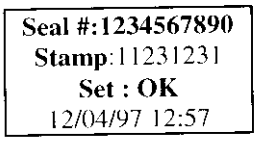
## 4.3 Setting a Seal

Setting a seal is a critical event in the process, an option is available for password use. According to the Configuration setting in the Menu, you may select whether to use a password or not.

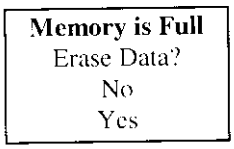
Press the **SET** key.
If you have entered a password the following message appears:


If you entered the wrong password, the following message appears:

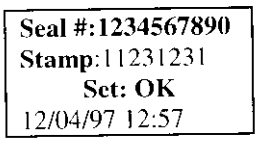

Press the **ENTER** key for another try.
If the password is correct, the following screen appears:




If there is not enough memory, the following message appears:




You can select between the Yes and No options. Selecting the "Yes" SETs the Seal and the following display appears:




Selecting the "No" option will resume the SET command.

In case the seal already exists in the HHT's memory, the following message appears:

| |
|---|
| **ID 1234567890** |
| **Exist. Delete it?** |
| Yes |
| No |

You can select between the Yes and No options. Selecting the "Yes" SETs the Seal. Selecting the "No" option will resume the SET command.

## 4.4 Special Functions

In order to perform other functions press the **MENU** key. The following screen appears:

| |
|---|
| VIEW DATA |
| CLEAR DATA |
| STATISTICS |
| SETUP DATE |

You can scroll between the options using the up (^) and down (v) arrows. A long press on an arrow causes a rapid scrolling.
While scrolling, the following options are also displayed.

| |
|---|
| SETUP TIME |
| SETUP ZONE |
| DISPLAY VER. |
| CONFIGURATION |
| DIAGNOSTICS |

Pressing the **ENTER** key activates the selected function. Pressing the **Esc** key will resume to the previous screen.

- **View Data**

**Data Structure**
Before going into details, you must understand the basic structure in which the events' data are organized.
An event is created after a READ operation, but only if something has been occurred to the seal from the previous reading. Occurrences that cause an event are: **SET** of the seal, **OPEN**ing or Closing (**CLSE**) the seal, **TAMP**ering (changing the seal's resistance) with the seal, and Low Battery (**LB**) of the seal.
Each time there is an event it is written in the reader's database. Each time you **SET** a seal a new page is created. A page contains up to 10 events (for IG-SA-20 or up to 100 events for IG-SA-22) that occurred to the seal starting with the last **SET** operation. For example, for a new seal, the page will contain the **SET** event. If a tampering event occurs, after the next

**READ** operation, the page will contain the SET event and the TAMP event. If then, the seal was opened and then closed, after the next READ operation the page will contain 4 events: SET, TAMP,OPEN CLSE.

Selecting the **View Data** function displays the following screen:

| **View Data** |
|---|
| VIEW FROM LIST |
| VIEW BY ID |
| VIEW BY SITE |

You can select between these 3 options using the arrow, up and down keys.

Selecting the **View by ID** displays the following screen:

| **View by ID** |
|---|
| Enter seal ID |
| _ _ _ _ _ _ |

Entering the Seal ID and pressing the **ENTER** key display the following screen (The first two rows are displayed alternately. If there is a TAMPering event and/or a Low Battery event, the last 2 rows will be displayed alternatively too):

| **Seal # 1234567890** |
|---|
| **PAGE# 001 OF 002** |
| SET 12/04 13:57 |
| At Site : 123 |
| **OPEN:22 CLSE:22** |
| **TAMP:01 LB** |

The above example shows the first page out of 2 pages. There are 47 events in that page : 1 - for the SET, 22 - OPENings, 22 - CLSEing, 1 - TAMPering (change of the wire) and there is a Low Battery sign for that seal.

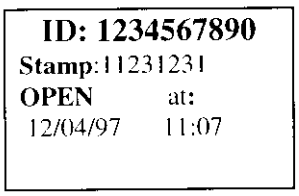
Pressing the **ENTER** key again will open the whole page of events (The first two rows are displayed alternately).

| **Seal # 1234567890** |
|---|
| **EVENTS LIST** |
| CLSE 12/04 13:35 |
| OPEN 12/04 13:32 |
| SET 12/04 12:41 |

As written above, you may see up to 10 events for one page in case of IG-SA-20 (or up to 100 events in case of IG-SA-22). The first 8 events (for IG-SA-20) are consecutive events, starting at the SET operation, and the last 2 events, are the 2 last events occurred to the seal. For example, if there were 16 events including the SET event, you will see SET as the first event, then 7 consecutive other events, and then the last 2 events for events number 15 and 16 (events number 9-14 are lost). The same logic exists for

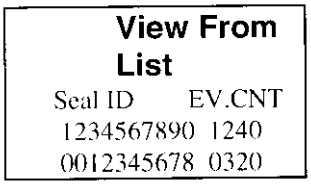
IG-SA-22. The difference is the total amount of events (100 instead of 10) and the stack for the last events (5 instead of 2)

Pressing the **ENTER** key on a specific row, displays the following detailed event window:



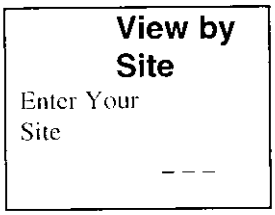

Pressing the **ENTER** key returns you to the View by ID menu.

The same logic is applied when you choose the **View from List** or the **View by Site** options, except for the initial procedure, in which you reach the desired seal.
In the **View from List** procedure you also have a down counter of events (**EV.CNT**) for each one of the seals on the list. When the counter is 0000 the seal must be replaced by a new one.
Selecting the **View from List** displays the following screen:

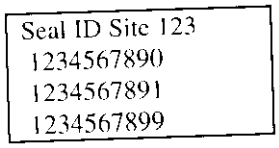



In this example, seal # 1234567890 has 1240 events left.
You may scroll between the seals using the up and down keys. You can choose the ID by pressing the **ENTER** key when the cursor is on the left of the desired seal.

Selecting the **View by Site** displays the following screen:




Entering the Site code and pressing the **ENTER** key displays the following screen:




The above screen displays all the seals set at the selected site. You can scroll between the rows one by one by pressing the up and down keys. You can choose the ID by pressing the **ENTER** key when the cursor is on the left of the desired seal. You can see the events' list by pressing the ENTER key again. Pressing the ENTER key again will show the event's details. Pressing the **ENTER** key again returns you to the View Data menu.

- **Clear Data**

Selecting the **Clear Data** function displays the following screen:

| **Clear Data** |
|---|
| CLEAR ALL |
| CLEAR FROM LIST |
| CLEAR BY ID |

Selecting the **Clear All** option erases all the seals' data from the memory.
Pressing the **ENTER** key selects the seal to be erased.
Prior to deleting the data, the following alert window appears:

| **Clear Data** |
|---|
| No |
| Yes |

You can select between the options using the up and down arrows.
Pressing the **ENTER** key selects the option.

Selecting the **Clear From List** option displays the following screen:

| **Clear From List** |
|---|
| Seal ID |
| 0000001029 |
| 0000001037 |

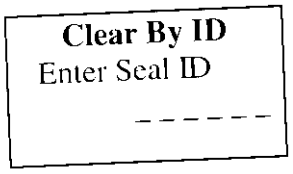
You select the seal to be erased and press the ENTER key.

You will get the following warning screen:

| **Clear ID** |
|---|
| 0000001029 |
| No |
| Yes |

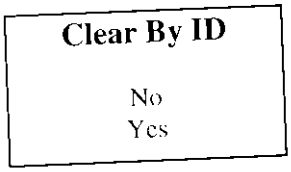
You can select between the options using the up and down arrows.
Pressing the **ENTER** key selects the option.

Selecting the **Clear By ID** option lets you enter the ID number to be deleted



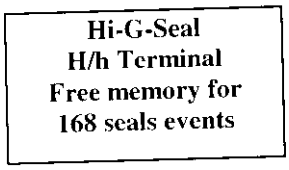

You enter the seal ID to be erased and press the ENTER key.

The following warning screen appears:

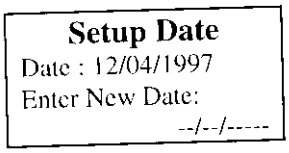



You can select between the options using the up and down arrows. Pressing the **ENTER** key selects the option.

- **Statistics**
  This special function lets you know the available free memory left for more seals events. Choosing this option will cause the following screen to appear:




- **Setup Date**
  Selecting the **Setup Date** function displays the following screen:




  To change the date, enter the digits related to DD/MM/YY (Day/Month/Year) for the European format (if you chose this format in the configuration function). Each time you press a numeric key the cursor moves in a cyclic manner to the next digit location. Pressing the **ENTER** key sets the new date.

- **Setup Time**

  Selecting the **Setup Time** function displays the following screen:

  **Setup Time**
  Time: 12:54
  Enter New Time:
  --:--

  To change the time, enter the digits related to HH/MM (Hour/Minute). Each time you press a numeric key the cursor moves in a cyclic manner to the next digit location. Pressing the **ENTER** key sets the new time.

- **Setup Zone**

  All the seals are set according to GMT (Grinwich Mean Time). The Hand Held Terminal has the local time. In each country, for each Time Zone, an offset must be entered (time difference) between the local zone to GMT. For example: In Great Britain the difference is 0. In other Western European countries the difference is +1. In Eastern USA the difference is –5 and so on.

  Choosing the **Setup Zone** function displays the following screen:

  **Set Time Zone**

  **Offset hr.:**
  **+00**

  By using the up (^) and down (V) arrows you can set the desired offset from the GMT. Pressing the **ENTER** key sets the chosen offset.

- **Display Ver.**

  Selecting the **Display Ver.** function displays the software version:

  Hi-G-Seal
  H/h Terminal
  Version
  2.00

- **Configuration**

Selecting the **Configuration** function displays the following screen:

| **Configuration** |
|---|
| SET PASSWORD |
| DATE FORMAT |

You can select between the options by using the up and down keys.
Pressing the **ENTER** key selects the option.

- **Set Password**

If you select the **Set Password** option, the following screen appears:

| **Password Setting** |
|---|
| No |
| Yes |

This option allows you either to decide whether you want to use a password for the SET operation or to change an existing password.
In order to enforce the use of a password for the SET function, select the "Yes" option. The following screen appears:

| **Password Setting** |
|---|
| Enter New Password |
| _ _ _ _ _ _ |

Enter your new password (up to 6 digits) and press the ENTER key.
If you don't want the use of a password for the SET function, select the "No" option.
If you want to cancel the use of an existing password for the SET function, press the "No" option.
If you want to change the password press the "Yes" key.
In both cases, if you want to change the password or if you want to cancel the use of a password for the SET function, the following screen appears:

| **Password Setting** |
|---|
| Enter Previous Password |
| _ _ _ _ _ _ |

In case you entered a wrong password you will see the following screen;

| **Password Setting** |
| --- |
| Your password |
| Is Incorrect |

You will have to retry the whole process.
In case you entered the right password and you chose to change the password, the screen that allows you to enter your new 6 digit password appears:

| **Password Setting** |
| --- |
| Enter New |
| Password |
| _ _ _ _ _ _ |

- **Date Format**
  If you select the Set Date Format, the following screen appears:

| **Set Date Format** |
| --- |
| USA FORMAT |
| EUROPE FORMAT |

European format: DD/MM/YY
USA format: MM/DD/YY

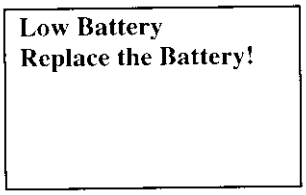
You can select between the two formats. Select the correct one by pressing the **ENTER** key.

Selection of the Diagnostics is for technicians only.

# 5. Troubleshooting

## 5.1 Low voltage

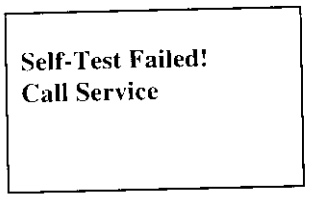
If there is a low voltage, the following message appears:




And you will hear a long beep.
The only operation you can activate now is to turn the HHT off!
Replace batteries. See para. 2.1 on how to replace batteries.

## 5.2 Self Test Failure

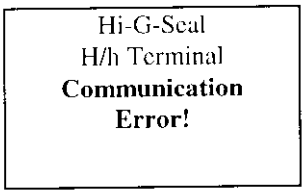
After turning on the HHT, it performs an automatic self-test. If there is any technical problem, the following message appears:




If this occurs, call for a service technician or send the device to the manufacturer.

## 5.3 Communication Failure

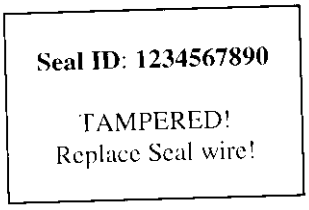
When you perform the **READ** or **SET** functions, and there is a communication error between the HHT and the seal, the following message appears.




If this occurs, try to decrease the distance between the HHT and the seal.
Try to change the angle between the HHT and the seal (the optimal angle is when the HHT is below the seal and parallel to it.
Try to replace the batteries in the HHT.
Try to communicate with another seal.

## 5.4 **Wire** Failure

If the following message appears, after performing a SET function, you must check the wire connection to the seal or replace the wire.




## 5.5 **General** Failure

In case you face an unexplainable problem with your HHT, it is recommended to turn it OFF and after a minute to turn it ON again. If the problem appears again call for a service technician or send the device to the manufacturer.

## 5.6 **Low Battery of the seal**

In case there is a **LB** event while reading a seal (in the View Data procedure) it could be a temporary state. If you see the **LB** sign once in many readings, you may ignore it. When you see it every once in a while, it is a sign of the end of the seal's battery life. In this case you must use a new seal.

# 6. Technical Specifications

## 6.1 Hand Held Terminal

Power: 4 batteries, 1.5 V "AA" size.
Communication Distance: 60 cm max.
Operating Temperature: 0 ° to 50 ° C
Storage Temperature: -20 ° to 80 ° C
Storage Memory Capacity: up to 170 seals.

## 6.2 Seal

Power: internal lithium battery.
Communication Distance: 60 cm max.
Operating Temperature: -20 ° to 60 ° C
Storage Temperature: -20 ° to 80 ° C
Storage Memory Capacity: up to 10 events.

FCC requirements § 2.1033 (b)(4)

# CIRCUIT DESCRIPTION, BLOCK DIAGRAM& SCHEMATIC DIAGRAM

This page is followed by the Hi-G-Seal hand held terminal transmitter description, block and schematic diagrams.

## 1. General.

The Hand Held Terminal IG-MA-20 (&22) is a device that enables the user to interrogate the Active Hi-G-Seals.

Interrogation of seals can be in one of the following situations.

- When a seal is SET at the first time.
- Later when the seal with the sealed item are inspected for proper sealing or verifying seal status.

Operation will be by the function keys on top of the Terminal.

The Key Pad is to enable to set numerical data.

The display will be with all the relevant seal data.

In case of a tamper situation, the Terminal will alert visually and audibly.

## 2. Display.

The display is a dot matrix LCD with 4 rows of 16 characters each.

The following information will be available on the display.

- Seal ID: 10 characters
- Seal Stamp: 8 characters.
- Seal status
- Date and Time:
- Total events in seal memory.
- Number and type of the events.

## 3. Keys and Indications.

Menu: Scroll through the menu options.

Site: Set the Site number.

ESC: Retract last step .

Enter: Confirm action.

: Scroll through the options in the upper direction.

: Scroll through the options in the down direction

Read: Read seal data.

Set: Set a seal just after sealing the container.

ON: Turn on terminal.

OFF: Turn off terminal.

Numeric Key Pad: Enter numeric values.

Rd: Data receive indication (Led).

Sd: Data transmit indication (Led).

On: When green- power is on, when red- low battery (Led).

## 4. Technical specifications.

Meets FCC requirements part 15.209.

Modulation: AM (Pulsed RF) ASK

Tx Frequency: 250 kHz ± 0.5%.

Rx Frequency: 250 kHz ± 1.5%.

Transmitted Output Power: 960μV/m @ 3m max.

Data Throughput: 0.5 kbit/sec transmit 2kbit/s receive.
Memory: Flash, size 128Kx8bytes.
Real Time Clock: With self-retaining battery for 5 years. Accuracy is up to 20 min per year.
Power: 4 X 1.5 volts, AA size Alkaline.
Current Consumption: 70mA max. @ On. 150mA max @ transmit.
Serial Communication: RS232 9600bps, 8bits , No parity,1 stop bit.
Battery life : 15 hours continues or 4000 readings.
Interrogation Distance to seal: 60 cm. Max.
Operating Temperature: - 20to 50 °C.
Storage Temperature: - 20 to 60 °C.

## 5. Operational Description.

Powering the terminal is by pressing the ON key. Switching it off is by the OFF key.

When the terminal is **on**, the display will display the Date and Time on the lower line.
Setting new seals. To Set a new seal we will use the **SET** key.
After a successful SET the data from the new seal will be displayed.
The data will include the ID, Seal STAMP and the STATUS.
READ. Pressing on the **READ** key the terminal will start to interrogate the seal.
The received data will be displayed and stored in memory.
As STATUS it will be possible to display, OK, NEW, TAMPERED.
Reading data from memory: Pressing the MENU will display View Data.
Date and Time setting: Selecting the SETUP DATE or SETUP TIME from the list in MENU mode will enter into setting mode.

6. Safety: N.A
7. Maintenance: No maintenance required , Reader can be opened for repair.

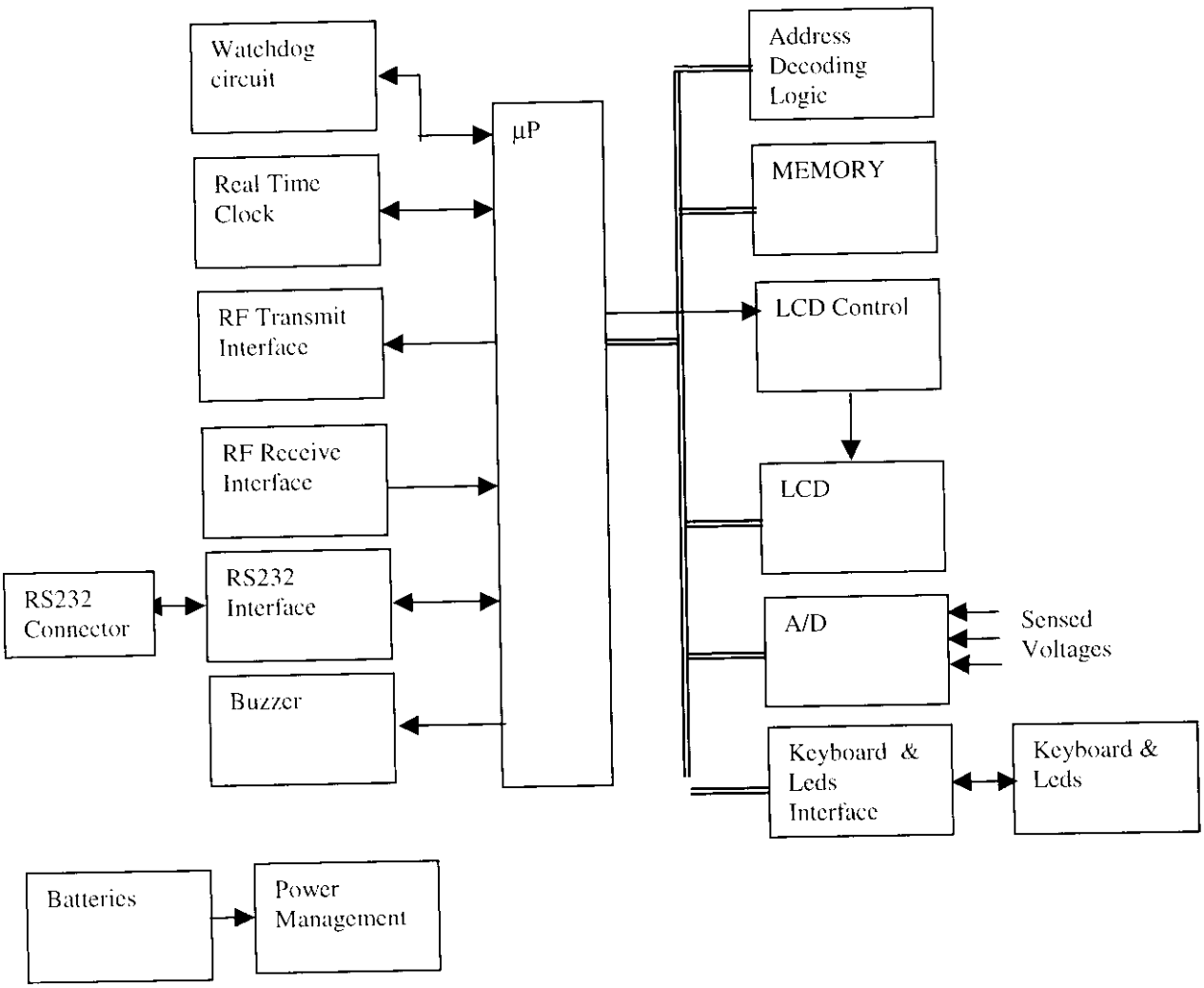
## Hand Held Terminal Circuit description:

1. Reference documents: Circuit Diagram #31U10020 REV-B ; 31010030 REV-A0

2. Functional description:
The HHT is used to communicate with the active seal/tag analyze the data, log it and transfer it via a serial port to a PC.
The HHT is battery operated, it has an internal replaceable 4 AA size alkaline batteries.
The power ON and OFF is controlled by a keys on the keypad.

Interrogation cycle begins by pressing the READ or SET key on the keyboard.
The HHT transmits a command/request to the seal and seal responds.
The data transmitted has a 250 kHz carrier, which is modulated with 2 kHz data.
The modulation method is pulsed RF.

3. Circuit description:
Block diagram:

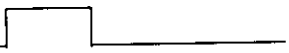


**µP :** The µP (U5, Pg. 2) is a 89C52 controller with a 16MHz clock.
**Address decoding logic:** includes U3,U6,U10,U12.
**Memory:** Includes U9 as SRAM and U1 as FLASH Memory (Pg.2).
**LCD Control:** U19 (Pg. 3) is a digital potentiometer, which used a control the LCD contrast. U20 and the components around it are used as buffer/amplifier to the LCD contrast voltage. JP1 is the LCD connector. JP4,JP5 are optional LCD connectors.
**LCD:** The LCD is graphic 64x40 with no backlight.
**A/D:** The A/D is used to control the system voltages. R19,R20 (Pg. 5 )and the group of components around them sets the input sensed voltages to the A/D. The A/D is U14.
**Keyboard & Leds Interface :** U13,U18 (Pg. 6) are the latches to the bus. The group of diodes are used for the keys, The Keypad board is connected to JP6.
**Watchdog circuit:** U24 (Pg. 2) is the watchdog timer , U2 is not populated.
**Real Time clock:** U4 (Pg. 2) is the real time clock with a 32768Hz clock.
**RF Transmit Interface:** U8 (Pg. 4) modulates the data with the carrier, which both come from the µP.U7 & U11 buffer and drive the signal to the antenna (Ferrite rod which is connected to pads H1,H3),C12,C13,C14& C48 resonance with the antenna. U25,U26 & U27 are not populated.
**RF Receive Interface:** U22 & U23 ( Pg. 4) receive the data from the antenna, detect it and transfer it to the µP.
**RS232 Interface:** U16 (Pg. 6) generates the RS232 voltage levels and buffers the RS232 lines and the µP. It also supply the negative voltage level to the analog circuitry. J3 is the serial communication connector.
**Buzzer:** BZ1 (Pg. 6 ) is a piezo buzzer for audible notifications and alarms.

1. Hardware & signal description

*RF DATA OUT :*

Interogation pulse:



20mSec

Place pulse:

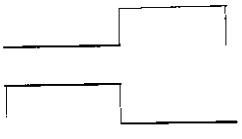
20mSec

*500KHz:*

Present only when RF-DATA is 'H'.

*RF-DATA IN:*

Bits definition:



512uSec

Signal duty cycle can vary between 1/8 to 7/8.

*POWER OFF:*

During system RESET should be 'L' or Tri-state . The signal goes 'H' when OFF key pressed or when no key pressed for TBD minutes or no communication for TBD minutes.

RESET

Occurred when: - Power on.
- Power falls for less then TBDv
- Watchdog enabled.

The reset pulse should be few tenths of mSec.

*REAL TIME CLOCK*

24 bits, minutes only. Includes backup battery for 5 years.
During power-on it will be powered from the system Vdd.

*VOLTAGE TEST*

Need to check 5 voltage levels in the circuit including one negative voltage.

*LCD*

Contrast control : Non volatile setting of LCD contrast . ( Automatic temperature compensation ??)

BUZZER

Small packaged piezo.

*RS232 BUFFER*

With shut down control.
Turn the system ON from the RS232 lines.

3. System block diagram

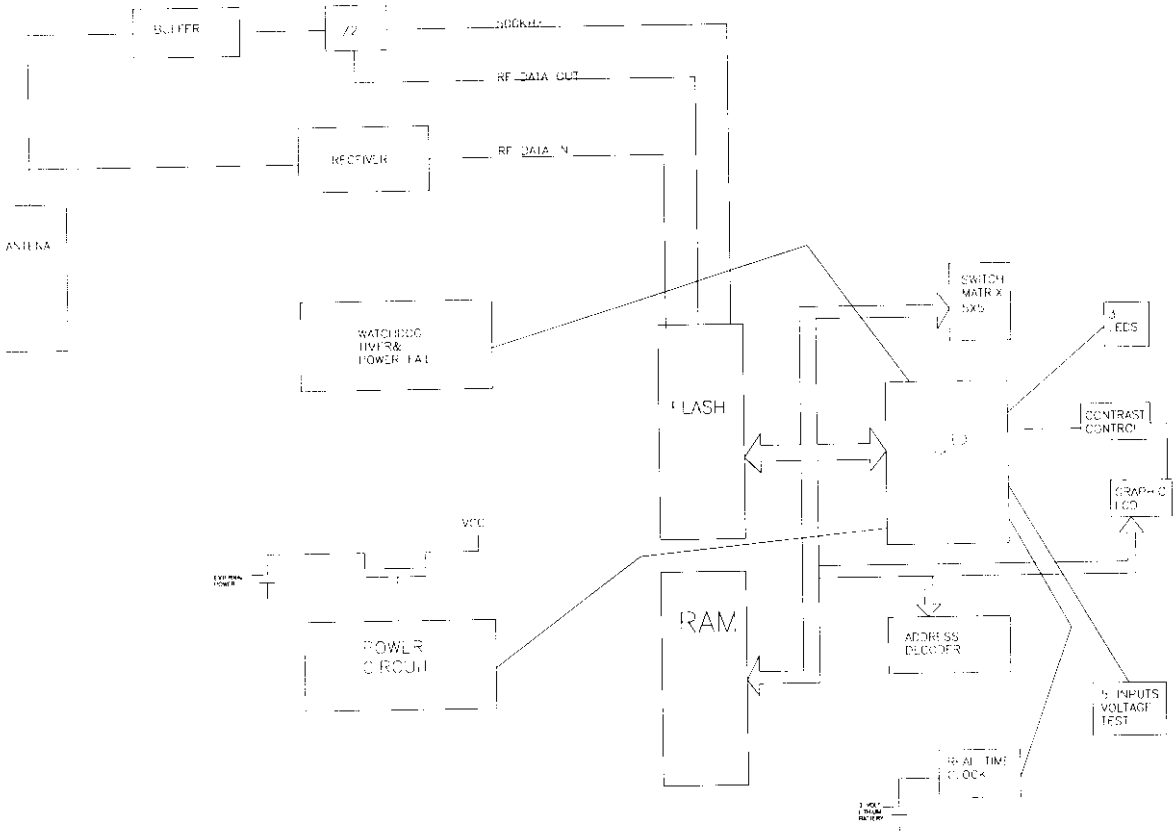


**Figure 1**
**Hi-G-Seal hand held terminal schematic diagram**

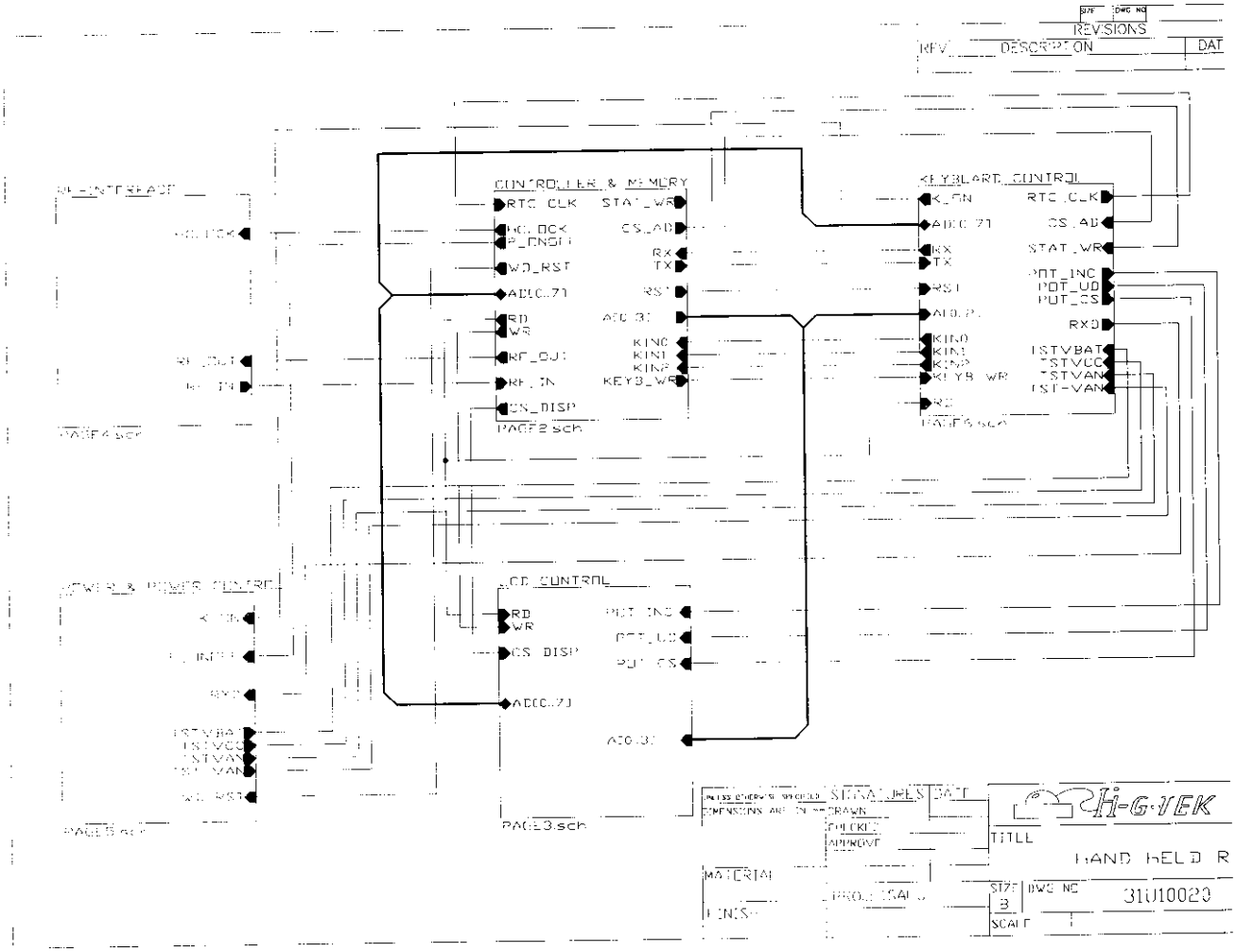


**Figure 2**
**Hand held terminal RF interface schematic diagram**