Data Logger Mitec SatelLite -T

Manual

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Manual

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Contents

Note! All references made to °F are inserted for information only. The instrument will **<u>only</u>** measure in °C.

Data Logger Mitec SatelLite

Mitec SatelLite professional Data Logger.

This is the manual for the Mitec 1-channel data logger SatelLite.

SatelLite is designed to satisfy high requirements regarding quality and handling. The instruments in the SatelLite family are encased in sturdy aluminium casing. The sensor is built-in and setup and reading is performed from a PC provided with a Mitec program. The likewise built-in crystal clock is provided both with time and date and can be started and stopped at the desired time.

Unique battery operation

The built-in electronics is powered by one single standard 1.5 V battery. The cost of batteries is thereby reduced to one tenth, compared to the cost of the special Lithium batteries used by similar instruments of other makes. The power consumption is very low and one battery can last over a year, all strongly depending on how the measurements are performed.

High accuracy

SatelLite-T measures temperatures within the range -40°C to 80°C /-40° to 176°F with a total inaccuracy of maximum ±0.3°C/0.54°F. The resolution is always better than 0.1°C/0.18°F.

This unique characterstic is achieved because the instrument changes measuring range when so is required. This means you only need one instrument to cover a wide measuring range.

The sensor is fitted on the outside of the casing which gives a time constant of only a few seconds. This means that the instrument can be used for measurements requiring high speed.

The built-in sensor is simple to remove for calibration. The programs from Mitec have built-in functions for a six-point calibration. The programs automatically assigns the data with sensor and instrument ID for complete and full traceability in accordance with the requirements as stated in ISO 9000.

Large memory

SatelLite is delivered with a built-in data memory that will not lose its information when the battery runs out. Three different memory sizes are available for, 4.500 or 20.000 measured values.

Made in Sweden

SatelLite is part of the Mitec system for professional collection of measured values. Measured data can be analysed with one or the other of our programs for Windows, WinLog or Monitor. These two programs can also be used for other Mitec products. A choice of additional products are available as accessories.

Mitec is a Swedish company. SatelLite is designed and manufactured in Säffle, Sweden.

Quick Start

First Attempt

The easiest way to learn SatelLite is to start by reading through this manual and then make a test measurement.

If you want to start directly with a measurement you can do this by following the instructions on this page.

What is needed

To carry out a measurement you need:

- Data logger SatelLite-T

- Program WinSat, WinLog or Monitor

Connect the battery

At delivery the battery is fitted in the instrument.

Sensor

SatelLite-T has a built-in temperature sensor.

Start with WinSat

There is no ON/OFF key. In standby position the instrument uses very little power. The green LED in the contact flashes when the instrument is in operation. Start the measurement with any of the programs WinLog, Monitor or WinSat.

See below and also the short description of the WinSat program.

THE MANUAL

This manual has four main parts. By all means, do a **QUICK START** but then read through the chapter **BASICS**!

"Quick Start" provides a brief information for those who want to start with practical measurements and that way learn how to handle the instrument.

BASICS and **HANDLING** will give you the necessary basic information you need to know in order to handle the instrument. These parts of the manual are a must to read.

ADDITIONAL INFORMATION includes descriptions of various items and can be read as needed.

Basics

Main Parts
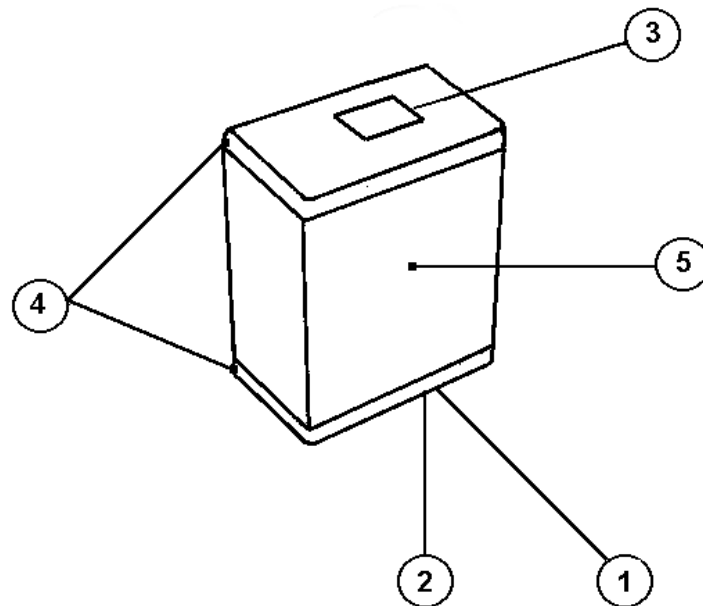
1..   4-pole contact device (male) for connection to the computer.

2..   Flashing green LED shows when activated

3..   Temperature sensor

4..   Remove these endpieces before replacing the battery

5..   Aluminium casing

Power Supply

SatelLite is designed and constructed for portable use.

Internally it operates with a power supply of 5 V. The primary power supply unit is a common 1.5 V battery.

It has a non-volatile memory and will retain its information even when the battery runs out.

Battery replacement

We recommend a 1.5V alkali battery of type IEC 6LR6. The battery is mounted to a holder inside the casing.

- Remove both end pieces.

- Extract the circuit card from the casing.

- Install a new battery. **NOTE! Turn the battery the correct way!**

- Put the circuit card in the lower end piece (the one with the contact device).

- Pull the aluminium cover over the card and snap fasten it to the end piece.

- Snap fasten the top end piece to the aluminium casing.

The LED shall flash three times when the battery is snap fastened to the holder.

A battery that is *temporarily* inserted incorrectly will not harm the instrument. However, after a while the protective circuit will burn off and this can cause serious permanent damage to the instrument. Therefore, always check that the battery is inserted the correct way.

Power consumption

In standby position SatelLite has a very low power consumption. During measuring the consumption will increase. The magnitude of the increase will depend on selected registration interval, measuring frequency and how often data is tapped from the memory. A normal life time for an alkali battery type LR6 is 1 month to 1 year.

See further information below.

Weak battery

SatelLite continuously monitors the condition of the battery and will tell you in the program when it needs replacement.

NOTE! Disconnect the cable to the PC when it isn't in use. The power consumption from the battery in SatelLite increases when it is connected.

Different types of batteries

SatelLite only uses a so called 1.5V Pen Light battery (14 x 50 mm). This type of battery is both inexpensive and common and can be bought practically everywhere.

We recommend an alkali battery type IEC LR6 as it has a high capacity.

However, do note that even alkali batteries have different capacities. Some of the cheaper types have a capacity that is as low as approx. 1800 mAh. Try to select a battery type that corresponds to the types indicated below.

We recommend:

Duracell MN1500 with a capacity of 2700 mAh

Varta 4006 with a capacity of 2500 mAh

At low temperatures the capacity decreases and in these cases we recommend 1,5 V Lithium batteries for example *Energizer FR6.*

Common dry batteries type IEC R6 can also be used, but they do have a life time that is less than half of the alkali batteries. We do not recommend use of the brown stone batteries due to their short life time.

You can also find NiCd batteries in this size, but again we do not recommend that you use them. One of the reasons is that they are a potential hazard to the environment and the other reasons are their poor capacity and relatively high cost.

Calculation of battery life time

The Mitec programs WinSat, WinLog and Monitor are used for the programming of SatelLite.

During the programming you also state the capacity of the selected battery. If the battery is new you state the capacity as indicated on the battery. If the battery is used you must estimate the remaining capacity.

The program will then calculate expected life time on the basis of how the instrument is setup and will indicate how many days it will last. This calculation is based on the assumption that the capacity will not fall due to e.g. low temperature.

Do note that the stated capacity is valid at room temperature. The capacity drops at low temperatures. This is especially important to note with brown stone batteries as they are quite unsuitable for use in temperatures below zero.

When the instrument is reprogrammed, the program will remember the consumed capacity in the battery and will take regard of that when a new calculation is made.

However, if you remove the battery this information will be lost and you must yourself estimate how much of its capacity is left. The program will automatically discover that the battery has been removed and will alarm for this.

If the battery runs out of power while measuring you will not lose the measured data, they can be read when a new battery has been installed.

Sensor

Built-in temperature sensor in SatelLite-T

SatelLite-T is designed for the sole purpose of temperature measurement. For this purpose it has a built-in sensor in the instrument cover.

This sensor is simple to remove and since it is equipped with a 20 cm / 7.9 inch long cable it can measure in very narrow spaces where the sensor does not fit in.

The sensor is mounted in a protective sleeve that is simple to snap loose using a screwdriver underneath its collar.

The sensor is a so called replaceable thermistor sensor. It has a very good initial tolerance and this is the basis of the good accuracy of the instrument.

Three measuring ranges

SatelLite-T has divided the sensor measuring range into three parts. The correct measuring range is automatically selected. In practice this means that a very wide measuring range can be handled by one and the same instrument. (Other similar products of other makes have a limited measuring range and several instruments must be used to cover the high, medium and low range.)

Individual calibration

Through use of a special, A/D-conversion technique it is possible to reach a very high accuracy. In addition also a very good resolution can be reached, in e.g. the interval 10°C - 40°C /50°F - 104°F it is as low as three 1/100 parts of a degree.

Each instrument is individually calibrated in six points. Two for each measuring range. The calibration is performed with a resistance standard traceable to international standards.

Re-calibration in the field

Re-calibration can be done in the field using a separate PC-program. For calibration of the whole system, including the sensor you need, apart from the program, a standard temperature of known accuracy.

Start of the instrument

The instrument is ready for use as soon as the battery has been connected. SatelLite has a very low power consumption in standby position and therefore has no power switch.

Resetting to zero after a battery replacement

As soon as supply power is connected SatelLite will automatically perform a resetting to zero. This is acknowledged by three flashes from the LED.

The instrument is now ready for use but not before certain configuration has been carried out with help of the PC program.

Please continue your reading under ”*Handling”* below.

Handling

Setup and Readings

Complete series of PC programs

All setup and readings on SatelLite are made from the PC. Mitec provides three different programs.

WinSat is specially made for SatelLite and only includes the basic functions.

WinLog is the standard Mitec program for communication, analysis and calculation and it can be used with all Mitec data loggers.

Mitec Monitor is the most advanced program and includes XY-diagrams, macro functions, modem communication, etc.

All programs are in the English language with manuals in English and support from Mitec.

Below we show only the functions in the programs that concern SatelLite at setup and checking. We refer you to the manual for each program regarding analysis of the measured data.

General information about program setup

The programs use somewhat different methods for "Setup" but the functions all look alike when you start them up. Below we introduce the common parts.
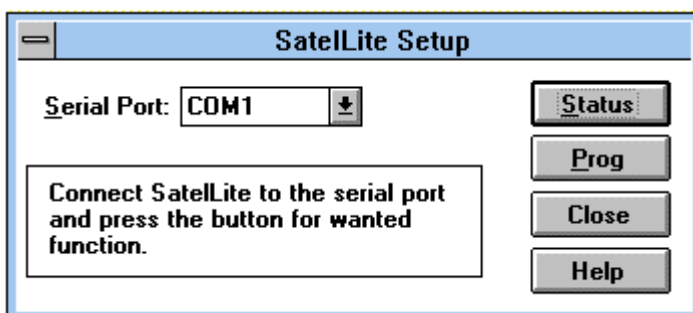
See further on in this manual for information about the installation of the WinSat program.

SatelLite Setup

The first box that is shown provides two choices, Status and Programming.

Status is used to show the configuration of the instrument and what will happen when **Prog** is used for instrument setup.

Optional communication port can be used.

Status, general

When the "STATUS" key is depressed you can see configuration and operation of the instrument.

Also see chapter *"Checking of Activity"*.

Programming, general

If you instead of status select "PROG" the box below will be shown.

Further functions can be reached if you depress the "ADVANCED" key.

You can now do the desired settings. See below for a closer description.

Set Date & Time

The clock is one of the more important parts of the data logger. The quarts crystal clock in SatelLite can show year, month, day, hour, minute and second.

The clock is read and adjusted from the PC-program.

SatelLite Setup

All configurations are performed under this function. Every time a new configuration is done the clock is also set.

The program reads the actual time in the PC and loads this information to SatelLite.

Therefore, make sure that the clock in the PC shows the correct time!

THE CLOCK

The clock is controlled by a quarts crystal and its accuracy is similar to a common wrist watch, i.e. the variation in error can be between a few seconds up to approx. 1 minute per month.

Setting of Registration Interval

The registration interval (the storage interval) is the time taken between two storages of measured values in the logger memory.

Setting of registration interval

- Select SatelLite Setup

- Depress the Prog key.

    The programming box (see above) is shown.

<u>R</u>egistration Interval: | 1 m | ± |

    Select registration interval from the scroll bar.

Store the settings

Store the settings by pressing PROGRAM or make additional settings in the ADVANCED menu. Choose number of measurements for a registration.

What is a registration interval

The principle for a data logger (measured value sampler) is that it automatically makes measurements and stores these in its memory for later reading.

A basic function is the registration interval, the time lapse between two storages in the memory. (Compare with the speed of the paper on a line printer).

The table below shows available registration intervals.

Interval	Interval	Interval
0.25 s	1min	1 h
0.50 s	2 min	2 h
1 s	5 min	4 h
2 s	10 min	6 h
5 s	15 min	8 h
10 s	30 min	12 h
15 s	--	24 h
30 s	--	--

How is a registration performed

The registered value is the mean value from a number of measurements. The number of measurements performed can be selected when programming. The alternatives are those shown in the scroll bar in the programming box.

What interval shall be chosen

Mainly two factors determine what interval to choose.

The process time constant i.e., the most important one is how fast the input signal varies. To get a reasonably representative picture of the variations in the input signal you must make sure of at least two storages per period. The period time is defined as the time lapse between e.g., two max values (or min values) in a varying signal.

Available memory is also of great importance. For every measurement you must make an estimate of the time required to fill the memory.

How data is stored in the memory

SatelLite normally has sufficient space for approx. 5.000 measured values and can be extended to accommodate approx. 20.000 measured values.

When the memory is full the oldest values can either be discarded and replaced by a new value (standard condition) or the measurement can be stopped. This is determined during the programming. See chapter "Automatic Stop of Measurement".

When is the memory full

The influencing factor here (apart from the memory size), is the registration interval.

NOTE! The available memory is not exactly 5000 values, it varies somewhat due to the configuration.

The tables below show the time it takes to fill the memory. With memory size 20 000 the times stated below will be quadrupled.

Interval	Time to fill memory	Interval	Time to fill memory	Interval	Time to fill memory
0.25 s	20 min	1min	3 days	1 h	199 days
0.50 s	40 min	2 min	7 days	2 h	398 days
1 s	80 min	5 min	17 days	4 h	796 days
2 s	3 h	10 min	33 days	6 h	1194 days
5 s	7 h	15 min	50 days	8 h	1592 days
10 s	13 h	30 min	99 days	12 h	2386 days
15 s	20 h	--	--	24 h	4773 days
30 s	40 h	--	--	--	--

Selection of Measuring Frequency

Select number of measurements per registration

In SatelLite you can choose how many measurements that shall be performed for each registration. The value that is stored (registered) is the mean value of the measurements.

- Select SatelLite Setup

- Depress the PROG key.

    The programming box is shown (see above).

Measurements per Reg.: `6 (10 s)`

    Select the measuring interval from the scroll bar.

Store the settings

Store the settings by pressing PROGRAM or make additional settings in the ADVANCED menu. Select number of measurements for a registration.

Measuring frequency states how often a measurement shall take place. A registration (storage of data in the memory) is the mean value from a number of measurements. The number can be chosen as required.
The table below shows available alternatives.

Interval	Measurements /registration	Interval	Measurements /registration	Interval	Measurements /registration
0.25 s	1	1min	1-240	1 h	8-125
0.50 s	1-2	2 min	1-240	2 h	15-240
1s	1-4	5 min	1-150	4 h	30-240
2 s	1-8	10 min	2-150	6 h	30-240
5 s	1-20	15 min	2-225	8 h	60-240
10 s	1-40	30 min	4-225	12 h	90-240
15 s	1-60	--	--	24h	180-240
30 s	1-120	--	--	--	--

Manual Start and Stop

The collection of measured values can start as soon as the setup described in the preceding chapter has been made. This can be done automatically or manually. Below we describe the procedure for a manual start/stop.

Immediate start of the measurement

The measurement can be started in conjunction with the programming of the instrument.

- Select SatelLite Setup

- Push the PROG key.

   The programming box (see above) is shown.

- Push the ADVANCED key.

    The dialogue box extends. The extension includes a section about start conditions.

Choose the alternative "Immediate" to start the measurement in conjunction with the programming.

Stop the measurement immediately

The measurement continues until the next programming opportunity
(unless you have selected automatic stop).
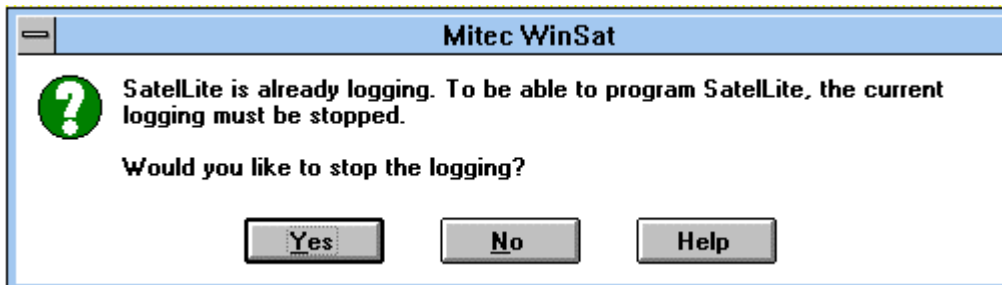
The above dialog box will show if you try to program a SatelLite while
a measurement is in progress.

Push ”YES” to stop the measurement and ”NO” to continue with an
uninterrupted logging.

Start and stop can also be made at a specific time. See chapters ”Automatic Start of Measurement” and ”Automatic Stop of Measurement".

NOTE. A reprogramming will automatically erase all previously collected information. This is the only time the memory will be emptied.

Conditional Start and Stop of Logging

Apart from starting the measurement with SatelLite **manually** it is possible to start the measurement **conditionally** or at a **specific time**.

The logging can stop when the **memory is full** or at a **specific time**.

Start at a specific time

- Select SatelLite Setup

- Push the PROG key.

   The programming box (see above) will show.

- Push the ADVANCED key.

   The dialogue box for programming is also provided with a box for start up condition.

Select the alternative "Time start" and enter date and time for start of the logging.

Store the Setting and activate Start

When the desired conditions have been set and the configuration is complete you push key PROGRAM in the dialogue box.

Note! When automatic start has been activated the text "**Begin**" will show at status check until the start conditions have been fulfilled and registration can start.

Thereafter the text "**Running**" will show.

Start at a **specific time** can be very useful when trouble shooting. Time start is also used when you want to synchronise several different measuring instruments and this way get measured values taken at the same time.

The measuring will proceed continuously after start until a stop condition has been fulfilled or you perform a manual stop.

NOTE! When start has been ordered and until the start conditions have been reached, the text **Begin** will be shown under Status check.

This means that measurement has commenced but that the start conditions have not yet been met. As soon as the start conditions have been reached the text **Running** will be shown in the display and storing in the memory starts.

The registration will continue until an automatic or manual stop has been ordered.
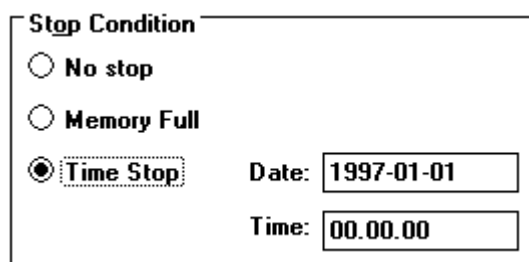
Stop at a specific time

- Select SatelLite Setup

- Push the PROG key.

  The programming box (see above) will be shown.

- Push the ADVANCED key.

  The dialogue box for programming includes a box for stop conditions.
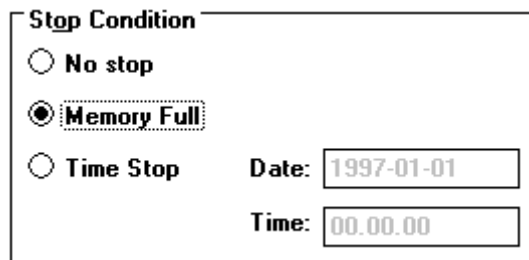
```
┌─ Stop Condition ──────────────────┐
│  ○ No stop                        │
│                                   │
│  ○ Memory Full                    │
│                                   │
│  ● Time Stop    Date: 1997-01-01  │
│                                   │
│                 Time: 00.00.00    │
│                                   │
└───────────────────────────────────┘
```

Select the alternative "Time Stop", enter date and time when you want the logging to stop.

Stop when memory is full

The box for stop conditions also includes the alternative "Memory Full".

```
┌─ Stop Condition ──────────────────┐
│  ○ No stop                        │
│                                   │
│  ● Memory Full                    │
│                                   │
│  ○ Time Stop    Date: 1997-01-01  │
│                                   │
│                 Time: 00.00.00    │
│                                   │
└───────────────────────────────────┘
```

Store the Settings and activate start

When the desired conditions have been selected and the configuration is completed you store the settings by pushing the PROGRAM key in the dialogue box.

Checking of Activity

LED on SatelLite

A green LED sits behind the computer contact. When the instrument is logging normally it flashes every four second. When zeroing it flashes every third second.

How does the instrument operate

For fast information about the procedure and how the instrument operates the Mitec programs have the function STATUS. This function you find under menu "SatelLite Setup".

SatelLite Setup

The first box shown offers two alternatives Status and Programming.

Status is used to show the instrument settings and what happens. Optional communication port can be used.

Prog is described in another place.
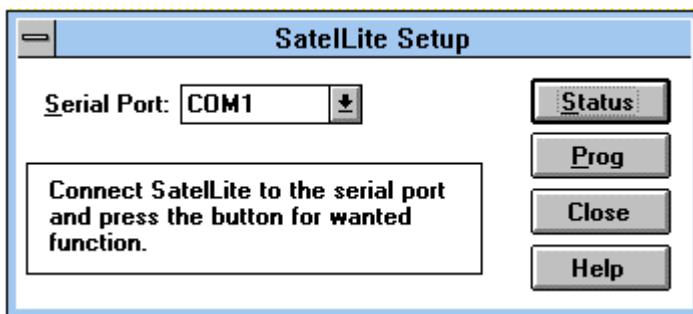
Status

<u>When you push the "Status" key</u> the information stored in SatelLite will be entered and displayed. The first box shown is the summary box shown below.

By pushing key "ADVANCED" you obtain further information:

```
┌─────────────────────────────────────────────────────────────────────────────┐
│ ▬                              SatelLite Status                              │
├─────────────────────────────────────────────────────────────────────────────┤
│ ┌─Information──────────────────┐  ┌───────┐   ┌─Logger──────────────────────┐ │
│ │      Logger: SAT-T #1064     │  │ Close │   │          Version: 1         │ │
│ │     Logging: Stop            │  └───────┘   │  Manufacturing Date: 1996-09-30│
│ │ Signal Type: Temp (°C)       │  ┌───────┐   └─────────────────────────────┘ │
│ │ Number of Reg.: 92 of 4773   │  │ Help  │   ┌─Battery─────────────────────┐ │
│ │ Left in Battery: 2700 mAh (347 days)│└───────┘ │ Programmed Capacity: 2700 mAh│ │
│ │ Current Time: 1996-12-30 08.55.10│ ┌────────┐│ Time since last change: 13 min│ │
│ └──────────────────────────────┘  │Advanced>││ Execution time since last: 35 s│ │
│ ┌─Program──────────────────────┐  └────────┘└─────────────────────────────┘ │
│ │ Program Date: 1996-12-30 08.49.41│        ┌─Logging─────────────────────┐ │
│ │ Start Condition: Immediately │            │ Oldest: 1996-12-30 08.49.42  │ │
│ │ Stop Condition: No Stop      │            │ Latest: 1996-12-30 08.51.13  │ │
│ │       Interval: 1 s (1 s)    │            └─────────────────────────────┘ │
│ └──────────────────────────────┘                                            │
└─────────────────────────────────────────────────────────────────────────────┘
```
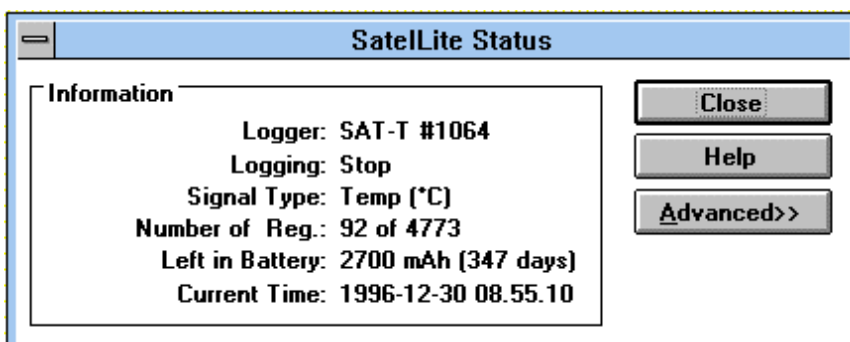
Status "Information"

Logger: Shows type of instrument and its serial number. Each instrument has its own individual serial number given during the manufacturing.

Logging: Shows current activity. This can be Stop, Begin or Running. Se below for explanation.

Signal type: Shows the type of input signal to the logger.

Number of registrations: Apart from the number it also displays the total memory space available. *Note 1.*

Remaining in battery: Consumed capacity is calculated. *Note 2.*

Current time: Shows the time in the logger when the status key was pushed (+3 seconds).

Status "Programming"

Executed: Date and time of the programming.

Start condition: Set start condition.

Stop condition: Set stop condition.

Interval: The registration interval. Within brackets it displays the time lapse between the measurements (the measuring interval).

Status "Logger"

Version: The instrument version number.

Manufacturing date: The date when the instrument software was loaded.

Status "Battery"

Stated battery capacity: The capacity figure entered by the operator at battery replacement. *Note 3.*

Time elapsed since last battery replacement: Time elapsed since the latest power interruption and new statement regarding the battery capacity. (In practise the time elapsed since the battery was inserted).

Operation time since the battery was replaced: Time the instrument has been used for logging, i.e. active operation time. *Note 4.*

Status "Logging"

Oldest: Time for the oldest registration stored in the memory at the status request.

Latest: Time for the youngest (latest) registration stored in the memory at the status request.

The table below explains the status information in box **"Information** / Logging".

STOP	No registration is active. The memory contains information collected during the previous measuring period. (Or is empty if no measurement has been done since the zeroing.	**RUNNING**	Means that the start condition has been met and measurement is in progress. This is the normal condition at logging.
BEGIN	This means that you have chosen to start on an external condition. Measurement has been ordered but the start condition has not yet been met.		

Note 1

Memory consumption. Note, the memory is full if the figures for number of registrations and available memory are equally large. Logging can still be in progress depending on the stop condition you have chosen.

Note 2.

Remaining in battery. This calculation is based on the capacity stated by the operator during programming. NOTE! The calculation is based on a typical power consumption and is not exact. SatelLite will remember how much has been consumed of the installed battery and will disregard a new statement for battery capacity. To change the capacity you must remove the battery and reinstall it.

Note 3.

Battery capacity. SatelLite will notice it the power has been disconnected and will give alarm for this at the next programming. The operator shall then enter a figure for the capacity of the battery that has just been installed. The capacity shall be entered in conjunction with the installation of the battery. This figure will be used by SatelLite until the battery is removed and installed again.

Read about power supply in chapter "BASICS".

Note 4.

Operation time. This time is the sum of the time that the instrument has been used for logging, i.e. the time for measuring. Standby with stopped logging is not counted. The operation time counter will be zeroed when the battery is replaced (when a new capacity is entered).

Download data to PC

Information from SatelLite can simply be downloaded to PC for further calculations.

The transmission is made by a serial communication via RS232. Normally you need make no settings on SatelLite and the transmission is started and controlled completely from the PC.
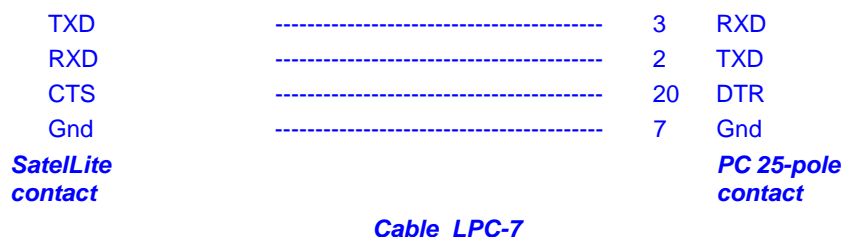
Connect the computer

The connection to the computer is done with a cable provided with suitable contact devices.

As an accessory to IBM PC and compatible units we carry cable LPC-7 in stock. This can be used both for 25 and 9-pole contact devices in a PC.

Connect the cable to the 4-pole modular contact on SatelLite and to a free COM: port on the PC.

NOTE! Do check that no other program, e.g. the mouse, uses that COM port on the PC!

TXD	--------------------------------------	3	RXD
RXD	--------------------------------------	2	TXD
CTS	--------------------------------------	20	DTR
Gnd	--------------------------------------	7	Gnd

SatelLite contact   *PC 25-pole contact*

Cable LPC-7

At startup of SatelLite you get a standard setting of the serial inport, which is 9600 baud, 8 bits, 1 stop-bit, no parity. WinSat and WinLog will automatically adjust to this.

Readout of measured data

Readout of the measured data differs somewhat between the programs. SatelLite shall be handled in the same manner as other products from Mitec in the handling of the readout.

Data is stored in the same manner and measured data from SatelLite can at the presentation and calculation be mixed with data from e.g. AT40 or other loggers.

See the manual for each program!

TRANSMISSION SPEED

The speed of the data transmission is in baud and this can be translated as bits/second. One character is made up of 10 bit. With a speed of 9600 baud you can transfer 960 characters per second and in SatelLite this means 500-700 measured values per second. In practice the speed is lower due to control characters, etc.

Program in PC

A program that can communicate with binary numbers is required to receive information from SatelLite.

The program WinSat is an accessory to SatelLite. This program can be used to transmit data to a PC for a simple presentation or for transmission to a spread sheet programs as Excel or Lotus 1-2-3.

Mitec can also provide complete communication and analysis programs for Windows. **Mitec WinLog** is a powerful program for communication, storage of data, calculation and presentation.

Mitec Monitor is an extended version of WinLog and this program includes automatic communication via modem.

WinSat as well as Monitor and WinLog require Windows 3.1 and at least a 386-PC with 4 Mbit RAM.

Series and Revision number

The Status function can provide information about instrument type and serial number.

You will also find a space for the instrument number on the label stuck to the instrument end piece. Check the series number with the "Status" function in the program and write down this number on the label using a ball-point pen.

Calibration

Individual calibration

A very god accuracy has been reached through the use of a special A/D-conversion technique. In addition a very high resolution can be obtained, e.g. in the interval 10°-40°C/50° -104°F it is as low as three 1/100 parts of a degree.

Each instrument is individually calibrated in six points when manufactured, two for each measuring range. The calibration is made with a resistance standard traceable to international standards.

Recalibration in the field

Recalibration can be made in the field with help of functions in the WinSat program. For calibration of the whole system, including the sensor, you require a temperature standard of known accuracy plus the program.

WinSat introduction

General information about WinSat

WinSat is a program in the same series as Mitec Monitor and WinLog.

WinSat can only be used with the Mitec SatelLite series, while the other programs also can be used together with other Mitec instruments.

How to Install

Insert the diskette in A:

- Select "Run" in the program manager "File" menu.

- Write A:\install

  The program will now be automatically installed. Answer to the questions as needed. Program group **Mitec WinSat** will be created.

Start the program

Double click on the SatelLite icon. This will start the program and display the welcome page.

The top part of the menu looks as the picture below.

Program function

The program is very simple to use and has been made so it is "self instructing". The handling of WinSat is only described in the **program help text**. You find this text under "?" on the menu.

Quick start

Click "File" and select "Setup". Here you do all the configurations needed to start up SatelLite. See previous sections in this manual.

Collect the measured data under "File" and "Sampling".

Diagrams will be created automatically as soon as the sampling is completed.

Structure

The measurement is performed on an **Object.** Enter the name of the object when starting the sampling.

You will find the measured data under the object name when you select "Open" and a diagram will be displayed.

In WinSat a measurement and a diagram is the same thing. Do note that you can "add" data to an already existing object.

The measured data will be stored in the same format as in the other programs from Mitec, Monitor and WinLog, and can be transferred to these programs.

Analysis

Measured data displayed in the diagram can be studied using the different tools.

Put the cursor in the diagram and click the **right mouse key**. Test!

Also test the zooming function by using the flexible axis's. Point to a value on the time or Y-axis and drag the value to a new position. Ready!

The menu has scrolling arrows and zoom keys .

And a key that restores everything.

Use the keys below to print out the diagram or to export it to the editing board. .

No calculations can be made in WinSat. Instead use WinLog or Monitor that both are equipped with an advanced and easy to use formula language.

Test all the program functions and search through the help text. .

Additional Information

What is a Data Logger?

Background

The term data logger we have, as with many other technical terms, borrowed from the English language. Log comes from the naval term *to log* meaning in a logbook, i.e. to make careful notes about events.

With data logger we then mean careful "notes" of measured data in a mass memory.

We prefer the term *measured value collector*, but it is of course more international to use the term *data logger*.

Mitec introduced its first data logger on the market in 1984. It was the 4-channel logger MTM20 that we called a TEMP-recorder. Shortly afterwards we introduced its sister instrument, the PULSE-recorder PM20. The next generation was the ANALOG-recorder AT30 and now we have come to the third generation, the UNIVERSAL-recorders SatelLite and AT31.

Our product names have made their mark. In Sweden you can e.g. look in the " Buyers Guide for Engineers " (Ekonomisk Litteratur AB) under "Recorder" where out product names have been used as headlines in the product index. We can only say Thank You! for that.

The data logger is not a new invention. You can find old literature references, such as e.g. "Airborne recorder and Computer Speed flight-test Data Processing System" from 1958.

The loggers were developed in step with the development of the semi-conductors. The microprocessor plays a very important role here.

The real and major break-through came in the beginning of the 90's after the logger had gained its general acceptance.

How does it work?

The principle is rather simple. The main parts of a modern logger are the microprocessor, the semi-conductor memory and an analogue/digital converter.

A sensor gives an analogue signal, e.g. 4-20mA. The micro processor that has a built-in clock controls the process. The sensor is read at set time intervals and the measured values are stored in the memory.

Eventually it has collected a number of measured values that form a *time series*. The time series can be printed out as a diagram on a printer or on a computer screen

Modern data loggers are rather sophisticated and offer different possibilities on how to treat the information. Below we have described some of the more common terms.

Memory is of course quite important. Common sizes are for approx.1000 values up to several 100 000. There are non-volatile memories available with a built-in battery so they will not lose data in case of a power failure.

Measuring channels will tell you how many sensors that can be connected at the same time. Handheld professional loggers generally have 2 to 8 channels.

Type of input tells you about the type of sensor that can be connected. Most sensors can measure temperature or a voltage signal e.g. 0-10V. Different types of sensors can be connected to the more advanced loggers.

Registration interval is the time between two storages in the memory. It is usually adjustable in steps between 1 s and 24 hours. The registration interval determines how fast processes you can measure on. A rule of thumb is to make at least two registrations per period for the measuring signal.

Measuring interval is the time between two measurements. The most modern loggers measure several times per registration to make sure of a more accurate value. The measuring interval can be adjustable.

A clock is required. A modern logger has a calendar clock (crystal clock) with date and time.

Start condition is the condition that must be met before measurement can start and data be stored in the memory. It can be manual start, time start

or start on external condition, (e.g. when a temperature is exceeded).

Stop condition determines when the measurement shall stop. It can be manual, on time, or when the memory is full.

Storing conditions can be set on some loggers. It is e.g. possible to store only the mean value during a registration or *several values*. e.g. min, mean and max.

How to take care of the measured data

The collected measured values are stored in digital form as data words. Before you can use the information it must be treated.

Older loggers only printed out the information as numeric values on a printer. This resulted in long and cumbersome tables that were hard to interpret.

The best way is to present the information in the shape of a curve. Some loggers can draw curves directly on a printer or a plotter, and this is acceptable if you are satisfied with unprocessed data.

The most common method is to transmit the information to a PC for analysis in a program.

The main advantages with this are that the information then can be stored on a magnet media for later analysis and that the work involved with the analysis has been made easier as the calculation and presentation capacity of the computer can be used.

Modern personal computers using Windows have made possible a very efficient handling due to the graphical interface using the mouse as a pointer.

What must be considered.

One of the first items is to make sure that you have an instrument that is up to the present work situation, in other words it must be "good enough".

Type.

You must first decide if the instrument shall be portable or have a fixed installation. For field measurements the requirements are low weight and battery operation.

Some suppliers use the PC also in the field. Don't forget that the PC is attractive to thieves, never leave it unguarded!

Some of the cheaper loggers are made as "black boxes" without keys and display. These leave you completely dependent on the PC for configurations and control of the operation, even in the field. These loggers often have a fixed built-in battery and the instrument will be dumped when the battery runs out.

Ergonomics

Unfortunately this area has been very "high-tech"-inspired. Many instruments are difficult to overview and have a number of keys for different functions. Select an instrument that has a logical construction. It should also have a display with letters and figures and some clearly marked keys.

Extension.

Also check the procedure for connection of sensors of different types and to extend the equipment. Some instruments are only constructed for certain types of sensors. If you want to connect other sensors you then either have to purchase a new instrument or special circuit cards.

Battery life time.

It is important to check the power consumption. A modern battery driven logger should not in stand-by position consume more than 0.1 mA. When measuring it may consume a lot more, approx. 30-40 mA. Do note that short registration intervals (1-30 secs.) increases the consumption sharply.

Input signal.

You get maximum flexibility if you select an instrument with universal inputs. To these you can, with a suitable cable and connection, directly connect different types of sensors.

Some loggers require external signal transducers to adjust the sensors. Consider that these generally use a lot of power and that they also take up space.

A very important aspect is the power supply to the sensors. If you have to arrange for an external supply it will mean a hazzle with extra cables.

Quality loggers have a built-in supply directly via the sensor cable.

Watch out for the power consumption here! E.g. a humidity sensor can exhaust a 9 V battery in 24 hours if connected the whole time. Select a logger that can control the power supply to the sensor.

Accuracy.

Many suppliers make no difference between resolution and accuracy and yet they are two different things. The resolution indicates how "small" the parts of the signal are that can be spotted. Many suppliers have for reason of cost only used 8 bits and this can give a resolution of 1/256. With a measuring range of e.g. 300°C / 572°F this means a resolution of just over 1°C / 1.8°F. You should ask for at least 10-12 bits (a resolution of 1/1000 to 1/4000).

Accuracy is an indication of how well everything works together. This should be specified in a technical unit, e.g. °C or in %. You should also require that the supplier can show a traceability for the calibration, i.e. that he can show that the instrument measures correctly.

Memory.

These days the memory capacity is no limitation. 25-50 000 measured values is standard. Do note! Some suppliers show the memory in kbyte (kilobyte = 1000 byte). To store a measured value with an acceptable resolution you need 2 byte i.e. 128 kbyte is sufficient for 64000 measured values. Most memories can also be delivered with a power failure protection.

Manuals.

Make sure you get manuals in your own language. Check that the supplier can give service!

Mitec data loggers.

The Mitec data loggers are designed and manufactured by Mitec in Säffle, Sweden. As a customer you are always close to the source. You can get help and advice if you have a measurement problem.

We deliver instruments for physical measuring signals, i.e. we don't leave you with a 0-10 V input. We also deliver the sensor or a cable that directly fits the sensor you already have.

Field adjusted.

Our instruments are made for the user. We put great emphasis on simple handling and on flexibility. SatelLite, our latest logger is based on our 10 year long manufacturing experience of data loggers for use in the field

Simple handling.

A display in English will tell you exactly how to make the configuration. The simple and clear structure of settings and readings ensures that you learn to master the instrument in your first tryout.

Flexible.

Universal inputs for volt, mA, electricity meters, temperature sensors, current clamps, flowmeters, etc. ensure that our instruments can be used for a great number of applications. Without reconstruction or additions. Our concept with "smart cables" see to it that you directly can se signal type and unit in the display without any programming.

Technical performance.

State-of-the art technology of the microprocessors provide us all with the possibility to build "high-tech-Christmas trees". However, our long experience has taught us that technology is not an end in itself. Our instruments have a "sufficient" capacity, to quote a known English car manufacturer.

You still do not believe us? Ask a colleague who already has a Mitec instrument.

Temperature - our most common measurement

The physical parameter that perhaps has the greatest influence on the environment and us human beings, is perhaps the temperature.

Consequently it is also the physical parameter most measured and the measurement applications are of great variety. Material we measure in their three aggregregation conditions - firm, fluid and in the gaseous form.

For this you require measuring equipment that will function in these differing environments. Equipment of the right shape, accuracy and reliability.

Below we describe some of the common types of sensors used for temperature measurement and some practical aspects of their use.

The temperature scale

For practical use, we in Europe use the Celsius scale that we all know. Based on the melting and boiling point for water it feels quite natural (that Celsius himself suggested the boiling point to 0° and the melting point to100° is an entirely different story).

The SI-unit for temperature is however Kelvin [K] where 0°C corresponds to 273.15K. -273.15°C is based on what is called the triple point of water - the absolute zero. A *temperature difference* of 1 K corresponds to 1°C.

In USA they by standard use the unit Fahrenheit [F].

Fahrenheit used a mixture of snow and ammonium chloride as a zero point and for the second fix point he used the boiling point for water. That the scale in-between got 212 points depends on the ability of mercury to expand.

Y[°F] = (X • 9/5+32)
X[°C] = ((Y-32) • 5/9)

Sensors for practical use

There are many different principles for the measurement of temperature. Below we only describe those sensors that can be connected to electronic output signals and that have found a wide practical use.

Thermocouples

Thermocouples use the principle that two metals of different composition and connected to each other generate an electric power that is proportional to the differential temperature over the metals. The connection power / temperature is rather complex.

Thermocouples are normally made up from two isolated wires that are connected at one end (the measuring end). In its other end is normally fitted a contact device for the special task.

There are a large number of different types of thermocouples available. Some commonly used types for practical use are J, K and T. See also below.

Type	Material	Colour, contact	Range °C
J	Fe - Cu/Ni	Black (blact)	20 - 700
K	Ni/Cr - Ni/Al	Yellow (green)	0 - 1100
T	Ni - Cu/Ni	Blue (brown)	-185 - 300

Thermocouples can also be bought on a roll from which you can yourself cut a suitable length and make your own sensor by pressing or welding the ends together.

Thermocouples are also available with collars in very small dimensions and as hand probes.

The measuring accuracy is average, in practice the best show ±1°C. The reference point (the cold soldering point) must be measured by the instrument used and here is a big source for potential measurement errors. Special, so called compensation wires are needed to elongate the thermocouple.

The criteria for selection of the sensor are e.g. mechanical design, temperature range and environment.

Resistance transmitters

The resistance transmitter has a different measuring principle compared to the thermocouple. In principle it is a resistance where the resistance changes proportionally to the temperature.

A classic transmitter is built up by a metal thread wired round an isolated body of glass or ceramics. Metals used are e.g. platinum (Pt) and nickel (Ni). Often the transmitter is named after its resistance at 0°C e.g. Pt100 (R=100 ohm) or Ni1000 (R=1000 ohm).

The relationship resistance / temperature is well known (almost linear) and is defined in different DIN-standards where also the inaccuracy is specified. Resistance transmitters are too delicate to be used naked. They are therefore generally encased in different types of metal pipes.

A very common type of temperature transmitter for the industry is the Pt100. It is exceptionally well tested and is manufactured in large numbers. It is available in many versions (casings) for use in different applications. Other advantages are its known accuracy and long term stability. One disadvantage is the low output signal, approx. 0.39Ω / °C. This means that a measurement error can occur due to the resistance in the connection cable. This problem can be solved by the use of a so called 4-wire connection that will eliminate the influence of wire resistance.

Pt100 is available in different classes according to accuracy.

Class B   ±0.35°C / 0.63 $^\circ$F

Class A   ±0.15°C / 0.27 $^\circ$F

1/3 DIN   ±0.10°C / 0.18 $^\circ$F

The accuracy above is given at 0 $^\circ$C / 32 $^\circ$F. The error increases with an increasing temperature. Other accuracy classes are also available.

Pt100 has turned into industrial standard and is often used by convention.

Thermistor

Also the thermistor is a type of resistance transmitter. It is built up of a semi-conductor material instead of a wire. The connection resistance / temperature is also here well defined and the manufacturers state the connection in their specifications for all different types

available on the market. The connection is non-linear but this poses no problem for the microprocessor based instruments of today.

Precision thermistors provide a very good accuracy and stability. Thermistors of high resistance are insensitive to cable area and are excellent for use in e.g. climate measurements.

Another advantage is their dimension. They are often made as a perl with a diameter of 0.5 - 2 mm / 0.002 - 0.008 inches. This means that they are very fast, with time constants of fractions of a second.

Temperature transmitter

Transmitter means sender but a good translation is signal transducer.

Industrial conditions often have a difficult electric environment with disturbances from various equipments. For this reason temperature transmitters are not usually connected with long wires. Instead the signal from a transmitter is transduced to a standard signal where 4-20 mA probably is the most common. This signal is quite insensitive to disturbances and it also permits the use of standardised inputs on the measuring devices.

Transmitters are available in different designs to suit different types of sensors and measuring ranges. There are also different mechanical designs available, e.g. for mounting to a DIN-rail, mounting in a measuring head or for wall mounting.

Practical measurement

The temperature is measured for many purposes and in many environments and thus also under many different conditions.

Some common applications are *measurement in air*, in *closed vessels* (containing gas or liquid), measurement on *surfaces* and in *solid materials*.

Measurement of ambient temperature

The ambient temperature has a very substantial influence on us human beings. For this reason it is probably the most common measurement.

Most types of temperature sensors can be used.

The measuring range should be from approximately -40°C to 100°C / -40°F to 212°F. The sensor should have an accuracy of approx. ±0.5 °C / 0.9°F, as most of them have. For a higher accuracy the sensor must be calibrated with a traceable reference.

The positioning of the sensor is decisive for the measured result. A common cause for errors in measurements is influence from radiation. All warm bodies radiate electromagnetic radiation that can cause measurement errors. Try not to position a sensor close to radiators, electrical apparatuses or other heat sources.

Outdoors you should of course avoid exposure to sunlight.

Also cold bodies cause a radiation exchange (*from* the sensor). Indoors the windows can be a source to measurement errors, and outdoors the night sky will have a great influence on the measurement. It is always best to use a radiation protection suitable for the purpose.

A good sensor for this purpose is the Mitec thermistor which measures between -40°C to 120°C / -40°F to 250°F with an accuracy of ±0.3°C / ±0.54°F. To this sensor there is also a special radiation protection available.

Measurements in closed vessels.

Common applications are measurements in water and other liquids in the process, heating, water and sanitation industry.

For these purposes it is advantageous to use the Pt100-sensor with a stainless steel casing. They are available in a variety of lengths and diameters and for different types of fittings.

Sensors with a 1/2" or 3/4" male thread that fits into different types of measuring pockets are quite common.

The measuring range is up to approximately 300°C / 572 °F.

Quite often a signal transducer (transmitter) with a 4-20 mA output is fitted in the casing (the measuring head). This makes it possible to use a common two-wire cable that can be drawn quite far without risk of disturbances.

Measurements on surfaces.

There are special sensors available for the measurement on flat surfaces such as wall and floors. These are flat and very thin to ensure a good surface contact.

A common application is external measurement on pipe lines. Thermocouples or thermistors are useful instruments for this type of measurement.

For best possible contact the material must be properly cleaned. Use thermo paste (so called silicone grease). The pipe should also be insulated round the point of measurement and preferably be provided with a radiation protection, e.g. aluminium foil.

When correctly performed this type of measurement will be very accurate.

High temperature measurements.

For measurements of temperatures above 300°C / 572°F one normally uses thermocouples.

These are available for measurements of up to approximately 2500°C / 4530°F. The most common version is type "K". When the temperature exceeds approx. 500°C / 930°F one normally uses thermocouples. They are encased in a metal piping with a diameter of 1 to 15 mm / 0.04 to 0.59 inches.

Common applications are found in incineration processes, flue gases, measurements on steel castings, etc.

Technical specifications

GENERAL

Number of measuring channels	1
Memory size	8k or 32k byte. 8k memory is standard, others are options.
Number of measured values	4.500 or 20 .000.
Clock	Crystal controlled, date and time
Registration interval	On time: 0.25, 0.5, 1.2, 5, 10, 15 or 30 sec, 1, 2, 5, 10, 15 or 30 min, 1, 2, 4, 6, 8, 12 or 24 hours.
Measuring frequency	Optional for each registration interval.
Power Supply	1 size AA 1.5V battery. LR6 (alkali) or R6.
Battery life time	1 month up to 1 year. (Depending on registration interval and measuring time)
Ambient temperature	-40°C to +70°C / -40°F to 158°F. No condense.
EU standard	EN50081-1, EN50081-2 EN50082-1

INPUTS

Types	Temperature, replaceable thermistor (SatelLite-T). Snap-in fitting for external calibration.
Input selection	Automatic detection.
Resolution	12 bits excluding characters
Linearising	Automatic

    Temperature, SatelLite-T

Measuring range	-40°C to 80°C / -40°F to 176°F (instrument max 70°C / 158°F, external sensor 70°C to 80°C / 158°F to 176°F)
Resolution	0.03°C to 0.1°C / 0.054°F to 0.18°F
Total inaccuracy with sensor	Max error: ±0.3°C (0.54 °F) @-20°C to 70°C, ± 0.4°C (0.72°F) @ 70°C to 80°C and -40°C to -20° C
Sensor time constant	5-30 s to 90% depending on the air velocity.
Calibration	Simulated resistance sensor. Resistance standard traceable to international standards.

FUNCTIONS

Start and stop conditions	Adjustable, time start, manual start and stop
Storage method	Mean value, adjustable number of measurements per registration.
Reading and setting	Via PC and one of the Mitec programs WinSat, WinLog or Monitor.

COMMUNICATION

Computer	RS232, 9600 baud. Control signal from the computer.
Indication	LED. One flash every 4th second while logging is in progress.

MECHANICS

Box	Aluminium 60 x 50 x 30 mm / 2.36 x 2 x 1.2 in.
Weight	80 g / 0.18 lbs. incl. battery
Contact device	4 pole modular contact 4/4

We reserve the right to make technical improvements without prior notice.

Connectors

4-pole contact

The 4-pole contact is used for communication with external units.

Mitec cables LPC-7 are used for connection to the computer. See the chapter about connection to the computer above.

CE-marking

Declaration of conformity

Manufacturer:	Mitec Instrument AB Västra Storgatan 18, P.O.Box 91, S-66122 Säffle, Sweden
Equipment type number:	SatelLite-T
Description of Equipment:	Portable Data Logger
European standards:	EN50081-1, EN50081-2, EN50082-1

We certify that the apparatus identified above conforms with the requirements of Council Directive 89/336/EEC as amended by Directives 91/263/EEC and 92/31/EEC.

September 9 1996
Mitec Instrument AB

Bertil Olsson
Managing Director

Service and Support

Telephone support

The Mitec products are constructed and manufactured by Mitec Instrument AB in Säffle, Sweden.

We offer full service of the equipment in our work shop. In case of a problem, please contact us on our telephone number +**46 533 16050**.

Fax & E-mail

Our fax number is + **46 533 16045**.

Our E-mail address is **info@mitec.se.**

Homepage

You find our homepage on: **http://www.mitec.se**

There you find Demo-versions of our programs, a listing of the latest probes and a variety of help-programs.

Goods

Equipment sent in for service and calibration should be sent to:

Mitec Instrument AB

Västra Storgatan 18

S-661 30 Säffle, Sweden

Always include an accompanying note and a simple description of what you want done.

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