

# TRANSRACE II



## CONTROL LINE SPEED TIMING SYSTEM USER MANUAL

VERSION II *for MS-DOS Computers*  
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# DESCRIPTION

## Sensor

The sensor box has a slit opening in its front, covered by a clear plastic sheet. Inside there is a single phototransistor, which receives light from the part of the sky in view through the slit. The sensor can actually be called a one pixel camera! The angle of view is vertically between 9° to 50° relative to the horizontal, and around 4° horizontally. The phototransistor light sensitive area is circular with a diameter of around 1 mm. The distance of the phototransistor to the slit is 110 mm at the lower limit and 200 mm at the upper. In front of the phototransistor there is an infrared blocking filter. When a model enters the field of view, it obscures a small part of the sky, and the light drops by a tiny fraction. The circuitry on a small circuit board detects this drop, outputs a signal pulse, and blinks a red light on the rear panel. From the F2A model dimensions, its range of flying heights, and the sensor field of view as above, the photocurrent drop can be estimated to around 0.5 %, rather independent of the flying height: Special techniques are employed to detect a 0.5% drop, adapt to the lighting conditions and exclude light variations from other sources than the model. For instance, the brightness of the sky could vary by a factor of ten! There has to be a lower limit of the field of view, as objects near the ground must not disturb. The pilot, mainly (!! ) but also background trees, circle fence and so on. This means that models passing lower than around 0.6 meters (2 ft) will be missed.

## Software

The sensor delivers its signal to the PC, where the software registers the time of arrival, using an internal clock. The software also handles most other aspects of registering speed flights for contests as well as practice. The speeds for all individual laps of the flight get displayed on the computer screen. The software can handle not just F2A but also other categories, which can be defined by the user. There are half a dozen other categories predefined, and it is relatively simple to add a category.

# PERFORMANCE

## Accuracy

To know the timing accuracy of the Transitrace system, an even more accurate system must be at hand, and there is none. Instead, some reasoning could be done: For F2A models flying at 80 m/s with a fuselage length of 0.4 m, it takes 4.8 ms from it enters the field of view until it is entirely visible. Somewhere in this interval the sensor output pulse is produced, meaning that the difference in time between the actual entry and signal output can hardly become bigger than this. As the speed is determined by the difference of two measurements, most timing errors will cancel. Any net timing error is due to differing conditions for the start and stop registrations, which could be due to flying height differences and lighting changes. It is a fair assumption that the timing error is well below 1 ms, corresponding to 0.025 km/h at 300 km/h. At the 2014 World Championships, where two independent systems were used, the time difference was typically less than 0.0004 s if the flight was at even speed.

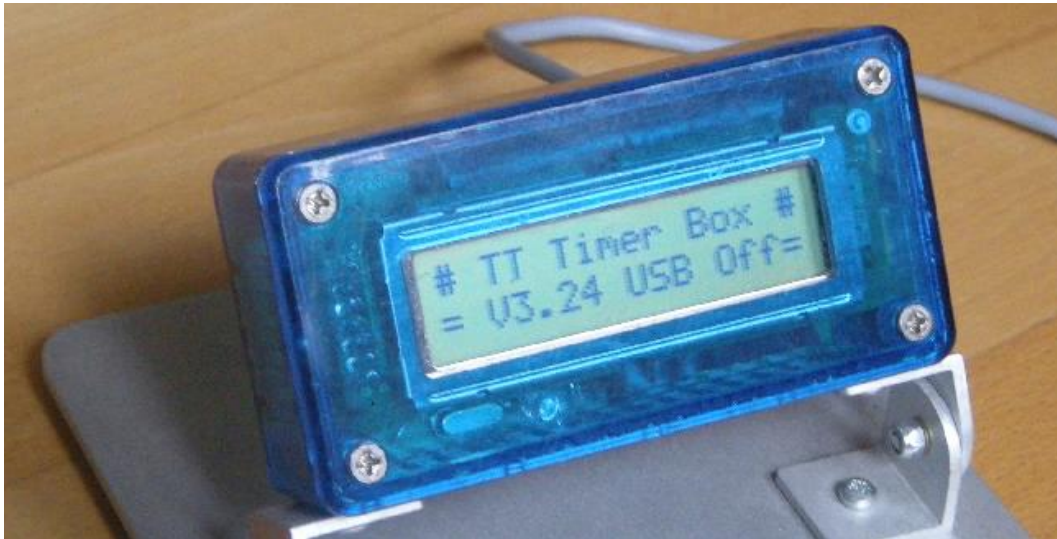
## Reliability

14 years of experience with the Transitrace system has shown that it is very reliable indeed. However, especially in sunny weather it sometimes happens that the sensor misses one or more laps for no apparent reason. It is suspected that reflections of the sun in shiny parts of the model or the lines cancel the dark image of the model. If this happens the sensor should be moved to another place where the sun reflections are different.

## FURTHER DEVELOPMENTS

### Windows Software

The program version for Windows is still under development. Windows cannot handle timing to the necessary precision, and therefore an external Timer Box has been developed:



This connects via USB to the Windows PC, and the Handle Judge Switch and one or two sensors connect to the box. All models of the sensor will work together with the Timer Box. However, it requires the Model II Handle Judge Switch and 7 metre cable. The Timer Box can also be used stand-alone, where the display is used to show lap data and results.

### Overhead Display

The LED display that I have used at several World and European Championships is supported by the TT software. It is made by the company Amplus Ltd in Hong Kong. The type designation is *AM03127-H11* <http://www.amplus.com.hk/> It has a 8x70 LED matrix. The present availability is uncertain. It is intended for indoor use, but I have been able to hop up the brightness, and use it with a light shield, for acceptable outdoor visibility. Contact me for advice if you are interested.

The display used by CMBL in Landres is also supported. Future Windows software could provide solutions for displaying the results in various ways.

### Handle in Pylon Detector

A few years ago I made an experimental design of a detector for sensing that the handle is in contact with the pylon. This is based on a magnetic principle, and the pylon fork and handle crossbar must be made of soft steel. However, I found that pylon forks are quite varying in magnetic properties. I have no plans to further develop this.

# GETTING STARTED

## SYSTEM COMPONENTS

The Transitrace system is composed of:

- **Sensor Unit**, with box and triangular support plate
- **Sensor to PC Cable**, length 7 metres
- **Parallel Port Adaptor**
- **Handle Judge Switch** with cable, length 2 metres. (Delivered without grip)
- **Extension Cable**, length 76 metres, wound on a plastic bobbin (optional)
- **This User Manual**
- **PC Software Kit**

The last two items are sent by e-mail upon purchase. The software can also be delivered on a floppy disk.

You must also provide:

- **OLD PC Computer**, with a parallel (printer) port, with MS-DOS alone.
- **Sensor Dolly Fender**, also serving as rain cover. **IMPORTANT!**
- **Computer Hood** for rain cover and light shield.
- **Grip** for the Handle Judge Switch
- **Screwdriver**, x-tip, Pozidriv #1

Recommended is also:

- **External battery** for the PC to allow enough operational time for the planned use.

**There is a very important limitation of the TT software:**

**THE TIMING PROGRAM CAN'T BE RUN UNDER WINDOWS.**

**It needs to be run in MS-DOS *only* mode!**

**The computer must have a Parallel Port (25 pin D-sub connector). A USB-Parallel Adapter will NOT work! A PCMCIA (PC Card) Parallel Port Adapter could work, if it comes with software to run under MS-DOS.**



## INTRODUCTION TO VERSION II

The first version of the sensor was delivered as a kit, with an assembled circuit board and loose parts for the box. The handle switch was a push-button switch, ready to use.

Version II has a completed sensor box, ready to use with battery installed, but the handle switch is just a bare microswitch with a LED (light-emitting diode) added. You must make a handle grip to complete it. The LED is used to indicate the timed flight. (The ALARM function, to provide a signal upon timed flight completion is no longer supported in Version II.)

The intended Windows version of the software and the stand-alone Timer Box are not ready yet, and therefore this version for MS-DOS has been prepared. All items will work together with the future Windows software and Timer Box.

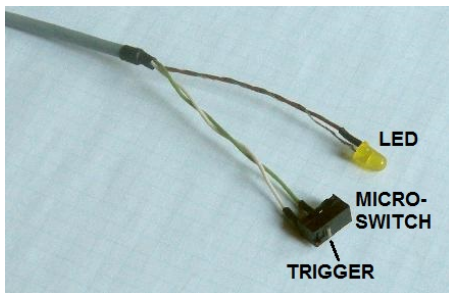
The version II sensor is a completely new design, but uses the same working principle, collecting light from a sector of the sky and detecting the change when a model enters the field of view. It has no power switch, but turns on automatically when the cable connects to the PC adaptor. The first version sensor could be sensitive to sunlight coming from behind. This is now corrected.

## PC REQUIREMENTS

The PC computer must be compatible with an IBM Personal Computer. The CPU must be at least a 386, preferably with a math coprocessor (387). It must have a parallel printer port. However, many laptop PCs have no parallel port. A USB-parallel adapter will not work here. A PC card (PCMCIA) parallel port adapter could work, if the manufacturer provides software for MS-DOS, but this is normally not the case. The Parallel Port is often configurable in the PC setup menu. The SPP or standard mode should be selected. The PC must also have means to load the software, which can be a floppy disk drive, a USB port which recognizes a memory stick, or a network port. A battery operated laptop type is practical for field use. It must be able to run the old MS-DOS operating system. Windows 98SE is the last version of Windows that allows running MS-DOS without Windows in the background. PCs with later versions of Windows must be configured for "dual boot", allowing startup with MS-DOS or Windows as alternatives. The screen visibility in outdoor lighting is a VERY REAL problem. You will need a hood over the screen to block out light. If your laptop is old, you probably need to install a new battery, or better still, use an external battery with higher capacity. Many laptops are quite picky about the input voltage, which needs to be stable at for instance 19V. If you use a 12 V battery you need a converter which outputs the specified stabilized voltage. A mouse is not necessary for running the Transitrace software.

## ITEMS YOU NEED TO MAKE

### *Handle Judge Switch*



The Handle Judge Switch is connected to the system through the 3-pin connector on the PC Adapter. The switch is delivered with just microswitch plus LED indicator, as seen on the left. You should make a grip for the switch and LED so that the switch is conveniently operated by hand, as



seen on the right. For electrical (thunderstorm) safety, the grip should be made of insulating material, not metal.

### *Sensor Dolly Protection*

The sensor unit needs protection from dollies, as well as from rain. A suggested design for a Dolly Fender: Material: Wood, laminated, thickness 19 mm (3/4"). Long Side: 30x60 cm (12x24"), Short Side: 30x36 cm (12x14"), Weight: 2.8 kg (6 lb) It must be heavy for it to stay in place upon a dolly impact. Join the two sides by a hinge so that it can be folded.

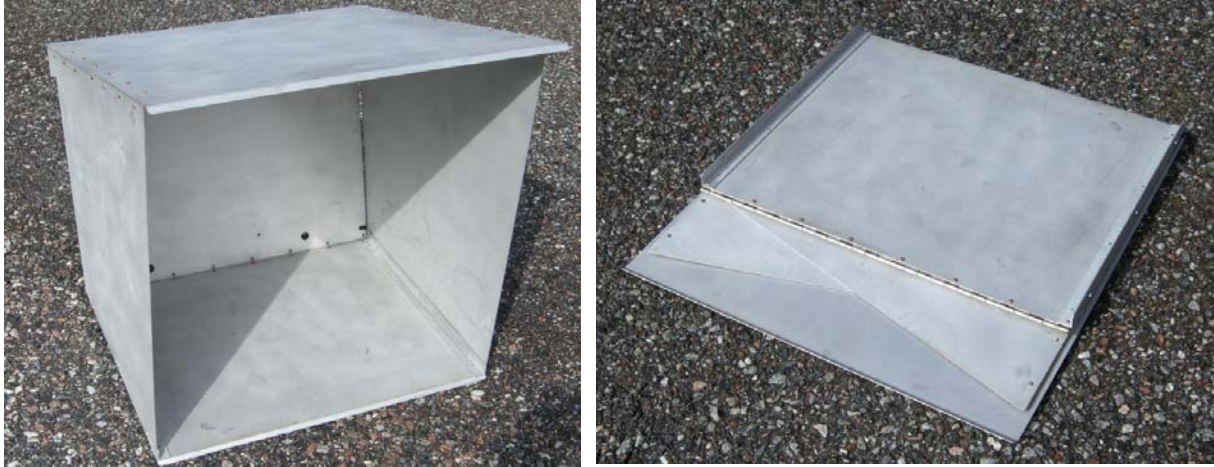
Weatherproof it by your favourite paint. A bright colour is preferred as it will make it cooler in sunlight. Avoid constructions such as a box with an opening just in the front,

since on sunny days it could become very hot inside such a box! If there is no fence around the circle, there should be some kind of cushion to prevent the dollies hitting the ramp from becoming catapulted up in the air, which could be dangerous. It should be positioned as shown in the picture, with the short side parallel to the side of the triangular base plate. Make sure it does not interfere with the sensor upper field of view. For clockwise flying, turn it the other way.



## Computer Hood

It is practical to have a hood for the computer, for light shielding and rain protection. Here is a design, which is foldable, made from aluminium sheet:



## SENSOR PREPARATION

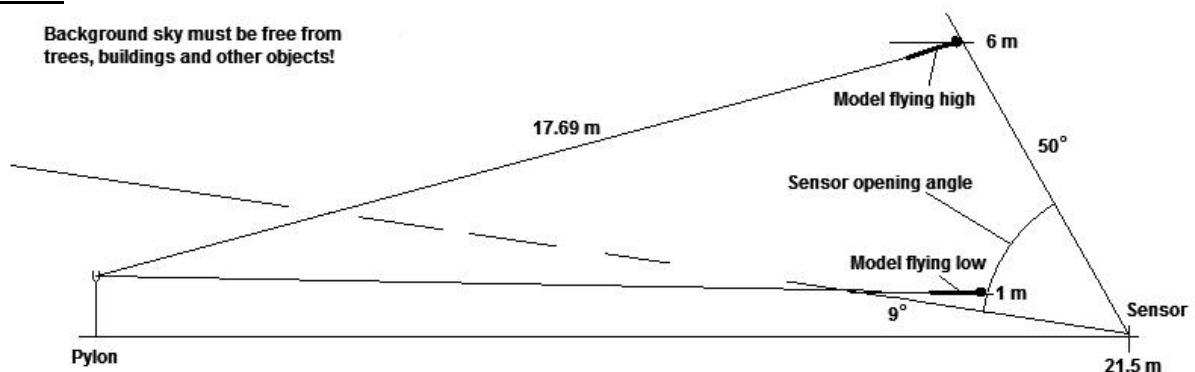
The sensor comes in two parts, the sensor box and the triangular base plate. Loosen the four screws on the sensor box bottom, insert them in the support plate keyholes, slide the box forward and tighten the screws. The sensor should stand on the three pointed legs at the triangular tips. After use you can take it apart again to fit it inside the box.



## FLYING SITE SETUP

### SENSOR LOCATION

The sensor distance to the pylon should be 21.5 metres for F2A. For other categories, the distance should be worked out from the allowable flying heights and line lengths, and the limiting angles of the sensor: Lower: 9°; Upper: 50°. There are recommended distances for many categories, predefined in the software. The sensor should have its transparent window pointing towards the pylon, or very slightly to the right (for counter-clockwise flying). There must be no objects, such as trees and buildings, obscuring the background sky in the field of view!



Attention must be paid to the position of the sun in the sky. Direct sunlight must not fall into the sensor's detector, as this will block the operation. (No permanent damage.) Around five degrees horizontal keepout angle from the sun including the haze around the sun is required, but the more, the better. The sensor direction and the schedule for the day's flying must be planned to avoid that the sensor gets hit by direct sunlight.

Under some conditions the sensor could attract insects, as it provides a shade. As insects could cause false sensor pulses, it is a good idea to have some insect repellent available to squirt on the ground around the sensor. (But keep the sensor window clean!)

For **speed contest use**, the sensor is typically placed right under the timing marker opposite the judges and computer operator, but for reasons described above, another position may have to be chosen. About using two TT systems in combination see more below.

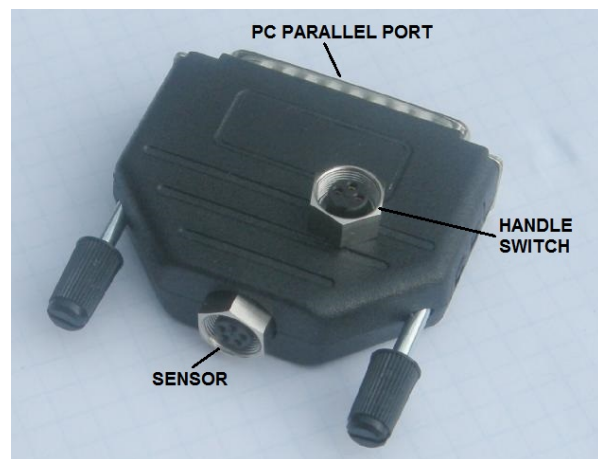
For acceleration classes, "AMA Proto", where timing starts at the release of the model, the sensor must stand at the take-off location, outside the pitman.

For **practice** flying it could be located at any convenient point, observing the above rules.

## HOOK-UP

Use the enclosed cable to connect the sensor to the 5-pin connector on the PC Parallel Port Adapter. Note that the connectors must be oriented correctly for proper mating. Never use force to insert a connector!

Screw the cable end connectors in place using light force. Connect the parallel port adapter to the PC, securing it with its lock screws. The sensor automatically turns on when connected to the PC Adapter. Upon turning on, the LED will light up for 2-3 seconds, and after that the sensor ready to operate. The 3-pin connector is for the Handle Judge Switch, see below. (On most computers the orientation of the 25-pin parallel port connector is such that the Handle Switch connector points up. If it points down, it is possible to open up the plastic shell and turn the connector.)



## LOCATING THE PC

For contest use, the PC must be located near the judges. The PC operator needs close cooperation with the official in charge of judging when the handle is engaged in the pylon fork, if the handle judge switch isn't used. Preferably it should be the same person, and the software is designed to make this double duty manageable. The best solution is to use the handle judge switch. All this means that the PC has to be located near the flying circle outdoors. If the screen is to be readable it will need shielding from rain as well as light.

## EXTENSION CABLE

For contest use, the sensor and PC are often located on opposite sides of the circle, and then an extension cable is needed. A cable of 76 metres length is provided for this purpose. Protect the mid-cable connectors from rain and from being stepped on. The simplest way is to wind the cable where the connection is around the bobbin. The extension cable can be used alone or in combination with the 7 metre standard cable.



## WEATHER PRECAUTIONS

**Rain:** The above type of dolly fender should also provide adequate rain protection for the sensor. If you use a different design, rain protection must be considered. If the extension cable is used, the mid-cable connectors need a cover for rain protection. Remember that for racing and speed categories requiring a landing gear, and no fender required, you still need rain proofing! The PC must also have rain protection.

**Thunderstorms:** A reasonable degree of protection from electric discharge is included in the design. However, if a thunderstorm is approaching, the cable between the sensor unit and the PC must be disconnected at both ends. Put the free connectors in plastic bags to protect them from getting wet. Bring the sensor to a dry place. Even thunderstorms at a distance could induce voltages that might damage both the sensor and the PC.

**Sun:** Make sure that the sensor stands in a shade, normally provided by the dolly fender, and that air can circulate around it, or it could become overheated.

## SENSOR FUNCTIONAL CHECK

The sensor will turn on automatically when it is hooked up to the PC. Make a functional check by sweeping your hand, or even better, a long 1 mm piano wire, in front of the sensor at varying distances, and verify that the rear panel indicator gives off red blinks. A blink should be seen every time a model passes in the field of view.

## SENSOR BATTERY

The sensor draws around 2 mA at rest and 27 mA during an output pulse, when the red indicator blinks. The recommended battery is an Alkaline 9 V battery, 6LR61, with a claimed capacity of over 500 mAh, which means a lifetime of over 200 hours of operation. Such a high capacity battery would seem unnecessary, but the high current when the LED blinks and the output signal is generated sets this requirement. A normal carbon-zinc battery should not be used. Avoid having the sensor turned on in lighting that runs on AC. The small flickering of such light will cause the LED to be turned on 50% of the time, increasing the power consumption sevenfold.

The sensor has a 'low battery' signal which will go active if the battery voltage goes below around 7.8 volts. Then the TT program will show a warning. There will normally still be many hours left of flawless operation when this happens. To replace the battery, remove the screws on the side panel and loosen the screw for the battery holder on the bottom.

## USING TWO SYSTEMS

The recommended way of using two Transitrace systems as the F2A rules prescribe:

- Place the two sensors with a separation of at least 15 degrees of arc (5.6 m at 21.5 m). The reason for this separation is to have the background sky and lighting conditions separated enough to get a due portion of independence.
- Operate the two computers with the same input information throughout.
- The Handle Judge should use both Handle Switches and operate them simultaneously.
- The first sensor is the primary system, normally used for the official result. The secondary system is used for verifying the result, and for backup if the primary system result is inconsistent.
- The computers should run from separate power supplies, such as two separate batteries. If mains power is available it should be used to charge the batteries (if external), not to directly power the computers.

# SOFTWARE

## REQUIREMENTS

In the following the English versions of Windows and MS-DOS are referred to. It is also assumed that you have a standard configuration. If you have a non-English version, some names and menus will be different. I hope you will find your way. Otherwise consult someone with knowledge in your national versions, and look at the internet.

**It is repeated here: There is a very important limitation of the software:  
THE TIMING PROGRAM CAN'T BE RUN UNDER WINDOWS.  
It needs to be run in MS-DOS *only* mode!**

### ---Why?

We have to get technical, and you can skip this if you want.

The timing system has no own hardware for its time base, but employs the internal timer of the PC standard hardware architecture. The program has a "polling loop", which reads the parallel port to check the sensor, which outputs a pulse when a model passes in the sky. Upon such an event, the time value from the PC internal timer is fetched, and used for the calculations.

The Windows system allows many tasks to run at the same time, and this is accomplished by the system trapping the program execution at every input/output operation, and returning control a while later. Due to this, the program may lose control for time periods up to 0.025 seconds. If this happens when a pulse is detected, it leads to a corresponding time error. As the sensor pulse from a model passing lasts for typically 0.005 seconds, it might even be missed altogether.

The program is made to warn the operator if it detects that such program interruptions happen.

Under Windows, the program can be run in "Evaluation Mode", however. It is also possible to review old flights, and a few other things. Only the actual sensor timing use is impossible.

To get rid of these interruptions one must exit from Windows altogether. This can be done in Windows versions up to Windows 98, but in NT, 2000 ME later versions, it is impossible. In such cases you have to set up a dual boot system, with a separate MS-DOS partition on the PC hard disk, or use a special MS-DOS boot diskette. The Windows NT, 2000 and XP systems sometimes uses the file system NFS. This is not compatible with MS-DOS. Instead you should have the file system FAT32 installed in order to have the TT files accessible from Windows. It goes too far to describe this here, and you need to consult someone who knows how to do it. Also look at the Transitrace User Website and other Internet sites for hints.

## GETTING MS-DOS ON YOUR PC

If your PC has a Windows system installed which is newer than Windows 98SE, you must configure it for "dual boot" and install MS-DOS as an alternative start-up system. On my web site there are some links to instructions. You can also search on the internet yourself.

In Windows 95, 98 and 98SE, there are three methods (at least) to get out of Windows and run MS-DOS alone. The most convenient one takes some preparation:

You should first copy a "MS-DOS Prompt" icon to the desktop.

It can be done this way: Minimize all programs so that the desktop is visible. Then click on "Start", move the cursor to "Programs", and over to "MS-DOS Prompt". Over this icon, click the right mouse button and then 'Copy'. Move the cursor to the desktop, to the location where you want to place the icon to copy. Then click right button, followed by 'Paste' in the menu. A copy of the "MS-DOS Prompt" icon will appear on the desktop:

Now you should change the name to something else, for instance "Transitrace".

This you do by clicking two times with a pause in-between on the "MS-DOS Prompt" text. Then you can enter the new name. Finish with Enter ↵.

Now you open the MS-DOS window by double-clicking on the icon. In the menu bar above the window that appears, click on the "Properties" icon. In this menu, click on the "Advanced" button. In the menu that follows, select "MS-DOS Mode". Close all menus by clicking on the



OK buttons, and then close the whole window. The next time you double-click on the icon you will leave Windows for MS-DOS, where you can run the TT timing software in full. Another method is to go to the "Start – Shutdown" menu and select "Restart in MS-DOS Mode".

It is also possible to get to MS-DOS Mode when the PC is started by holding down the F8 key before Windows starts to load, and at the menu that comes up, selecting alternative 5, "Command Prompt only".

You may have to make modifications to the MS-DOS configuration in case you have non-English keyboards. This is done by modifying the AUTOEXEC.BAT file which resides in the top folder (C:\). You have to look up information on the internet for this.

The log files that the TT program produces are useable under Windows, which means that you can import the timing results into Excel and Word documents by starting Windows after the timing is finished, or by copying the files to a Windows computer.

## MS-DOS BASICS

There is an appendix at the end of this document, for those who have little experience with MS-DOS. You can look for more information on the internet.

## SOFTWARE INSTALLATION

The software is distributed as a compressed self-expanding program. The file name is ttyymmdd.exe, where yymmdd is a number representing the program version date. Example: tt151017.exe. You can do the installation under Windows if the file system is compatible with MS-DOS (FAT32, not NFS). First you should create a new folder. You should place it in the top level on your main disk, and name it "TT15". The location becomes. C:\TT15 ("15" is used to represent the year when you download.)

You have to get the most recent version by sending an e-mail request to me:

[goran.olsson@ee.kth.se](mailto:goran.olsson@ee.kth.se) or [olsson@kth.se](mailto:olsson@kth.se) or [goran@go-cl.se](mailto:goran@go-cl.se)

If your Transitrace computer has no network connection, you must find a way to transfer the files from your e-mail computer. If both have floppy disk drives the problem is solved. If your modern computer has no floppy disk drive, you can buy an external USB floppy disk drive for it. A Windows 98SE computer with a USB connector might be able to recognize a USB memory stick of the same generation. If all this fails, e-mail a request for the software on a floppy disk.

Transfer the ttyymmdd.exe file to the Transitrace computer and place it in the TT15 folder.

Then you should run the program you downloaded. Double-clicking on the program name in an Explorer window can do this. Or in MS-DOS type

**TTYMMDD** (where YYMMDD is replaced by the numbers of the file you received.)

and press the Enter↵ key. (See below for more information about MS-DOS.)

This will lead to a number of files being created in this folder.

## FUTURE UPDATES

Have a look at the Transitrace User web site now and then, to see if there are any upgrades, fixes or other new information available: <http://www.go-cl.se/tt/>

If you see a notice of a new program version, send me an e-mail request for it!

Also, join the Transitrace Yahoo group where everybody can discuss things! Instructions are found on the above web site. Information about updates will be sent to all members.

# OPERATION

## THE TRANSITRACE PROGRAM

The Transitrace application program is called TT. For timing it must be run under MS-DOS. More information on how to get a Windows computer to start with MS-DOS alone is found above and in the Appendix below.

Note: All MS-DOS commands should be completed by pressing the Enter↵ key.  
Upper or lower case letters do not matter.

### ***Checking the PC DATE and TIME***

Old PCs often have problems with the battery used for the real-time clock. Therefore you should check and if necessary set the date and time before you start the TT program.

Type the command:

**DATE**

The computer date is now shown. If necessary enter the correct date in the same format as it was shown. If no change is necessary, just press the Enter↵ key.

Type the command:

**TIME**

The computer time is now shown. Proceed in the same way as with DATE.

### ***Starting under MS-DOS***

In MS-DOS you should first change the current directory (folder) to your Transitrace directory. Here we assume that this is named TT15 and is located at the top level of your hard disk C. You type:

**CD \TT15**

Then you start the application program TT by typing its name:

**TT**

It is possible to define the category when starting the TT program by adding the category name. For example:

**TT F2A**

It is also possible to add the A command directly when starting the TT program by adding the command letter after the category:

**TT F2A A**

This way automatic mode is entered directly. By adding these command lines to the AUTOEXEC.BAT file, just turning on the computer will make it start registering flights without any further user input:

**CD \TT15**

**TT F2A A**

When you are finished with TT program (through the Q key), and wish to load Windows again, you type the command EXIT or WIN.

### ***Starting under Windows***

**NOT for timing, only for learning to operate the program!!** In a computer running Windows 98SE, the TT program can be run in a MS-DOS window for evaluation and for viewing flight logs, but not for flight timing. To start TT under Windows, click the 'Start' button in the lower left corner. Then click on 'Run...'. In the 'Open:' field, type 'command' and then click on 'OK'. Now a MS-DOS window will open. In this window you should proceed just as described above. You can also go via the "MS-DOS Prompt" icon in the Start - Programs menu.

## RUNNING THE TT PROGRAM

As a rule, operator input is done by pressing single keys on the keyboard as specified by a menu shown at the bottom of the screen. Sometimes instructions to enter text or a number are given. The input should then be given and finished by pressing the Enter↵ key. The operator also has the handle switch for use when attention is on other things than the keyboard. When you start the program, the screen will show the Main Menu: (The view is vertically compressed to save space here.)

```

                >>> TRANSITRACE SPEED TIMING <<<
                    By Goran Olsson

Version II 4.00
Computer Date: Sat May 31 2014                Time: 12:00:00

No category is entered. Press the X key to set the category.

Round: 1 Attempt: 1 Log File: tt140531.txt Name File: nnexamp1.txt

MAIN MENU
Press key:
| L(view Log) | X(category) | T(Test) | S(Screen) | E(Evaluate) |
| Y(sysinfo)  | N(Names)   | H(Help) | Q(Quit TT) |                |

```

At the top there is a header with information about the program version, and the date and time of the PC are shown. If the TT program is started under Windows a warning is shown:

```
WARNING: COMPUTER RUNS WINDOWS! *** THE TIMER WILL NOT WORK! ***
Log review and evaluation will work. For timing, use MS-DOS alone!
```

All warnings and other things that need attention appear in contrasting colour, not shown here. If you have not calibrated the timer of your PC, this message is shown:

```
NOTE: No timer calibration done on this PC.
Assumed timer clock frequency: 1193181.8 Hz
```

There are also other checks done, and additional warnings could appear. The messages

```
Round: 1 Attempt: 1 Log File: tt140531.txt Name File: nnexamp1.txt
```

are explained below. At the bottom there is a Main Menu, showing the available alternatives.

### MAIN MENU

The menu selection is done by pressing the key corresponding to the leftmost letter of the menu item. For example, pressing the 'L' key will lead to the View Log menu. Here is an overview of the alternatives. They are described in detail later.

- L(view Log)** View Older Flights
  - Y(sysinfo)** View System Information
  - X(category)** Change Contest Category
  - N(Names)** Handle Names of Competitors and Contest
  - T(Test)** Test Sensor and other things
  - H(Help)** Handbook type Help, with Rules
  - S(Screen)** Change Screen colours and graphics to suit your PC
  - Q(Quit TT)** Quit the TT program
  - E(Evaluate)** Enter or exit Evaluation Mode
- If the category is set, two more menu items appear to the left:
- C(Contest)** Contest Flight Recording with registration of Round, Attempt and Competitor, and keeping track of attempt time.
  - A(Auto)** Automatic Flight Recording without registering contest data. Useful for practice, as the system can be unmanned, but also useful for small contests.

## **Evaluation Mode**

By pressing the 'E' key, the program will enter or exit 'Evaluation Mode'. When in Evaluation Mode, these messages are shown on the Main Menu screen: At the top right corner:

► Evaluation Mode ◀

And just above the menu:

**NOTE: In evaluation mode the sensor input is disabled.  
Sensor lap indications are simulated by pressing the Z key.**

This mode allows the TT operator to get practice at home. It works also under Windows, and is entered automatically if Windows is detected. The 'Z' key is in effect for mimicking sensor lap indications when flight recording is active.

## **Checking the Setup**

When the system is set and ready, it is a good idea to check that it works, by pressing the keys 'T' for test and then 'S' for sensor. See further below in the "Test Functions" section.

## **Category Selection**

It is possible to define the category when starting the TT program by adding the category name after "TT". For example: **TT F2A**

The category can also be changed inside the program. By pressing the 'X' key, the Contest Category menu is entered. A list of available categories is shown. At the bottom of the screen this menu is shown:

### **CATEGORY ENTRY**

**Enter Category:** \_ (followed by Enter↵)  
or M(return to Menu)

Type the category name you want to select just as it appears in the list, and finish with the Enter↵ key. After the category is selected, there is first a reminder page:

**WARNING: THE CATEGORY IS CHANGED!  
IF THIS ALSO INVOLVES A LINE LENGTH CHANGE, THE SENSOR  
MUST BE MOVED TO THE POSITION GIVEN BELOW!!**

	<b>CATEGORY: FAI-F2A</b>		
<b>Timed Laps:</b>	<b>9</b>	<b>Count-in Laps:</b>	<b>2</b>
<b>Speed Formula:</b>	<b>3600.000/time</b>	<b>Start on Release:</b>	<b>No</b>
<b>Unit:</b>	<b>km/h</b>	<b>Maximum Speed:</b>	<b>340</b>
<b>Attempt Time (min):</b>	<b>3</b>	<b>Tolerance (sec):</b>	<b>0.120</b>
<b>Roundoff option:</b>	<b>1 decimal trunc</b>		

**\*\*\* Sensor should be located at 21.5 m radius \*\*\***

Pressing any key leads back to the Main Menu screen.

The speed categories are defined in a number of files. The category files have names like the categories, with the extension '.TTC'. For instance, the F2A definition file is named 'F2A.TTC'. See more below in section Category Definition Files.

These categories are included in the software package:

<b>F2A</b>	FAI F2A Speed, 9 laps = 1 kilometre
<b>F2C</b>	FAI F2C Team Racing, 10 laps = 1 kilometre, lap times (practice only)
<b>AMA-A</b>	AMA A Speed (60 ft lines, 7 laps, mph)
<b>AMA-BCJ</b>	AMA B, D, or Jet Speed (70 ft lines, 6 laps, mph)
<b>AMA-HA</b>	AMA ½ A Speed
<b>AMA-F40</b>	AMA Formula 40 Proto
<b>AMA-21PR</b>	AMA 21 Proto
<b>AMA-HAPR</b>	AMA ½ A Proto
<b>SWE-MINI</b>	1 cc Speed, like F2A, but with 12 laps = 1 km
<b>SWE-A</b>	1.5 cc Speed, like F2A, but with 11 laps = 1 km
<b>SWE-BC</b>	5 cc and 10 cc Speed, like F2A, but with 8 laps = 1 km
<b>SWE-SEMI</b>	2.5 cc Speed, like F2A but with 10 laps = 1 km
<b>TCAR</b>	Tether Car on metric track (8 laps = ½ km)
<b>RC200M</b>	For R/C records over a 200 m distance (experimental, two sensors OR-ed)

(AMA = Academy of Model Aeronautics, USA; SWE = Swedish categories)

For the Proto classes, the timing starts at the release of the model. It is important that the pitman moves away after the release. There is a delay before the sensor is enabled, and at this time the field of view must be cleared. This delay corresponds to the lap time at the defined maximum speed for the category.

It is possible to create your own category files for whichever event types you may have. Below in the section "Category Definition Files" there is information about how to create new categories. You can use an existing one as a template, edit it as you wish, and save it under a new name you choose. (Except "M", as it is used to return to the Main Menu.)

## CONTEST MODE

If you press the 'C' key, for contest, you will enter the Contest Mode.

NOTE: The TT program does not know the starting order, nor does it deal with the overall structure of the contest. It just handles the attempts, and uses the numbers you enter here to identify the competitor, round and attempt. Optionally, the names of the competitors can be entered, but the minimum requirement is to designate a competitor number 1...98 to all competitors before the start of the contest. (See also below in section *Competitor Names*.)

### *Entering the Flight Data*

The screen will now show:

►(headline)◀                    ►►► TRANSITRACE SPEED TIMING ◀◀◀

(list of competitor names)

(Vertical screen space removed)

```
CONTEST
Category:   FAI-F2A
Round:      1
Attempt:    1
```

```
Enter Competitor Number:
or | R(Round) | A(Attempt) | X(Category) | M(Main Menu) |
```

There is an identification of the category, here FAI-F2A. At the bottom is a menu:

If the Round and Attempt numbers are correct, just enter the competitor number, followed by the Enter↵ key. (The Round and Attempt numbers are kept for the following attempts until changed. They are shown also in the Main Menu.)

To change the Round, Attempt or Category, or to return to the Main Menu, press the corresponding key according to the menu.

After the competitor number is entered, there is a provision to enter the competitor name. The name will be saved, and will automatically be applied the next time the same competitor number is used. The entered names will also appear in a list on the screen.

NOTE: When entering names, avoid accented or national letters. MS-DOS and Windows use different coding, so the names will appear strange when transferring data to Windows. Use only the English alphabet A-Z and a-z if you intend to transfer the data to Windows.

NOTE: During a contest, it is likely that you will use the competitors' practice flights for your own practice with the system. It is a very good idea to enter an invalid attempt number here in such cases, to avoid later confusion with proper contest attempts. The program does not check the numbers, so you could use, for instance, "0" to mark practice flights. You can also enter an invalid round number.

After all data is entered, the yellow LED on the Handle Judge Switch will turn on to indicate that all is ready for the attempt to start, and this menu will appear at the bottom screen:

```
CONTEST
Category:   FAI-F2A
Round:     1
Attempt:   1
Competitor: 39   Name: Gofast, Marlon
```

Press Handle Judge Switch and RELEASE it to start attempt or press key:  
S(Start attempt) | C(Change whole entry) | N(change entry Name) | M(Main Menu)

If you need to correct the data, press 'C', 'N' or 'M', whichever is the most suitable.

### **Starting the Attempt**

If the data entered are correct, you should do nothing until the moment when the attempt period starts. Then there are two different ways to start the attempt, by using the handle switch or a keyboard key.

**Using the Handle Switch:** When the attempt is about to start, hold the handle switch pressed down. At the exact moment when the attempt starts, release the switch!

**Using the Keyboard:** At the exact moment when the attempt starts, press key 'S'!

When the attempt is started, the yellow LED will turn off, and the screen will show:

```
► (headline) ◀          ►►► TRANSITRACE SPEED TIMING ◀◀◀ Category: FAI-F2C
                                     (competitor name)
                          Started: 12:02:12   Time Left: 2:57
                                     Comp: 17
                                     Round: 1
                                     Lap Speed (km/h)   Att: 1
```

waiting

(Vertical screen space removed)

```
SPEED TIMING
Press key: _ (or use Handle Switch)
spacebar (Handle engaged in pylon) | B(Break)   |
V (Handle disengaged from pylon) |
```

If you run in evaluation mode, the additional menu item | z(sim lap) | will appear, as well as the comment **NOTE: sensor disabled - use z key!**

In this case you have the means to simulate all laps of a flight by pressing the 'Z' key at suitable intervals.

It is a good practice to note down the Started time of day in the handwritten backup record you should always keep, to minimize the risk of later confusion.



## ***Flight in Progress***

The display will start the countdown of the attempt time left. When the model becomes airborne, and sensor pulses are coming in, the lap data should appear:

	<b>Lap</b>	<b>Speed (km/h)</b>
<b>Flying</b>	<b>1</b>	<b>151.10</b>

In case the model lands before the official flight has started, this message will appear:

**Landed - waiting**

As the competitor may start flying again, the operator should do nothing. If the competitor starts flying, the program will start capturing the laps again. Only in the case that the competitor shows clearly that there is no intention of a restart, for instance by taking the model out of the circle, the operator should press the 'B' key to Break. This will cause all laps to be listed in the Results menu, see below.

Note that sometimes a pilot will start flying very high to improve the engine setting. This may cause sensor lap indications to be missed, and the **Landed - waiting** message may show up during flight. This will normally correct itself when the model starts to go fast.

## ***Handle-in-Pylon Judging***

Here the very important duty of the operator begins:

Watching when the handle is engaged to or released out of the pylon fork, and providing input to the TT program about this. First of all, the rules and their interpretation must be well known on this point. The TT program has two different ways of capturing the input from the operator. The recommended method is to use the handle switch, but it is also possible to use the keyboard. These methods work differently, and it is important to understand this.

### **Using the Handle Judge Switch:**

When the handle is judged as engaged to the pylon, immediately press and hold down the handle switch. Keep it held down as long as the handle is engaged to the pylon. When the handle is judged to be released out of the pylon, immediately release the switch. If the release was made during the countdown, stay alert for any re-engagement of the handle.

### **Using the Keyboard (not recommended):**

When the handle is judged as engaged to the pylon, immediately press the spacebar key. (This should not be held down.) When the handle is judged to be released out of the pylon, immediately press the 'V' key. The keyboard keys are chosen so that the operator can have attention on the pylon and still find the keys. The fingers should be resting on these keys for fast action.

Note that for both methods, the TT program takes care of the countdown (2 laps for F2A) as well as the provision for the pilot to release the handle during the countdown to have the countdown stopped.

For the categories such as AMA Proto, where timing starts at the release of the model, the handle switch or the spacebar key should be pressed at the moment of release.

There could be separate officials for the PC and handle watch, but they would need very swift communication indeed. As it is essential to get this done fast and fairly leads to the strong recommendation that the handle judge is the person that operates the handle switch or the spacebar + 'V' keys. It is very important that the start of the official flight is communicated to the pylon and height judges so that they observe the rules only for the timed flight. The rules make this a hard task for the officials even without the timing system! In the end it is quite possible that there will be a lap synchronization error. Therefore there are means to shift the official laps in the TT system afterwards, see below. If the timing has actually started, the flight should be cancelled, but this must be a decision by the official in charge.

## **Timed Flight**

When the handle is engaged, the official laps are also displayed, starting with -2 (for F2A):

Handle engaged in pylon Counting-in	Lap -2	Lap 6	Speed (km/h) 291.04
--	-----------	----------	------------------------

Flying

When the official timing starts, the Handle Judge Switch LED turns on, and the screen shows:

Timed Flight	Lap 0	Lap 8	Speed (km/h) 293.15
--------------	----------	----------	------------------------

Flying

The official laps will be counted and the lap speeds will be shown. The judges must be prepared to operate the required sound alarm when the timed flight is completed.

## **Attempt Timeout**

If the attempt time runs out, the display shows:

Time Left: 0:00  
Attempt timed out

Also in this case, the operator should press the 'B' key to get all lap speeds (if any) listed. The "Attempt timed out" message will only appear if the time limit is reached before the handle was engaged in the pylon. Note that this timeout does not affect the flight recording, which can proceed normally. If the flight should be cancelled due to the timeout (or other reason), the operator has to select the C(Cancel) option under the Validate menu. (See below.)

Also, if no laps at all were flown when the attempt ends, the B(Break) key should be pressed.

## **Irregular Flight Events**

All the time during the flights as well as afterwards, when the complete flight data is shown, the operator must be alert that the system correctly registers the flight, and that the data agrees with what actually happened in the circle. Among the factors that can disturb the correct sensor registration are:

1. *The model is flying too high or too low*
2. *A bird, an insect or other windborne object is passing in the sensor field of view*
3. *Extreme lighting conditions (Sun reflections in the pan or lines?)*

Only events that affect the official flight including the count-in laps need any deeper consideration. And of these, only the registering of the start and finish of the timed flight are critical to the actual timing, while the other lap registrations are important only to the proper lap counting.

Isolated missed lap indications can be corrected by the system with the assistance of the operator, see below in the Missed Laps section. If many occur in a row, this becomes impossible. It may still be possible to reconstruct a timed flight, but this involves reading the data in the log file and manual work. An example can be found on the TT web site.

Sometimes a pilot chooses to fly as high as possible initially, to improve the engine setting. This could lead to the sensor passes not getting registered, or extra sensor registrations when passing the opposite point of the circle, or any combination thereof. This should not affect the official flight, which must be done at a low elevation, but the operator must be aware of this, and avoid being confused by the irregular registrations.

The TT program has a time filter that will remove most “bird” events. After each sensor indication there is a dead time before another sensor indication is accepted. This time is determined by the maximum speed defined in the Category Definition File. For F2A the maximum speed is 340 km/h, and the dead time becomes 1.1765 s, equal to the lap time for that speed. If a model flies at 300 km/h the lap time is 1.3333 s, and there is an interval of 0.1569 s where a “bird” event registration is possible. This will be seen as a sudden increase in speed. However, when the true model indication comes a bit later, this will be filtered out, so no extra lap is counted. Instead, at the following lap a sudden decrease in speed is shown. The operator needs to be concerned only if such events are seen for the start or stop laps of the official flight. Only if the speed is lower than half the maximum speed a “bird” event can cause an extra lap to be counted.

### Finished Flight

When the timed flight is finished, it is clearly reported on the screen, and the Handle Judge Switch LED turns off. The sound alarm to the pilot must then immediately be given. This information is shown on the screen:

```

Timed Flight Completed   Laps      Lap   Speed (km/h)
Flying                  8-16     20   282.02
                               Time (sec) Speed (km/h)   Result:
                               Electronic: 12.20596  294.938           294.9

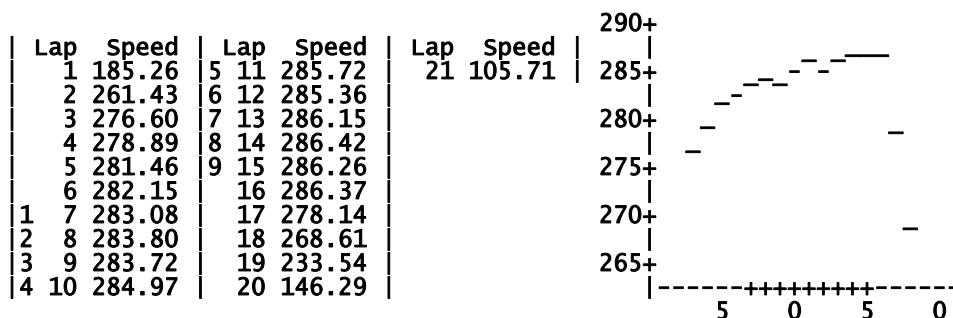
```

As long as the model is still flying, the Lap and Speed figures will be updated.

The **Result** figure is the official result, i.e. the speed of the timed flight after applying the decimal handling according to the rules. In the case of F2A, this means truncation to one decimal. There are four options for the handling of decimals. The one to use is specified in the Category Definition File. See below for a description.

NOTE: It may in rare occasions happen that the three decimal and one decimal values look inconsistent. For instance, the display may show **293.500** **293.4**

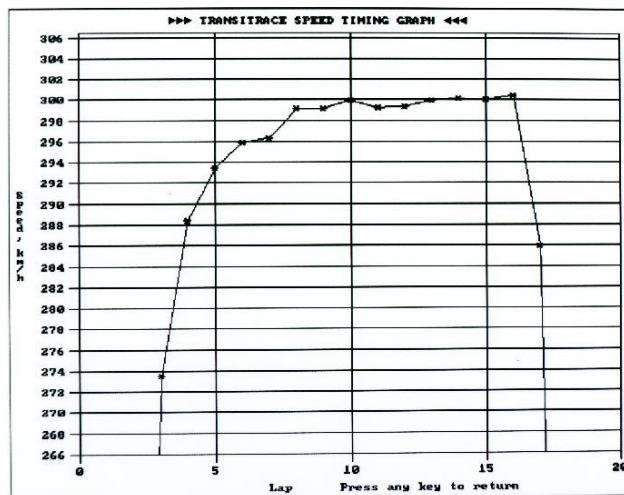
This is because the 15-digit resolution internal number is used for both the round off to three decimals and the truncation to one. Values such as 293.4995..... will give this outcome, which is fully correct! When the model lands, the program gets no more lap indications, and after a timeout period, the individual lap times and speeds are tabulated and plotted:



The plot vertical axis covers the top 25 speed units (km/h for F2A). The top of the scale is taken from the top speed to the next higher 5 unit value. Each plot step corresponds to .8333 units. The horizontal axis shows the lap numbers for laps 5, 15, 25 and so on as a 5, and for 10, 20 and so on as a 0. If the number of laps exceeds 30, the plot will not fit. In such case the command **P(Plot)** appears. By pressing the key ‘P’ the plot will show, together with the command **L(List)**. Pressing the key ‘L’ will show the lap list again.

The official timed flight laps are marked with extra numbers to the left in the list, and by ‘+’ marks in the plot. If the course is more than 9 laps, lap 10 will show as 0 and so on.

There is also another way of showing a plot of the flight. However, it does not work on all PCs, and therefore it is not included in the menu. By pressing the key 'G', a plot such as the one to the right is displayed. Press any key to return. If this graphics mode does not work on your PC, the program may halt, so test this before you use it for real flights!



(The example figure shows Paul Eisner's 4<sup>th</sup> round flight at the 2014 World Championships.)

If the official flight was completed, there is at the bottom a menu:

```

RESULTS
Press key:
C(Comment) | N(Next flight) | S(Shift timed flight) |
V(Validate) | M(Main Menu)

```

Just as before, pressing the key corresponding to the letter will perform the menu selection. When the flight is finished, while the data are not yet stored, the operator has the means to make some corrections, and add comments. The menu items are described in the following. When the attempt handling is finished by exiting through the N(Next flight) or M(Main Menu) keys, the data is stored in a log file. The flights can later be reviewed using the View Log menu.

### Comment

By pressing the 'C' key, the following text appears:

**Enter comment text for this flight! (Press Enter key twice to finish)**

Here you can enter any text, line by line. The Enter key ends the lines, the usual way. To finish entering lines, press the Enter key twice. You can use backspace to edit text, but after a line is finished by pressing the Enter key, it cannot be changed.

The text you enter is written into the log file. A comment could be used to report rulings about the flight that affect the official result. If, for instance, the handle is lifted out of the pylon, or the flying is too high, the flight should be cancelled. The officials need to make a comment to this fact in the results file for the results to be handled correctly by the contest organization. The result is still written to the file, which is useful if a protest is upheld. The comments appear right after the data for the flight in the log file. The Review Log screen has room for three comment lines, but up to 600 characters can be written to the log file.

### Validate

Pressing the 'V' key leads to a menu for adding information about the flight to the log file. Validation is not necessary, but doing it after every flight makes the log file more informative:

```

Enter stopwatch 1 time:
or validate directly:
E(Electronic result) | C(Cancel flight) | A(Attempt) | B(Break)

```

Here you can enter the times from three manual stopwatches. This is normally never done in F2A after the rules were changed. Instead use the keys 'E', 'C' or 'A' to place the appropriate note in the log file. If stopwatch times were entered you can also press 'M' in case that manual timing was used for the official result. The program uses the FAI rules procedure to handle the stopwatch times. The times are entered in seconds with a decimal point and two decimals. If a stopwatch malfunctioned, just enter a zero. The final decision on whether to use the manual result or the electronic result, or to cancel the flight is left to the operator, but the program gives its recommendation. If a mistake is made, the procedure can be redone until the Next or Main commands are given.

### ***Shifting the Timed Laps***

This menu choice is present only if the official flight was started. If there was a synchronization error so that the program got the timed laps too early or too late, this can be corrected. Press the S key. This query appears:

**Enter number of laps to shift the official flight!**

Enter a positive number if you want to shift the official flight to later laps, negative otherwise. Example: "-2" will shift the official flight two laps earlier. "1" will shift the flight one lap later.

### ***Missed Laps***

A model may fly under the sensor field of view, which means that laps may be missed. Unusual lighting conditions may also cause this. If this happens outside the official flight, it has no consequence. If inside the timed flight, the lap counting is in error. A missed lap is easily spotted, since the registered lap time is roughly doubled. Correction of a missed lap is done by the operator, guided by the software. The program makes a check and if a time doubling is found, it prints a warning message. At the same time, the menu item **I(Insert missed lap)** appears. The bottom of the screen will show:

```
RESULTS
Press key:                               WARNING: Missed lap? Time doubled at lap: 11
C(Comment) | N(Next flight) | S(Shift timed flight) |
V(Validate) | M(Main Menu)   | I(Insert missed lap)   |
```

If you agree that there is a missed lap. Press the 'I' key. The program asks for the lap number. You enter the suggested number, in this case 11, and finish with Enter↵. The list and results data are updated. In case the lap reconstruction is done at the start or stop lap for the official timing, the official result will be based on reconstructed times and not the true sensor times. In most cases the error will be very small. Only if the engine goes slower or stops near the end of the timed flight, there will be a significant error. The judges have to decide if the flight should be valid, or if the competitor should be given a replacement attempt.

### ***Next***

Pressing the 'N' key leads to the next flight attempt menu, after first saving the current flight data in the log file. You will be asked to repeat this key, to prevent writing incomplete data by mistake.

### ***Main***

Pressing the 'M' key leads back to the Main Menu, after first saving the current flight data in the log file. You will be asked to repeat this key, to prevent writing incomplete data by mistake.

## AUTOMATIC MODE

By pressing the A key in the Main Menu, Automatic Mode is entered. Automatic Mode is suited for practice, but can be convenient for small contests, where the need for a complete record is not essential, and the competitors can be distinguished by other means. It works much like the Contest Mode, with the difference that the timing of a number of flights can proceed without operator attendance. A long series of practice flights can be done, and all flight data will be displayed and recorded in the log file. It is still possible to use the handle switch or spacebar key to start official timing, just as in Contest Mode. After each flight, the lap speed list will appear, and commands can be entered for adding comments, stopwatch times and so on, just as for Contest Mode. If such work is ongoing, the automatic flight recording is off, but is resumed when the AUTO menu reappears. When the sensor is passed next time, the program automatically starts registering the new flight. However, the first lap will not be registered, as the system is busy saving the previous flight data. The data of the previous flight are still shown, but commands (other than 'B' for Break) can no longer be given. When the model lands again, the new flight data appear. Walking in front of the sensor should be avoided, as this is seen as a new flight, and causes the command mode to be exited. The system will of course have no competitor information, but if the times of day of the flights are noted down, a particular flight can be identified in the Log review. If Automatic Mode is used for contest flights, the attempt time has to be kept manually. Note that if a competitor lands and restarts during an attempt, two flights will be registered.

### ***Starting the PC in TT Automatic Mode***

As is mentioned in the STARTING TT section the automatic mode can be entered directly when turning on the PC by adding these command lines at the end of the AUTOEXEC.BAT file. This is very convenient for practice flying:

```
CD \TT15 (or whatever your TT directory is called)
TT F2A A
```

## OTHER PROGRAM FUNCTIONS

### ***Competitor Names***

The competitor names are kept in NAME REGISTRY files, linking a name to each competitor number. It is possible to have many registry files, and select one of them for active use. A name registry can be prepared in advance or built while the contest progresses. It is also possible to use the Windows Notepad text editor to make a registry in advance. In addition to the competitor names, the registry also can hold a headline text, which will be shown at the top of the screen and in the logs. It is normally used for the contest name. Names are handled in Name Menu, reached from the TT Main Menu by pressing the 'N' key. Here the screen will show list of names of the active registry. As delivered, the TT program is configured to use the name registry called EXAMPL, with a bunch of silly names. You can use this for practice, and add or change names. Under the name list, the screen will show:

```
NAME REGISTRY IN USE: EXAMPL      File: nnexamp1.txt
```

#### NAME MENU

Press key: \_

E(Edit name) | H(Headline) | C(Change registry) | S(Save as) | M(Main Menu) |

The actual registry file name is composed by the prefix "nn" followed by the registry name, and a suffix ".txt". This file name should be used to access the registry from outside the TT program, while inside the TT program, only the shorter registry name is used. The file name of the registry in use is shown in the TT Main Menu.

**To edit or add a name:** Press the 'E' key. You will first be asked for a competitor number (in the range 1...98), and then for the name:

**EDIT NAME**

Enter Competitor Number: 39 Enter Name: Gofast, Marlon

Note that you have full freedom to enter the name in any format you wish, surname first or surname last, the country or club included or not. The numbers need not be entered in order, they will be sorted. However, there is a limitation if you want to use the names in Windows. MS-DOS and Windows use different standards for encoding accented and non-English letters. Therefore avoid them and use only letters a...z and A...Z.

The new name will appear in the list. If you used a number already used, the new name will replace the old.

**To edit or add a headline:** Press the 'H' key. You will first be asked for a headline (maximum length is 15 characters).

**To change the registry:** Press the 'C' key. A list of registries will be shown. The bottom screen will show:

COMPETITOR NAME REGISTRY (Registry name 6 characters maximum)  
Enter Registry Name: \_ (If not in the list, a new one will be created)  
(Finish by pressing Enter key)

The registry you entered will be shown as in use, and its competitor names will be listed. If you entered the name of a registry that does not exist, for example "abcdef", you will get the question:

Create new Registry File nabcdef.txt ? \_  
Y(Yes) | N(No) |

Press the 'Y' key to confirm that you want to create the new registry.

**To save the registry under a new name:** Press the 'S' key. The bottom screen will show:

SAVE AS  
Enter Registry Name: \_ (Registry name 6 characters maximum)  
(Finish by pressing Enter key)

Enter the registry name you want, just as for the change command. The registry in use will now have a new name, and the corresponding file will be saved. This operation is convenient if you have a new contest where most names reappear. You can make one list for use at all contests.

**To change competitor numbers while keeping the names:** This is most easily done outside the TT program, under Windows, by opening the registry file in the Notepad text editor.

**A hint:** It is practical to add a dummy competitor name to every registry, such as "Test Pilot" with a high number. You can use this entry when testing and practicing with the TT program.

## View Log

All registered and logged flights can be reviewed anytime afterwards. In the Main Menu, press the 'L' key to get to the View Log menu. Here all stored log files will be listed column wise in date order. All flights from one day are placed in one file, identified by the date. The format used is YYMMDD: Year, Month and Day in 2 digit format. Example: Flights from 31st May, 2014 would be found in 140531. The full name of this log file is "tt140531.txt". A maximum of 81 log dates can be shown on the screen. Therefore delete older files or move them to another directory. The name of the file currently in use for logging flight data is shown in the Main Menu. It will always have the date identifier of the current date. Make sure to check that the date and time are set correctly in the PC, or the logging will become confusing. In the Log Menu the bottom screen shows:

```
REVIEW LOG
Enter flight log date! _
YYMMDD(Date) | T(Today) | M(Main Menu) |
```

Enter the six digit date code of the log you wish to view, or just 'T' in case the flight is from today. Then an overview of all flights for the selected date is shown. The list may run over many pages. Use 'N' or 'T' keys to browse through the pages. The bottom of the screen shows:

```
Enter number of flight to review! _
or | N(Next page) | M(Main Menu) |
```

To select a flight to view, enter its flight number, and press Enter↵. The flight data will be shown in a format similar to the normal flight presentation. At the top left is shown:

► REVIEW LOG ◀ to mark that this is not the recent flight. A data summary appears:

```
ETime MTime1 MTime2 MTime3 ESpeed MSpeed EResult MResult Ruling
13.0166 13.04 13.00 13.07 276.570 276.144 276.5 276.1 $ Electronic
```

(In the case shown manual stopwatch times were entered.) The bottom screen shows:

```
Press key: | T(Time Stamp View | P(Plot) | B(Back to Overview) |
```

**P(Plot)** appears only if more than 30 laps are flown. Pressing 'T' gives a list of time registrations for all sensor hits of the flight, with 7 decimals. A maximum of 56 times can be displayed. Also the times for handle events, Engaged (EN) and Disengaged (DI) are shown, a maximum of four. If more, the last four are shown. This can be useful for manually recovering a flight with more missed laps than the software can handle.

The alternate plot mode described in the section *Finished Flight* is available here too, by pressing 'G', but it does not work on all PCs, and is not included in the menu. Pressing 'B' gives a return to the top of the flight list.

## Screen Modes

There are six different combinations of colours and contrasts available for the computer screen. There are also three different options for plot graphics. In the Main Menu, press the key 'S' to get to the Screen Mode menu. The options are shown in six fields of the screen. Enter the number 1...6 of the screen mode that gives the best readability on your computer. The character sets differ on different computers, which could lead to that the speed plots look strange. Therefore three options are available for the plot graphics. Enter the letter A...C to select the plot graphics which gives the best look of the ramp plotted. (You may have to change the PC character set to "Western" to see a meaningful plot.)

You will be asked if the change should be permanent or not. If you reply 'Y', the new Screen Mode will be used every time TT is started until changed again. Either the Screen Mode or the Plot Graphics can be changed at a time. To change both, visit the Screen Mode Menu twice.



## Test Functions

In the Main Menu, press key 'T' to enter the Test Menu. Here five tests can be selected by pressing the key:

<b>P(Plot)</b>	A plot with a staircase ramp is shown. If the steps are not even, the Plot Graphics should be changed in the Screen Mode menu.
<b>G(Graphics)</b>	A full screen graphics plot is displayed. Does not work on all computers!
<b>A(Alarm)</b>	Tests the alarm available in the Version I system. No longer supported.
<b>S(Sensor)</b>	Allows the Sensor and the Handle Switch with LED to be tested. Secondary Sensor is shown but not supported.
<b>T(Timer)</b>	The computer hardware timing consistency is checked. Let this test run once for at least one hour on your computer. It stops automatically after 10 000 seconds (2h 47m).

### Timer Test

The timing is shown as a diagram, where the rows represent the timing. The middle row represents the correct timing, while rows above and below represent positive and negative errors, respectively. A ">" appears in arrow according to the result. If correct, a string of ">" should grow in the middle row of the screen. If a ">" appears above or below this line, there are timing inconsistencies in the PC. There could be processes in the PC, such as a screen saver or power saver that interferes with the timer. Such things can probably be turned off in the computer Setup Menu, which normally can be accessed by pressing a specified key when the computer is turned on. Refer to the manual for the PC or an expert. If this does not help, another PC must be used.

### Help

By pressing the key 'H' in the Main Menu, two help files can be selected, Instructions, by pressing the key 'I', or Rules by pressing the key 'R'. The Instructions are a very brief version of this manual, and the Rules are the 2014 F2A rule text.

These texts can be browsed by pressing keys as shown at the bottom of the screen:

Press key: \_  
Page 2 | N(Next page) | P(Previous page) | T(Top page) | M(Main Menu) |

The Instructions file name is "instruct.txt" and the Rules file name is "rules.txt". You can edit these files as you see fit. For instance, you can translate the Instructions to your own language, and add rules for local categories to the Rules file. Make sure to keep the format of 20 lines per page and 80 columns maximum. Use the Windows Notepad text editor.

### System Information

In the Main Menu, pressing key 'Y' will display system information. Refer to this information when reporting problems. Here is an example of the screen information:

```
Program Compiled: Sep 05 2014 13:48:09 +0200
COMPUTER:
Date & Time: Sat Sep 06 2014 12:08:57
MS-DOS Version: 7.10 2567
Parallel Port: Address (hex): 3bc 378 278 In Use: 378
                Data (hex): ff bf ff
                Status (hex): ff 7e ff
Assumed PC Timer Clock Frequency (Hz): 1193181.8
Timing Uncertainty due to speed of:
  Computer (seconds): ±0.000023
  (Sensor (seconds): ±0.0002 )

STATISTICS:
Total Sensor Pulses: 0
Pulses removed by time filter: 0

Sensor and TT program designed by: Goran Olsson, Sweden
E-Mail: goran@go-cl.se

Press any key to return to Menu
```

## HINTS ON RACING USE

The Automatic Mode is suitable for this kind of use. Locate the sensor to the mechanic's left. Then the mechanic can wave the left hand in front of the sensor at the moment of release, and likewise upon the catch. This way pitstop timing can be studied in detail, in addition to the obvious speed and lap registration. For F2C lap times instead of lap speeds will be shown, as this is the traditional quantity of interest for racing. This can be changed in the Category Definition File for F2C. However, in the log files lap speeds are registered.

## FILES USED

The TT program uses input from a few files:

TT.TTT	The PC configuration file, containing Calibration, Screen Mode and other data for the computer used.
*.TTC	The Category Definition Files. 13 files are included. For example: "F2A.TTC" is the category file for FAI F2A.
TTYMMDD.TXT	Log files. YYMMDD is the date code. TT140815.TXT (last round of the 2014 W/Ch) is included as an example.
NF.TXT	This file holds the file name of the Name Registry File in use.
NNX.TXT	Name Registry Files. NNEXAMPL.TXT is included as an example.

### *Flight Log Files*

The TT log file, TTYMMDD.TXT is created in the same folder as the TT program. It contains the complete flight log with the complete result and all individual laps tabulated. It is used for Contest as well as Auto Modes. There is one page per flight. If this file is printed, these pages can be handed over to the competitors. For every lap there is a lap time and speed, and also a "Time Stamp" with the time of arrival. It is given in seconds since the attempt start, with seven decimals. This time stamp allows full resolution data to be exported to other programs. An example how to import data to an Excel spreadsheet and make a plot can be downloaded from the TT web site.

As soon as the official course has been flown (9 laps for F2A), the speed for the most recent course is given for each following lap. The times for the engagements and disengagements of the handle in the pylon are also listed.

For the Log Review to work properly, it is important not to edit the flight log files.

### *Category Definition Files*

The file for F2A serves as an example:

FAI_F2A	Category; One word
9	Timed laps count
3600	Speed calculation: divide this by time
km/h	Unit for speed
3	Attempt time in minutes
2	Count-in laps
0	1 if timing starts at release (AMA Proto)
340	Maximum speed in used unit
.12	Stopwatch tolerance
1	Roundoff (see manual)
0	Display lap speeds (0) or lap times (1)
21.5 m	Recommended sensor radial distance (in preferred unit)
0	Not used

The TT program only uses the first item of each line. Everything after the first space is just a comment. The items must appear exactly in this order, and there must be no extra lines. Use a plain text editor to edit, such as Notepad or EDIT in MS-DOS. The file name must not be "M", must have 8 letters maximum length, followed by the extension ".TTC".

The first line has the category name, as it will appear in the TT header. Note that the "\_" is needed to join the words of many-word category names. Otherwise just the first word will be shown. The maximum length of the category name is 13 characters. For tether car categories the category name on the first line has to begin with "Car".

The comments explain the rest. The maximum speed should be set to ~10% higher than the highest speed likely to occur for the *fastest lap*. (Note this for standing start categories, such as Proto.) This value determines many aspects of the timing, and make sure to follow this rule!

The round off number determines how the official result is rendered:

Roundoff:	1	2	3	4
Result:	1 decimal truncated (F2A)	1 decimal rounded	2 decimals truncated	2 decimals rounded
Examples:				
Values from:	289.3000	289.2500	289.3300	289.3250
Through:	289.3999	289.3499	289.3399	289.3349
Given as:	289.3	289.3	289.33	289.33

### **PC Configuration File**

The file TT.TTT contains all data that is specific to the PC computer the program is run on. The file has six lines with one parameter on each. A 0 (zero) on the line means that a default value is applied. Under normal circumstances, do not change this file!

<b>File Content</b>	<b>Explanation (not in file)</b>
1193181.8	The PC Timer Clock Frequency after calibration
1	Screen Mode (1...6)
0	Reserved
0	Plot Graphics Type (0...2) for (A...C)
0	Parallel Port (0...3) (0 = Auto)
0	Serial Output (0 = Off; 1 = On)
0	Serial Format (0 = GO; 1 = CMBL)
0	Serial Format Options
0	Reserved

The clock frequency will be updated by calibrations made by the TTCAL program. The second and fourth lines are updated in the Screen Mode Menu. The other parameters can be manually edited if there are problems, such as with the parallel port on the PC. The serial output should normally be off. This is used to drive an overhead display, and will likely require further modification of the TT program. Two displays are supported, GO and CMBL.

## SENSOR MAINTENANCE

- Remember that the Sensor is a precision item, and should be well and carefully kept and handled at all times.
- Protect the Sensor from rain and dummies! Keep the transparent window free of dirt. Wipe it clean if necessary using tissue paper and window cleaning agent or diluted dishwashing agent.
- For transport, you can remove the bottom tripod plate and pack all items in the cardboard box. Keep the screws inserted in the sensor box, but do not tighten them.
- The power consumption is 2 mA. The battery should last at least 200 hours of operation. If the sensor has little use, the battery should be changed every 3-4 years in any case due to self discharge. Note that a discharged battery could start to leak, which could damage the sensor. Use only an alkaline high grade battery, type 6LR61. To change the battery, remove the right panel and loosen the central screw at the bottom. Remove the battery and snap off the battery connector. Connect the new battery, install it and tighten the holder screw.
- There is no support for self-repair of the circuit board or other things in the sensor. The same applies for the cables and connectors. You should send a faulty or suspect part to me for repair in its complete state.

## PC TIMER CALIBRATION

The Transitrace speed timer uses the PC internal timer controlled by a quartz crystal clock. This timer keeps track of the date and time of the PC when it is turned on. When the PC is turned off another low power timer running from a battery takes over. When turning on or off the PC a jump of up to one second may happen. This means that you cannot rely on the PC real time accuracy to know the PC timer accuracy. The crystal has a nominal frequency of 1,193,181.8 Hz. It can deviate by perhaps as much as  $\pm 900$  ppm (parts per million) (roughly 50 seconds per day). Therefore it might be worthwhile to have a better reference. (To get an error of 0.1 km/h at 300 km/h for F2A would take a 333 ppm timer error.) Most PCs will give a greater accuracy than manual timing by a large margin, even without any calibration. A PC timer error will not upset the competition placing if the same PC is used throughout, as all results get the same error. However, a calibration is worthwhile to reduce the error that the PC timer contributes. The calibration described here aims to determine a more accurate value of the crystal clock of your PC. This is then stored in a file used by the TT program.

What you need to do is to compare your PC timer to the time of the best time reference you can get. On the internet there are good time references, such as this one: <http://time.is/>

You should view this web page on your Internet computer, and run the calibration program on the Transitrace computer. After the start registration you must close the page, and shortly before the stop registration you must open the page again. This is important, as the web page reads the internet time only when opened, and is updated using the computer clock. A convenient method is to use the web page to first calibrate a normal electronic stopwatch over a 24 hour period and then calibrate the PC using the stopwatch.

The program provided for this is called TTCAL.EXE. It is delivered together with the TT software downloaded from the Transitrace web site. You have to run it under MS-DOS, just as the TT program. You start the program in the same way as the TT program, only that you type TTCAL instead of TT, and then follow the instructions.

You may have to repeat the procedures a couple of times before you get a result good enough to warrant an update of the calibration. You afterwards have the choice of whether to update the calibration or not. The program will give warning or error messages if the results are inconsistent or wrong, in which case you should not update. After an update of the calibration, you could repeat the procedure to verify that you now have a better accuracy.

The quartz crystal frequency is dependent on temperature, so in reality a precision better than 10 ppm cannot be obtained. The accuracy of these calibration methods also limits the precision to about 10 ppm. Do not bother to update the calibration if your deviation is smaller than this!

**The calibration routine creates or updates the “TT.TTT” file. After a calibration, do not overwrite this file with copies from other PCs, or the file from an updated TT version!**

### ***Calibration***

The calibration requires you to watch the Internet time reference page and type start and stop keys on your Transitrace computer keyboard at the same time as the seconds change. As this cannot be done with a precision better than 4/100 seconds, the test needs to run for around 30 minutes, so that the error gets small enough in relative terms. The test also has to be repeated, to verify consistency. This means the calibration takes around 1 hour, but it only has to be done once for each PC you use.

Run TTCAL and in the menu press the ‘S’ key. Times will be taken twice, and the times of the reference and your computer compared.

The TTCAL also allows calibration by a Frequency Meter, but this requires special equipment. Press the ‘F’ key to use this method. The blink frequency of the Handle Switch LED is then measured.

### ***Calibration when updating software***

If you want to preserve the calibration you made when updating the TT software you must first use the ‘Y’ command in the Main Menu of the old TT program. You should write down the “Assumed PC Timer Clock Frequency (Hz)” shown. The value should be within of 0.1% of 1193181.8. Then use the command `EDIT TT.TTT` in the folder for the new TT program. Replace the number on the first line with the number you wrote down. Exit and save the file.

# APPENDIX

## MS-DOS Basics

IN MS-DOS, all programs are executed by typing commands, followed by the Return (Enter↵) key.

The system tells you that it is ready for a command by displaying a “command prompt”, which normally looks like this:

C:\>

The text before the > shows the directory (folder) which is your “current directory”. Commands will operate in this directory unless other directories are specified. Commands can be typed with upper or lower case characters. Two examples, using the first useful command:

C:\>**DIR** List all files in the directory  
C:\>**DIR \*.TTC** List all TT category files. ( \* is a symbol for ‘any text’)

If you want to change to the diskette instead, just type **A:**

C:\>**A:**

The command prompt will change to:

A:\>

A few useful commands:

<b>CD</b>	Change directory. Example: <b>CD \TT15</b> This will change to the directory C:\tt15. You can see that this has happened as the prompt now looks like this: <b>C:\tt15&gt;</b> To change to the top directory: <b>CD \</b> To move to the next upper directory: <b>CD ..</b>
<b>MD</b>	Make directory. Example: <b>MD OLDLOGS</b> This will create a new directory under the present one, named OLDLOGS.
<b>EDIT</b>	View or edit the content of a text file. The EDIT program uses the mouse and has a scroll down menu similar to windows programs. Example: <b>EDIT TT140531.TXT</b> Views the log file. (Avoid changing any log files!)
<b>COPY</b>	Copy a file. Example: <b>COPY TT140531.TXT A:</b> Copies the file to a diskette.
<b>MOVE</b>	Move a file. Example: <b>MOVE TT13*.TXT OLDLOGS</b> This moves all files with name beginning with TT13 with the extension .TXT to the directory OLDLOGS.
<b>REN</b>	Rename a file. Example: <b>REN SPEED1.TTC SPEED2.TTC</b>
<b>DEL</b>	Delete a file. Example: <b>REN SPEED1.TTC</b>
<b>DIR</b>	Lists the files in the present directory.

## Contest Checklist

You should make a sheet with instructions on how to set up the PC with power supply and how to start it up for running the TT program.

- **Sensor Location:**
  - Is the Sensor located at the correct distance from the circle centre and pointing towards the centre?
  - Are all aware of this: IF A CATEGORY SWITCH MEANS ANOTHER LINE LENGTH, MAKE SURE TO MOVE THE SENSOR ACCORDING TO THE INSTRUCTIONS!
  - Is the sensor standing horizontally?
  - Will the sun shine directly into the sensor at any time of the contest duration? If such a case is unavoidable, is an intermission scheduled?
  - Is the background sky in the field of view unobstructed? Vertical limiting angles: Lower: 9°; Upper: 50°. Horizontal angle of view: 4°.
  - Is the lighting that hits the sensor slit flicker-free? Sunlight shaded by tree foliage is not stable and might cause spurious pulses. Add an extra shade if this is the situation.
  - Is there an effective dolly and rain protection hood for the sensor?
  - Is insect repellent at hand for use if insects are drawn to the sensor?
- **Cabling:**
  - Is the sensor cable laid out with reasonable protection?
  - Are the connector screws lightly tightened?
  - Are the mid-cable connectors protected from rain and stepping on?
  - Is the Handle Judge Switch connected to the PC Adapter?
- **PC setup:**
  - Is the power supply to the PC adequate? If a battery is used, is the capacity enough for the duration of the day's contest?
  - Is the computer screen of sufficient brightness and effectively shaded from sunlight to remain clearly visible throughout the contest duration?
  - Is the date and time of the computer correct?
  - Has a check that the Sensor and Handle Switch are operational been done? (Main Menu - Test - Sensor)
- **Operator Training:**
  - Is a copy of this User Manual at hand?
  - Has the system been set up well before the contest starts, so that the practice flights can be used to verify the system and train the operators?
  - Have the special cases been given due attention so that their handling is well understood?
    - Insertion of Missed Laps
    - Shifting Laps of the official flight
    - The appearance of "bird" events

## QUICK GUIDE

### *Run a contest*

Beforehand learn all the rules for the category at hand, and this manual. This guide is very brief and covers only the normal sequence of events.

- 1) Start the timing program by typing TT followed by the Enter key.
- 2) From the Main Menu select the Contest Category by pressing the X key. Then a list of all the defined categories is shown. Type the name you want, followed by the Enter key. After this, a warning is always shown to alert of the correct sensor position. Then press any key. Now in the MAIN MENU important data for the category are shown.
- 3) Enter names of competitors. This can be done in two ways:
  - a. In advance. Press the N key and follow the instruction in the manual.
  - b. As you go. See below.
- 4) Prepare for Contest Attempt by pressing C.
- 5) Enter the competitor number followed by the Enter key, or if necessary change Round or Attempt by pressing the R or A keys. If no name is registered for the number, enter it when instructed.
- 6) When all is set for the attempt to start, the LED on the Handle Judge Switch will turn on.
- 7) When the attempt is about to start, press the Handle Judge Switch, and release it exactly when the attempt starts. The LED will turn off. Remaining attempt time is shown.
- 8) When the flight starts, check that lap speeds are registered.
- 9) If the pilot lands without making a timed flight, observe the remaining attempt time, and if the attempt time is out, give a signal. If the pilot restarts go back to 8).
- 10) When flying, observe the pilot, and when the handle makes contact with the pylon fork, press the Handle Judge Switch. If the attempt time is out before the handle makes contact, give a signal. If the handle is taken out of the pylon, immediately release the switch. The countdown proceeds if the handle stays in the pylon, otherwise it is reset.
- 11) When the timed flight starts, the LED turns on. Alert the Height and Binocular Judges. If the handle is taken out of the pylon, release the switch. If done during the timed flight, the result is a zero.
- 12) When the timed flight is completed, the LED turns off. Alert the judges and give a signal to the pilot.
- 13) When the model has landed, all the lap speeds are listed and plotted. Check that they are consistent. If all looks OK, announce the official result.
- 14) If the result is judged invalid for any reason, write a comment to the log by pressing C.
- 15) If a result was achieved, write it down. If the competitor has another attempt, make a note. An unsuccessful last attempt gives a zero result.
- 16) Finish the attempt by pressing N twice and repeat from 4), or M twice to go back to the Main Menu.
- 17) After finishing, in the Main Menu, press Q to finish the TT program.