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Software User's Manual

(SUM)

for

IntraCfg

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Change Record

Date	Version	Who	Description
06-Jul-09	0.10	RB	Quick Guide part of document
13-Aug-09	0.11	RB	The chapter "How to update INTRAs Firmware" added.
3-Mar-10	1.00	RB	Additional text on compatibility between firmware – and INTRAcfg-versions.
23-Mar-16	2.00	RB	Revision to adapt to current version of IntraCfg V2.04 and firmware ifw_216 and ifw_217 resp.
09-Jul-16	2.01	RB	Material on icb-2 connectors and cable added.

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1 Introduction

As of INTRA #66, a new controller with a new user interface has become part of INTRA. This new controller – termed INTRA Controller Version 2 (icb2) – provides a user interface based on remote procedure calls. Hence it is no longer possible to configure INTRA using a simple terminal, but one has to use a PC with the configuration utility IntraCfg installed. This is a handicap, but far outweighed by the advantages of a graphical user interface as provided by IntraCfg.

A user who wants to supervise or control INTRA from within his own application should check the dynamic link library (RPC_lib3.dll) that is available from our website.

Once configured, INTRA runs autonomously¹. But when configuring INTRA, you should understand what all these parameters mean. Therefore this document not only explains IntraCfg, but also covers the aspects with respect to the firmware (ifw) working in INTRAs controller. Hence it is also an INTRA-Manual.

2 References

Normally, a user does not have to bother about the remote procedure call interface. Except when he wants to make his software system to talk with INTRA. Such a user should have a closer look at the document [2] listed below and the dll available from our internet site www.brusag.ch. Details about the protocol can be found in [1] – but a user of the dll does not have to dive into this document.

1	INTRA Software Interface Definition Document (SIDD) R. Brusa, BRUSAG CH-8712 Stäfa	V 1.02 3-Mar-10	INTRA/SIDD/ 1827-BRU
2	Short Documentation of the Rpc_lib3.dll	V 1.01 8-Jul-14	INTRA/DOC/ 2273-BRU
3	INTRA Firmware – Quick Guide to Update the Firmware	V 1.03 10-Sep-14	INTRA/DOC/ 2267-BRU

3 A Quick Guide to INTRA

3.1 Setting up INTRA for Configuration

3.1.1 Installation of IntraCfg

IntraCfg (V2.05 or higher) can be downloaded from our website. It does not require an installation. Simply copy IntraCfg.exe to a suitable folder. It may be helpful to create a link to IntraCfg.exe on your desktop.

We have tested IntraCfg on Windows XP, 7, 8.1 and 10.

3.1.2 Interconnecting your PC with INTRA

The setup operation described in this paragraph may be performed in the lab or with the tracker already installed at its site.

¹ most user prefer to supervise INTRA and thus remain connected to its user interface during operational use of the tracker.

The INTRA controller V2 (icb-2) is linked to your PC using RS232C interfaces. Most modern Laptops or PCs do no longer have this type of interface, but a RS232C to USB-adapter will work fine.

The [Excel sheet](#) (see register Sockets) includes information about the pin assignment and color coding of the INTRA Main Socket X1 – for 10- as well as for 8-wire cables. For the sockets of the icb-2 see figure 1.1 below.

Figure 1.1 The sockets of the Intra Controller Board Version 2 (icb-2). From left to right: Encoder PA, Motor PA, Encoder SA, Motor SA, Sun-sensor, X1 Main socket, Heater PA, Heater SA, LAN-socket (not used)



Access to the X1-socket through the service opening is possible, but rather cumbersome. We therefore deliver the tracker with a 30 cm piece of cable connected to X1. The end of this piece "duplicates" the X1 socket and is easy accessible through the service opening.

In the following, we assume that you connected STxD to pin2 of the COMx connector (DB9p) of your PC, SRxD to pin3 and S GND to pin 5. PWR+/PWR- should be connected to a power supply that is able to deliver up to 2A at 24 VDC. The Heater power may be left unconnected for now.

Something to be remembered later on when working with IntraCfg:

- IntraCfg does not send any characters or messages to INTRA, except if accordingly instructed by a corresponding user action – e. g. clicking on an action button in one of IntraCfgs windows or by keying in characters on the keyboard.
- Characters entered from the keyboard are sent to INTRA – but are ignored, because they do not correspond to the protocol.
- Failing attempts of IntraCfg to receive an answer upon clicking on an action button will generate a corresponding error message in IntraCfgs main window or in the status line of the corresponding window.
- During launch, IntraCfg reads in data from the registry. If these data are not found, it generates default values for INTRAs eeprom-parameters and records them in HKEY_CURRENT_USER\Software\brusag\IntraCfg. You may update these eeprom parameters at any time by clicking on the Save-button in the Registry field of the IROM window of IntraCfg.
- The registry also includes data on the status and position of windows. These settings are updated each time IntraCfg is closed, hence the layout of the windows of IntraCfg will be maintained from one session to the next.

3.2 Using your Tracker and IntraCfg the Very First Time

A tracker shipped to our customer has important parameters stored in its EEPROM. We strongly recommend, that you firstly make a backup of these tracker-specific data. They are essential for proper working of your tracker.

- Double-click on the IntraCfg-Icon on your desktop and the program will launch and ask you for a path to save its log-file. Click ok for now, we will deal with this later on.
- You may have to select a suitable COM-interface for communication. Use RemoteCfg>comsettings and select as required in the selection window that opened upon this command.
- Switch on the power to Intra and you should receive the startup message of INTRA's redboot loader – and 4 seconds later – the start message of INTRA's firmware. If nothing becomes visible, you should check your link between INTRA and your computer and you should also check if you are using the correct COM-interface (when using an adapter this is sometimes not so easy).
- Select RemoteCfg>TimeDate, then click the Remote button. Check in the field at the bottom of the Time & Date Window that the time was properly read in from Intra. Now you have verified, that communication works both ways.
- Check that your PC has accurate time (preferably recently synchronized to a time server of the internet) and that your **PC is running on UT not local time**. Then click SendNow.
- Select RemoteCfg>EEProm and in the IROM-window that now opens, click on GetRAM.
- Make a screenshot of this IROM-window now and store it away in a safe place.
- In addition you may click on Save-button in the Registry-field in the IROM window. Then start regedit and export the settings stored in HKEY_CURRENT_USER\Software\brusag\IntraCfg. You may use this file to restore eeprom data later on in case you lost them.

The About menu of IntraCfg provides information about the current version of the program. This may be important for some users using (very) old versions of the firmware, because the current version 2.04 is probably not compatible with all old versions of the firmware. The startup message of INTRA's firmware includes its version. If you are using an IntraCfg older than V2.04 or a firmware older than ifw_216, please update. All required files and tools can be found on our website.

3.3 Getting online with IntraCfg and your Tracker

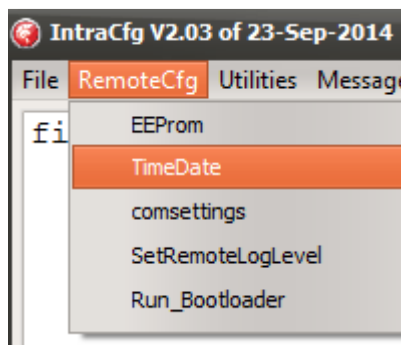
This chapter assumes, that your tracker is powered, linked to your PC and IntraCfg is up and running on your PC. When shipping a tracker, we position both axis slightly positive – that is clockwise from the zero mark. This makes it ready for an init-operation where it determines/reestablishes the absolute positions of both axis. It is important to memorize this position in case you tracker loses its position information – for whatever reason. Then you must again bring it into this position to be ready for an init-operation. We recommend that you take a picture of both flashes – as delivered and store it away.

Prior to an init-operation, we should see that some data are correctly set for subsequent operation – time and date and geographical coordinates.

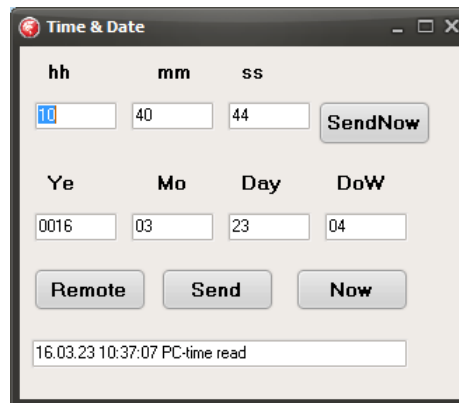
You bring up the TimeDate window using the corresponding entry in the RemoteCfg Menu.

The time and date as displayed is read in from the PC.

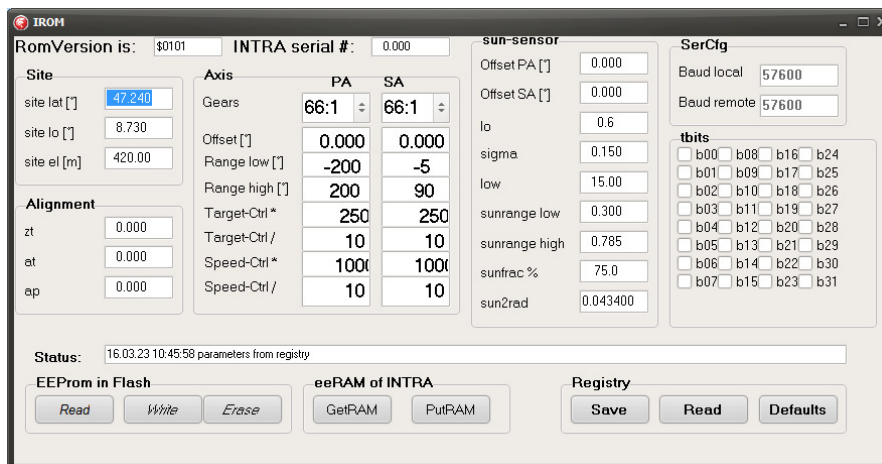
Hint: If your PC is running on UT, you may simply click on **SendNow**. This reads the time of the PC's clock and links it up to INTRA.



Enter current time and date - **UT please, not local time** - and click **Send**, then close the Time & Date window or use the SendNow button if your PC runs on accurate UT.



As next step, you should configure some of the parameters in the EEPROM. Get the EEPROM window using the RemoteCfg-Menu. It will display default values.



Now click on the **GetRAM-button**. This will transfer the contents of the RAMcopy of the INTRA-ROM-contents to your PC and display it in the IROM window. Especially, you should note that INTRA serial # now displays the serial number of your tracker e.g. 66.203 where 66 is the number of the mechanical part of INTRA and 203 the serial number of the controller board.

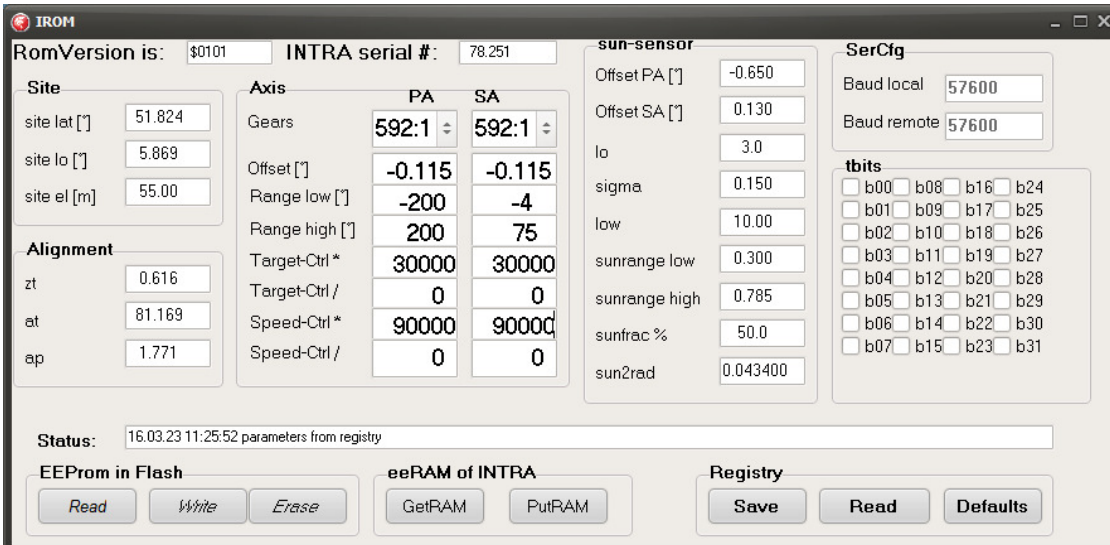
Next, we recommend to save these original settings for later consultation. Click on the **Save button** in the Registry frame. This will write current settings to the registry under the key:

HKEY_CURRENT_USER\Software\brusag\IntraCfg

We recommend to export this entry to a file (*.reg) using regedit and to store it in a safe place.

A tracker comes with its specific settings stored in its flash-rom. Some of these parameters are essential for the proper working of the tracker. Upon power up, the firmware reads the parameters from flash (the so called EEPROM data) to RAM. Saving these original settings to a file as described above is essential, if you ever have to revert to original settings.

In case your tracker has gears 592:1, gear-settings are accordingly and some of the axis parameters of the control loop are different as shown below:



Now please enter the parameters of your site in the 3 fields inside the Site-frame., **latitude** (north is positive), **Longitude** (East is positive²) and **elevation** (m above sea level). Then click **PutRAM** followed by a click to the **Write** button in the "EEProm in Flash"-frame. The new settings are now in the RAM of the controller and also in its ROM (emulated in flash). Hence during subsequent power ups, INTRA will come up with these settings read from ROM during power up.

The parameters in the Axis-frame, as well as most of those (see below) in the sun-sensor-frame are tracker specific and should not be modified. The selection boxes in the tbits-frame are reserved for tests by the manufacturer. These boxes are actually used to enable/disable various test outputs of the firmware (ifw-version-dependent)

Sun-sensor Offsets: These values were determined during initial field tests. You may further edit these values [°] to adjust pointing for your instruments.

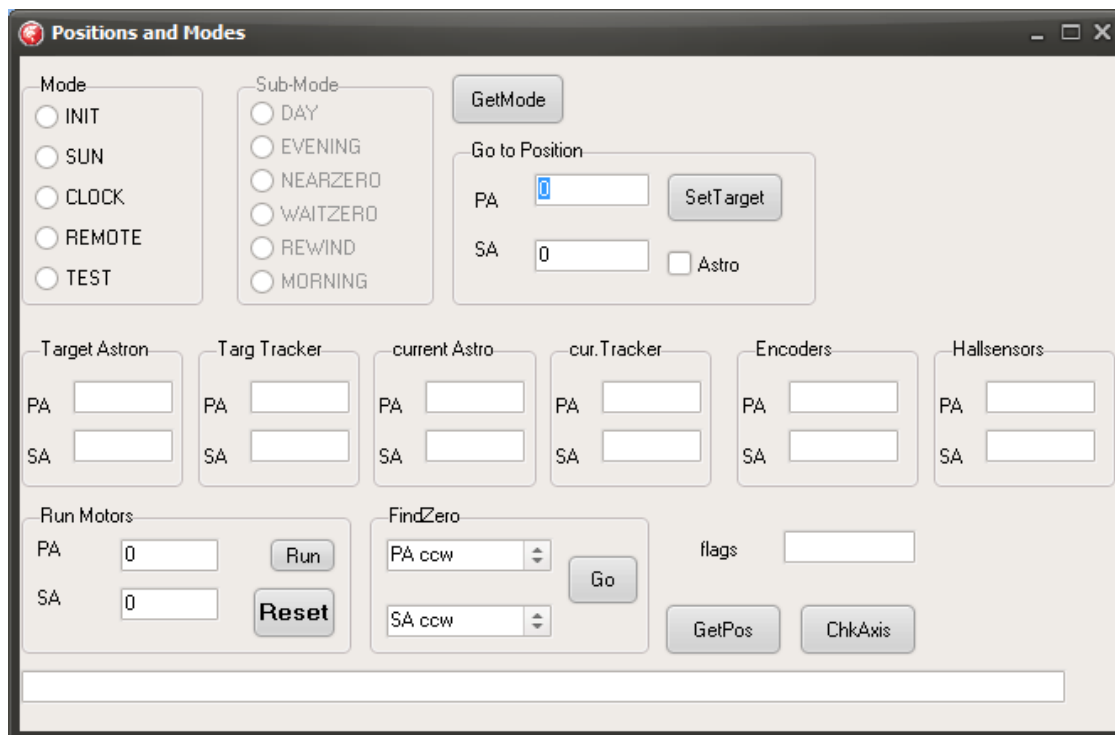
Next is then to help INTRA to set up the position of its axis. Typically, an INTRA is delivered with its axis at positions 5° , 5°. This situation is depicted below:

In order to make things more visible, we have positioned INTRA in such a way to make both its flanges visible. The one at the bottom is the flange of the primary (vertical) axis (PA) and the flange to the right is the flange of the secondary (horizontal) axis (SA with sun sensor). The position shown here is indeed 5°,5°. One can see that both flanges are slightly rotated clockwise from their zero position. From this you may correctly conclude that the PA is (approximately) at its zero position when the milled groove with the two threaded holes is parallel to the top surface of the pictured unit. And similarly for the SA. Its zero is when the milled groove with the sun sensor is parallel to the top surface.



² in contrast to the convention followed in the firmware of the controller version 1.

Clicking on the menu-item Utilities>Position, the "Positions and Modes"-Window opens.



Now let us assume that the position of the axis is not nearly as depicted above. You can move the axis into the correct position for the FindZero-Command using the "Run Motors" entries. You can do this for both motors at the same time or one after the other. The PA- and SA-fields accept an argument in the range from -999 to +999. -999 is full speed ccw, 999 is full speed cw. Enter a value in one or both fields, then click on Run. Motors start to run according to the speed set. If you are happy with what you see, click on Reset to stop the motion(s).

If once both axis are near the 5°-position, click on the **Go-button** of the FindZero frame. The motors start running ccw and stop a few seconds later when the zero mark of the encoder disk is encountered. Click on **ChkAxis**-button. You should get a message telling you that both positions PA and SA are valid. Click on GetPos to see the actual position.

A word of caution: The Run Motors command disables range- and other checks on both axis. It simply runs motors as instructed! Make sure that the tracker can move freely, otherwise some damage might occur.

A few words of additional explanation on the FindZero command:

The two selection boxes inside the FindZero frame allow to specify in which direction the motors should move: ccw, cw or – where – means "no movement". Following a click on the Go-button, the motors move accordingly – until they encounter the zero mark or have made a path of app. 15° - whichever comes first. In fact it is possible to repeat the FindZero command many times. Assume the current position is app. e. g. 100,35. After 3 FindZero operations, the SA would come up with valid positions (Use ChkAxis to see this). Then you would select SA – and continue with the FindZero operation until also the PA reports position valid.

We recommend to perform the FindZero operation always with both axis a few degrees positive (cw) of the zero and use the ccw movement.

Once this find zero operation is successful, time and date properly set and site parameters also correctly entered, your tracker is ready for use. In the mode frame, click on **Sun**. The tracker will move to the position where it expects the sun – this based on current date, time, site- and misalignment parameters. And if the Sun is really within the field of view and sufficiently bright, it will start active tracking.

The controller has an onboard battery that keeps the real time clock running when power is down. The battery will be good for several years. The RTC also includes a few bytes of RAM where essential mode and position information is stored upon power fail. This information is read back upon power up and hence, INTRA resumes operation at the position and mode that was in effect upon power fail.

Despite of the fact that essential position information is maintained during power fails, we recommend to perform a "FindZero" operation following power up – especially when power was removed while the motors were operating at high speed. In order to facilitate this "FindZero" upon power up, we recommend to follow the procedure shown below prior to powering down INTRA:

- Click on **Remote** in the mode frame
- Enter 5 in the PA- and SA-fields in the "Go to Position" frame then click **SetTarget**
- Wait for INTRA to reach this position – check by clicking the **GetPos** button.
- Switch power off

3.4 How to update INTRAs Firmware

This topic is treated in a separate document. See file [140908_INTRA_update_guide_103.pdf](#) available from our website.

3.5 Installation of the tracker

With both axis of the tracker at their zero position, installation should be performed such that the sun monitor points (approximately) toward the point of intersection of the south meridian with the horizon.

If an installation is less than perfect, it's no problem. INTRA will learn about it and automatically correct for such misalignments between its system – the tracker system - and the astronomical system. More on this in the reference section.

INTRA is attached with its PA-flange on a flat horizontal surface. The dimensions of the PA-flange are given in the figure below³. The M6-threaded holes of the 32 x 32 m grid are intended for attachment of INTRA to its base. Note that the base must have an opening – preferably of a diameter not smaller than the Ø60 mm of the flange. The high flex 10- or 8-wire-cable that comes with INTRA is fed through this opening. For the insertion of the cable, you must open the service opening on the top surface of INTRAs case.

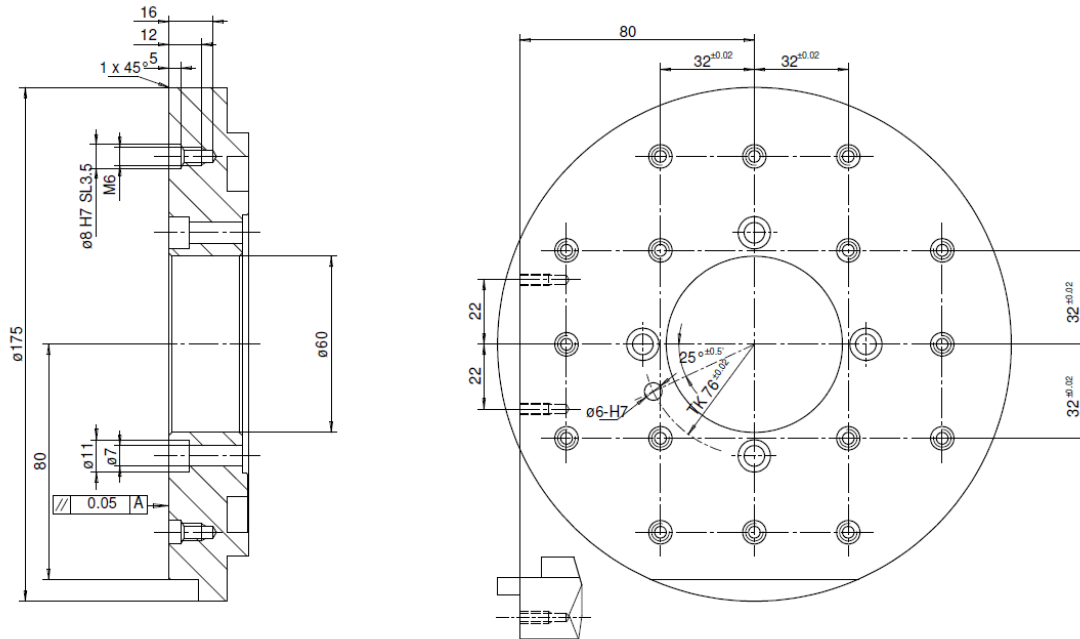
The 10pin Molex connector (X1) of the electronics board is not well accessible. Therefore we deliver INTRA with a small cable-tail connected to the X1 connector. This tail has the same Molex socket on its end as the one on the board and hence allows easy connection of the cable. Having connected this cable you should pay special attention to two things:

- INTRA rotates and there must be sufficient cable inside its housing to allow for this movements.

³ The SA-flange is identical – except that it has an opening for the sun monitor.

- You must provide a fixation – somewhere at the base plate – that prevents the cable from "creeping" out of INTRA housing with time.

Finally, you must take care that INTRA's case is **properly grounded**. And now you are ready to connect the 24 VDC power supply, the serial interface of a PC and possibly also the 24 V power supply of the heater to the cable. See also the § "Connecting your PC with INTRA".

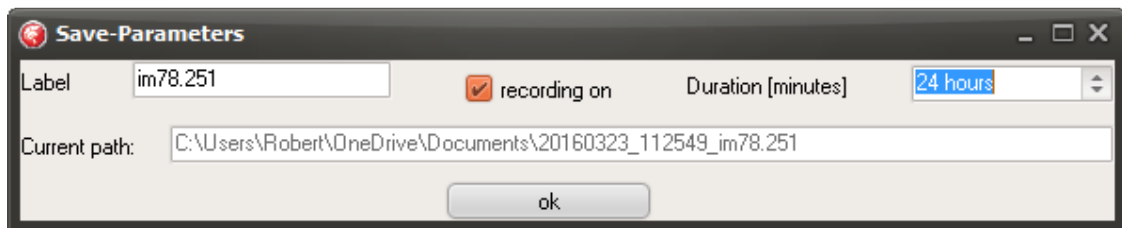


4 Reference Section

4.1 The File Menu

4.1.1 save

Selecting save opens a dialog as shown below:



When recording on is selected, the save-menu will appear checked and the program records all terminal input received from INTRA on disk. Periodically, a new file is started. The period may be selected in the Duration field. The filename generated consists of the date, time and the contents of the Label-field. The file format is csv (comma separated variables) for easy import into a spreadsheet.

4.1.2 path

Selecting this entry opens a path/file selection dialog. Clicking on ok restarts recording as described under "save".

If recording is already in progress, a dialog box requests confirmation that indeed you want to close the current file and continue with a new one.

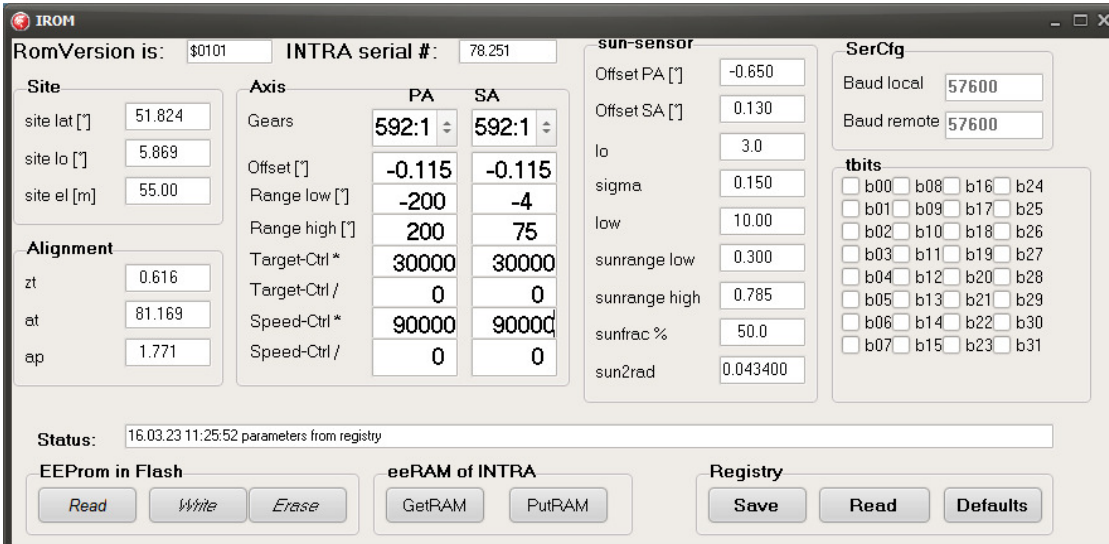
4.1.3 exit

Closes all files and terminates program.

4.2 RemoteCfg

4.2.1 EEPROM

Opens the EEPROM dialog.



Some of these parameters are informative only, but most of them are actually used in computations by the firmware. Some of the parameters are defined at the factory (M), some are defined by the user (U) and some are computed/updated (P) by the firmware during operation.

Parameter	by	Comment
RomVersion	M	Identifies the format of the IROM-type the firmware expects.
serial #	M	identifies the tracker (78) and its controller (251)
Site	U	The user defines latitude (E>0), longitude (N>0) and altitude of site.
Alignment	U,P	Misalignment between tracker- and astronomical system. Typically left all zero by the user and the firmware then updates it according to its analysis of data collected. If the misalignment is larger than the field of view of the sun sensor (app. ±5°) the user should define appropriate initial values. zt: Zenith-distance of the pole of the tracker system at: Azimuth of the pole of the tracker system ap: rotational misalignment of the primary axis with resp. to south.
Axis		
Gears	U,M	Must be set according to the gears operating in your tracker (66 or 512)
Offset	M	Offset of zero mark of axis from true right angle position with the other axis.
Range low	M,U	low "end of course" for primary and secondary axis.
Range high	M,U	high "end of course" for primary and secondary axis
Target-Ctrl *	M	control loop parameter
Target-Ctrl /	M	control loop parameter
Speed-Ctrl *	M	control loop parameter
Speed-Ctrl /	M	control loop parameter
Sun-Sensor		
Offset PA	M, U	pointing offset primary axis
Offset SA	M, U	pointing offset secondary axis
lo	M	extraterrestrial sum of all quadrants
sigma	M	extinction coefficient

low	M	minimum elevation angle under which data are not used for alignment error computations (analysis) at the end of the day.
sunrange low	M	if measured signal is less than this fraction of computed value $I(m)$, data are not used for analysis.
sunrange high	M	if measured signal is higher than this fraction of computed value $I(m)$, data are not used for analysis.
sunfrac	M	If collected data are less than sunfrac percent of possible data, no analysis will be performed with the data collected this day.
sun2rad	M	factor to convert computed pointing errors to degrees. Depends on geometry of sun sensor ⁴ .
SerCfg		
Baud local	M	Baudrate of local COM-interface (fixed)
Baud remote	M	Baudrate of remote COM-interface (fixed).
tbits	M	bit-boxes that enable or disable diagnostics output of the firmware. Normally all boxes are deselected. Resulting output of any selection depends on the version of the firmware currently installed on your tracker.

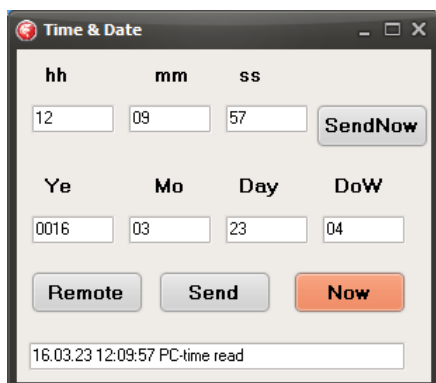
At the low rim of the IROM-windows one finds a field where communication status messages are displayed – as they result from clicking on any of the buttons below this field.

Button	What it does
EEPROM-Buttons	involves remote procedure calls
Read	Read EEPROM-data to RAM-copy
Write	Write RAM-copy to EEPROM
Erase	Clear all data in EEPROM
eeRAM of INTRA	involves remote procedure calls
GetRAM	load EEPROM-data from RAM-copy of the intra firmware to local EEPROM data (on PC)
PutRAM	upload local EEPROM data into RAM-copy of Intra firmware.
Registry	local procedures only
Save	Write local EEPROM data (PC) to registry
Read	Read EEPROM data from registry into local EEPROM data of PC
Defaults	Initialize local EEPROM data (PC) with default values. Data are not written to the registry – unless you click on the Save button.

4.2.2 TimeDate

Clicking on this menu entry brings up the time-date window as shown below.

⁴ Sensors V1 sun2rad = 0.135385 sensors V2 sun2rad = 0.0434. INTRA #70 is the first tracker that was delivered with a sensor V2.



Remote: Read time & date from controller board of remotely connected INTRA.

Send: Uplink time & date as shown to remote controller board and set the RTC on the board accordingly.

Now: Update window to display time & date as read from the clock of the PC.

SendNow: Combines Now and Send buttons into a single action. You may use this button to set time & date of your INTRA, provided your PC is operating on accurate **universal time [UT]**.

4.2.3 comsettings

You may select the serial interface your PC is using to communicate with INTRA. The baud rate and format is fixed to 57600 – no handshake, no parity, 8 data- and 1 start- and 1 stop bit. (57600,n,8,1,1).

4.2.4 SetRemoteLogLevel

This enables or disables log-output by the firmware. Typical usage is with setting eSEVERE. Then you get only output that signal a severe issue.

4.2.5 Run_Bootloader

As of INTRA firmware ifw_212, the firmware includes a hook that allows to catch the bootloader by sending a corresponding command. Clicking on Run_Bootloader, IntraCfg executes the sequence:

- It sends a special command to the firmware that will restart the controller board, launching its bootloader
- After a short interval, the bootloader is caught by sending it a ctrl-c (ASCII 03)
- And, after a second short delay, IntraCfg sends the string "load -m ymodem<cr><lf>" and
- terminates

Now you may start e. g. Hyperterm and download a new version of the firmware (mot-file) using the ymodem protocol. If you don't start a download, the bootloader will time out (1 to 2 minutes) and run the existing firmware.

The bootloader can be involved after power up of the firmware by sending a ctrl-c within 4 seconds from power up. You then may enter the command
load -m ymodem<cr><lf>
and then start with the download of the firmware.

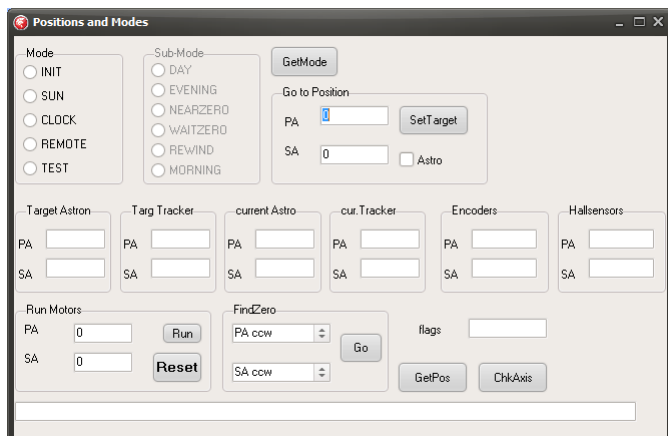
4.3 Utilities

4.3.1 WhoAml

Clicking on this entry will display the ROM-version and the version string as fetched from the remotely connected INTRA. The string also includes the hardware-version of the board – icb-210 or icb-250.

4.3.2 Position

This entry brings up a window that allows to control many aspects of INTRA. The Position window is shown below:



No parameter is visible at first. Remember: IntraCfg does not communicate with the tracker unless told to do so. Available commands are:

GetMode: Updates the display of current Mode and Sub-Mode of the tracker. Clicking on any of the Modes (except TEST) will put the controller in the corresponding mode. Sub-Modes are not selectable, but controlled by the remote INTRA only – and displayed after pressing GetMode.

SetTarget: The positions specified in the PA- and SA fields are uplinked to the tracker. If Mode is REMOTE (or later set to REMOTE) it will move to the specified position. Positions specified are wrt the tracker system – unless the Astro is checked, then positions are wrt the astronomical system.

Run Runs the motors with the speed as specified in the PA- and SA-fields in the Run Motors frame. Speed is specified as a number in the range [-999,999] where – means ccw rotation of the axis. This command allows to move INTRAs axis under manual control – independently of the current status of the position and mode of the tracker. When clicking on Run, the tracker is set into TEST mode and just moves according to the speed specified. Be careful and watch what it is doing. No obstructions?

Reset Stops movement of either axis and restores previous mode of INTRA.

Go Start movement to locate the zero marks of the PA and SA. The direction of the search is selected from the resp. selection boxes in the FindZero frame. ccw (counter-clockwise), cw (clockwise) or – (no search). The FindZero-Command moves an axis until it encounters the zero mark or it completed a move of 15° - whatever comes first.

GetPos Updates the positions information displayed in the 12 fields above.

ChkAxis Fetches flags from the tracker and displays them in the message field at the low rim of the Positions and Modes window.

The positions displayed include 4 systems of coordinates and target (where it should go) and current values (where it currently is). The 4 systems are:

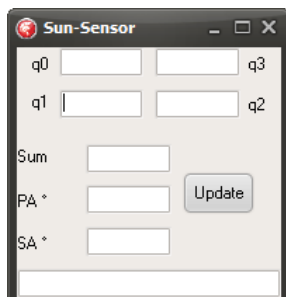
Astron Astronomical system – or better what INTRA assumes as the astronomical system, based on the misalignment parameters currently in effect.

Tracker Position deduced from the signals of the encoder disk taking into account the offset of the zero mark from the EEPROM data.

Encoders Raw count of encoder signals – 9380 per 360° The count is cleared when hitting the zero mark of an axis.

Hallsensors: Raw count of hall sensors. 3 per rotation of the motor. Ratio to encoder counts depends on gears installed and the ratio of the worm drive (150 nom.). The counts are cleared when hitting the zero mark of an axis.

4.3.3 Sun

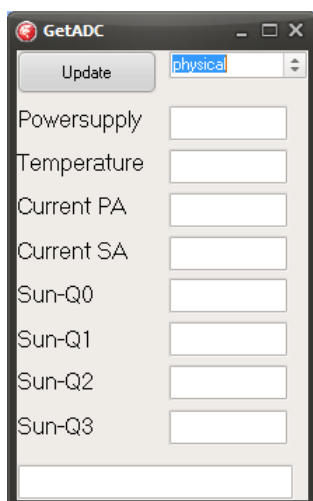


When clicking the Update button, the q0 to q3 fields display the signals of the 4 quadrant sensor. The Sum displays the sum of q0..q3, and PA, SA the pointing error as computed from q0..q3. The field at the low rim is used to display communication status messages.

4.3.4 Memory

This entry is for use by the manufacturer only and is not documented.

4.3.5 ADC



You may select the units (Raw, Volts, Physical), click update and the 8 channels of the ADC will be displayed in their respective fields.

The entry at the low rim of the window is used to display communication status messages (which result from clicking the Update button).

4.4 Messages

INTRAs controller implements an internal ring buffer (in RAM) where diagnostic messages are stored – headed by a time stamp. The entries under this menu allow to see and administrate the contents of this (remote) ring buffer.

- LoadLog Fetches the remote ring buffer and displays it in a text window.
- UpdateLog Fetches possible new data from the ring buffer and displays it in a text window.
- ClearLog Brings up a window that allows to select the remote log-level (Severe, **Short**, Extensive)

4.5 LocalLog

Select loglevel for local program (IntraCfg). (Severe, Short, Extensive). The entry that is currently in force is checked.

- end of text -