TRACK'AIR
Aerial Survey Systems

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TRACKER system

Hardware installation

USERS MANUAL

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1 - TECI-3 TRACKER EXTERNAL CONTROL INTERFACE

Last updated June 16 2003

The **TECI** (Tracker External Control Interface) is the “black” box component of the **TRACKER** airborne system. The TECI takes care of all the real time operations that the PC cannot easily perform. The TECI-3 is the current version of the TECI box and this manual will describe the specifications of this TECI. The older types are all basically identical to the TECI-3 (connections of TECI-1 might be different) but the TECI-3 is more dedicated and more multi functional as the older types. Also the standard TECI-3 is equipped with a GPS receiver inside the box (currently the Garmin 25 but starting end summer 2003 the Garmin 15 (WAAS enabled GPS receiver) will be used inside the TECI-3. So far, the TECI allows Tracker to be the only aerial survey airborne system capable of operating under Windows.

Its purpose is to interface the portable computer running the **snapSHOT** program with the airplane GPS receiver(s) and the camera. Its two main functions are triggering the camera at predetermined positions and to register a pulse at the midpoint of the exposure.

The **TECI** has the following features:

- Easy installation.
- Easy to handle.
- Internal GPS receiver. (Garmin 25, starting end summer 2003 Garmin 15)
- Broad range of mid-exposure-pulse input pulses:
    - High active TTL.
    - Low active TTL.
    - Pulse width 1 to 100 ms.
- Broad range of camera types that can be controlled:
    - RC20/30 camera
    - TOP camera
    - RMK IRU/ICC camera
    - LMK1000 camera
    - RC10 camera
    - Various Small Format cameras (also digital cameras)
- Most commercial GPS-receivers can be connected.

PRECAUTIONS

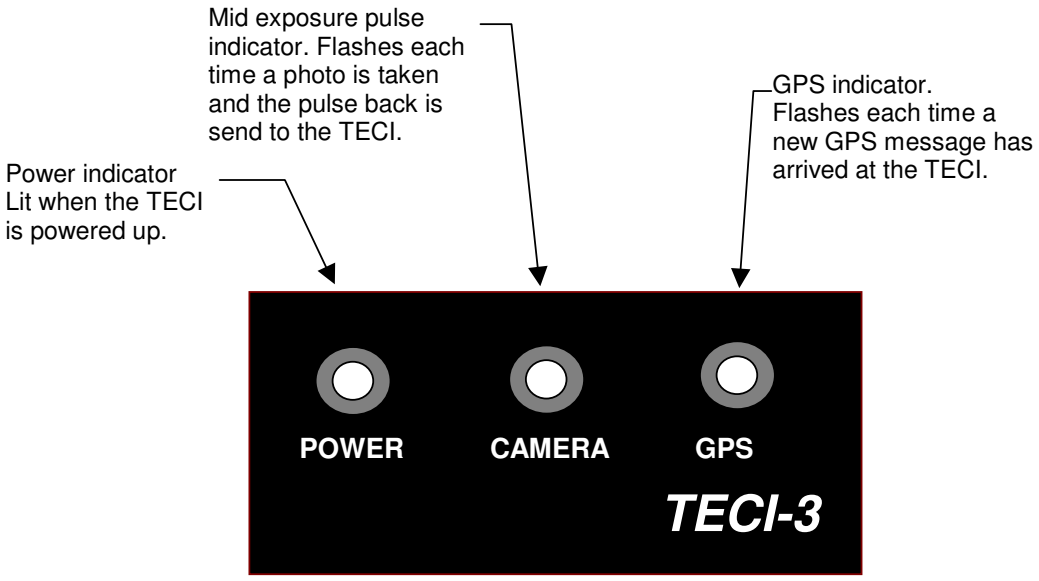
- **Never connect anything to TECI when the power is on.**
- **Never connect the TECI to any equipment whose power is on.**
- **Do not allow liquid to spill on the housing, as this is most likely to cause serious damages.**
- **Never try to open the housing. There are absolutely NO user serviceable parts inside. If the unit does not work, send it back for exchange or repair. Units that have been open will have their guarantee invalidated.**
- **Use only a power source rated for the equipment. Connecting the unit to alternative main current will irremediably damage it and invalidate the guarantee.**
- **The unit is fitted internally with several sensor pickups that will detect any wrongdoing. Units that have been damaged by obvious negligence will have their guarantee invalidated.**

2 - TECI-3 DESCRIPTION

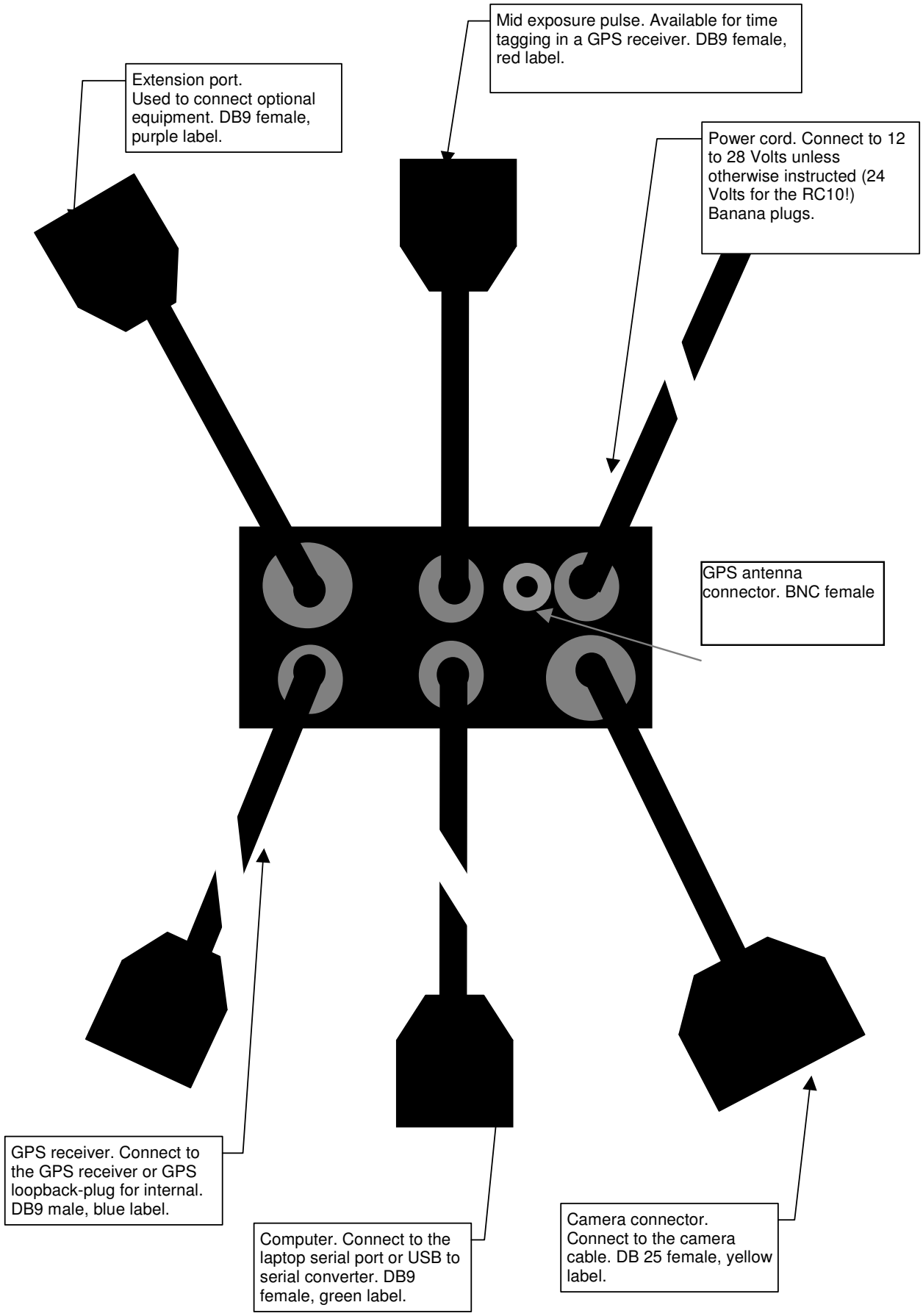
The TECI-3 is in fact a stand-alone computer interfacing system, equipped with a number of microprocessors taking care of the data communication between the GPS receiver, the camera, external devices like the CDI-display and the (laptop) computer running the SNAPshot program. Inside the TECI there is a GPS receiver that can be used for navigation, but disconnecting this GPS receiver and using your own GPS receiver is also possible. All serial communication to and from the TECI is controlled by the TECI microprocessors. Also these microprocessors take care of the image-taking process, pre defined by the user via the TRACKER software. The pulse that is coming back from the camera is also time-tagged and returned to the computer to be recorded in the software.

The basics of the TECI are described below:

FRONT VIEW



CONNECTORS (BACK OF TECI-3) THE ORDER MIGHT DIFFER



LAST UPDATED 20 APRIL 2000

POWER REQUIREMENTS

DC 12 to 28 Volt: .....…….200 mA maximum (without external devices connected)

Internal (self resetting) circuit breaker……..500 mA

NOTE: **The housing is grounded to the minus of the power supply.**

PHYSICAL CHARACTERISTICS

Dimensions.....113 x 58 x 330 mm (W x H x D) typical

Weight .....approx. 2 Kg

Front panel .....Power 'ON' LED (red)
Camera pulse-back detect LED (green)
GPS Signal detect LED (yellow)

Rear panel .....Extension port cable, DB9 female + busses.
Mid Exposure Pulse (M.E.P.) output cable, DB9 female + busses.
GPS Antenna connection, BNC female on housing.
Power input cable, 2 Banana plugs red and black.
GPS serial data input cable, DB9 male + busses.
Computer serial cable, DB9 female + screws.
Camera (trigger out & M.E.P. in) cable, DB25 female + busses.

The TECI-3 (Tracker External Control Interface-3) is the 'black-box' component of the Tracker system. To allow clients & technicians to identify & detect problems that might occur in/with the TECI, we've provided the info in this document. It describes the basics of the TECI-3 functions, the connector description of the TECI-3 connectors and some useful tips for measuring certain values and even solve problems/failures.

The TECI-3 box.

On the back of the TECI-3 there are 7 different connections available. Five of them are DB-connectors with coloured labels, one is the power input connection, a cable with 'banana-plugs', and the other one is a BNC female connector mounted directly on the housing, this is the antenna connector for the internal GPS receiver (Garmin 25 or Garmin 15).

The connections described here are the following: (f=female/holes, m=male/pins)

Connection name:	**Short usage description:**	**Connector type:**
Power Input	Providing DC input power for the TECI-3-box, 12-28 Volts	2 banana pugs
Computer	Connecting the PC with the TRACKER software to the TECI-3	DB9 f
Mid Exposure Pulse	Providing 3 different leveled M.E.pulses for external GPS (+more)	DB9 f
Camera	Sending different leveled trigger pulses to the camera (+more)	DB25 f
Extension	Connecting extension devices to the TECI	DB9 f
GPS	Inputting data from external GPS receiver (+more)	DB9 m
Antenna	Connecting GPS antenna to the internal GPS receiver	BNC f

The Power Input Connection:

The TECI operates using the battery voltage present in the aircraft, most common this is 24 Volts, but the system also works with a single 12 Volts battery. *Note that some cameras need the 24 Volts to operate properly!* The black banana has to be connected to the minus of the available voltage (ground or GND) and is internally connected to the TECI-3 housing! This connection is inside the TECI-3 box protected with an auto-resetting fuse of 0.5 Ampere (500 mA) to prevent the equipment from being damaged by accidentally connecting a voltage to the housing. The red banana has to be connected to the plus of the available voltage. Also this voltage is internally protected using an auto-resetting fuse of 500 mA to protect the electronics inside for over-current in case of a failure.
Please note that it is extremely important to use the same power source for all equipment attached to the TECI-3 system to prevent ground loops or other damage causing miss-connections!

Internally the TECI-3 box is transforming the inputted power to the levels used by the electronics, but the input power also available on an output connector and can be used to trigger a camera with the input power or to set a desired power for a certain camera or other device needed in a certain situation. The current draw by the TECI is completely depending on the amount of attached equipment/devices and the provided DC voltage but will never exceed 500mA. The TECI-3 with the internal GPS receiver without external devices connected will draw about 170mA @ 24Volts & 210 mA @ 12 Volts. If the TECI-3 without external devices is asking much more current than stated here, please contact us.

The Computer Connection: (green label)

This connector is the path via which the TRACKER software on the computer will communicate with the TECI-3. Only 4 pins are actually used in this connector; data transmission, data reception, a 'DTR' status line and a Ground connection.

The signals at the DB9 female Computer connector are described here:

Pin 1	Not connected	Pin 6	Not connected
Pin 2	Serial (RS232) data line from computer to TECI	Pin 7	Not connected
Pin 3	Serial (RS232) data line from TECI to computer	Pin 8	Not connected
Pin 4	'DTR' – Data Transmit Ready status line	Pin 9	Not connected
Pin 5	Ground (GND, housing TECI)	-	-

The Mid Exposure Pulse Connection: (red label)

WARNING

It is essential that you determine what is the pulse required by your GPS receiver. Mismatches will results in systematic errors that will affect the results of your GPS post-processing

This connector provides different leveled pulses to send an 'event' to an external GPS unit for extra GPS data logging. The default timing of a standard Mid Exposure Pulse (MEP) is 10 ms (0.01 seconds). Every event enabled GPS receiver should be capable of dealing with such a pulse. 3 Standard MEP pulse types are available TTL falling, TTL rising and on 'open collector sink' output. This plug also contains the PPS output of the internal GPS receiver and 2 inputs for PPS pulses, one responds to a TTL falling signal and the other to a TTL rising signal. 2 Pins are reserved for +5Volts power and a ground connection.

The signals at the DB9 female M.E.P. output connector are described here:

Pin 1	PPS input 'falling edge' *	Pin 6	PPS output 'rising edge' internal GPS receiver *
Pin 2	TTL output 'rising edge' **	Pin 7	Not connected
Pin 3	TTL output 'falling edge' **	Pin 8	PPS input 'rising edge' *
Pin 4	'open collector sink' output **	Pin 9	+ 5 Volts power
Pin 5	Ground (GND, housing TECI)	-	-

***** The PPS signal from an external or the internal GPS receiver can be connected here. A falling edge pulse is a pulse that drops from a voltage (from 3 Volts up to 28 Volts) to zero Volts during the PPS pulse. A rising edge pulse is a pulse that jumps from zero Volts to a voltage (from 3 Volts up to 28 Volts) during the PPS pulse. To make sure these inputs work properly note the following: If the falling edge input is used, the rising edge input has to be connected to a positive voltage (for example to pin 9, the + 5 Volts output), when the rising edge input is used, the falling edge input has to be connected to Ground (pin 5). Make sure that you connect to the corresponding input; connecting for instance a rising edge PPS pulse to the falling edge input will result in a pulse detection delay identical to the pulse-length! Note that the PPS pulse from the internal GPS receiver can easily be used by the TECI/ TRACKER system by looping pin 6 to pin 8. Pin 1 can be connected to pin 5 to prevent false pulses entering the system.

** The 'open collector sink' trigger output will switch to ground during the trigger pulse. The 'open collector' output can deliver 100 mA maximum! Usage of the TTL falling (TTL low) or TTL rising (TTL hi) MEP outputs is subject to voltage and current limitations! The voltage outputted here is 5 Volts for a logical 1, and 0 Volts for a logical zero. The maximum current may not be higher than 10 mA! The falling edge pulse is a pulse that drops from 5 Volts to zero Volts (logical 1 to 0) during the trigger pulse. The rising edge pulse is a pulse that jumps from zero Volts to 5 Volts (logical 0 to 1) during the trigger pulse.

The Camera Connection: (yellow label)

This connector provides different leveled pulses to trigger different types of cameras. The default timing of a standard trigger pulse is 200 ms (0.2 seconds), but also an extended pulse (about 800ms) is available at this plug. T*rack'Air can provide as an option software settable 'standard' trigger pulses, please contact us for details.*
The connector also receives the so-called Mid Exposure Pulse (MEP) from the camera as an acknowledgement from the camera that a photo has been made. *Not all cameras provide such a pulse, Track'Air can deliver a very accurate MEP-generator to be built into your camera, but also other acknowledgement solutions are possible; please contact us about the possibilities.*
If your camera is capable of receiving serial annotation data to be printed on the film during the run, this connector also provides the serial data to the camera. The details of the data format and such can be found in the TRACKER manual. Also receiving data and an RTS signal line are present at this connector.

The signals at the DB25 female Camera connector are described here:

Pin 1	Not connected	Pin 14	Ground (GND, housing TECI)
Pin 2	Serial data from TECI	Pin 15	Zener-diode connection, for settable voltage ***
Pin 3	Serial data to TECI	Pin 16	Settable voltage output ***
Pin 4	Not connected	Pin 17	Input voltage, protected by fuse 500mA
Pin 5	'ready to send' RTS signal line	Pin 18	Not connected
Pin 6	'open collector-source' 800ms trigger *	Pin 19	Not connected
Pin 7	Not connected	Pin 20	'open collector-source' trigger, using settable voltage
Pin 8	Ground (GND, housing TECI)	Pin 21	'open collector-sink' trigger, using settable voltage
Pin 9	External power input for pin 6 'open collector' *	Pin 22	Not connected
Pin 10	Input 'falling edge' M.E.P.**	Pin 23	TTL level trigger output 'falling edge'
Pin 11	Input 'rising edge' M.E.P.**	Pin 24	TTL level trigger output 'rising edge'
Pin 12	Settable voltage output ***	Pin 25	Auxiliary output TECI ****
Pin 13	Ground (GND, housing TECI)	-	-

***** At pin 9 an external positive power voltage can be provided. This voltage will be 'switched on' during the extended trigger time (hardware-set to 800ms) and outputted at pin 6. Also connect the minus/ground/GND of this voltage to one of the ground connections (pins 8, 13 and 14) of the TECI! The 'switch' used here can deal with a higher current than the standard TTL or open collector outputs.

****** The M.E.P.-signal from the camera, MEP-generator or other acknowledge-pulse generating device can be connected here. A falling edge pulse is a pulse that drops from a voltage (from 3 Volts up to 28 Volts) to zero Volts during the M.E. pulse. A rising edge pulse is a pulse that jumps from zero Volts to a voltage (from 3 Volts up to 28 Volts) during the M.E. pulse. To make sure these inputs work properly note the following: If the falling edge input is used, the rising edge input has to be connected to a positive voltage (for example to pin 12, the settable output voltage ***), when the rising edge input is used, the falling edge input has to be connected to Ground (pin 8,13 or 14). Make sure that you connect to the corresponding input; connecting for instance a rising edge pulse to the falling edge input will result in a pulse detection delay identical to the pulse-length!

*** The settable voltage works as follows: The voltage provided at pin 12 and pin 16 is standard equal to the input voltage (normal 24 Volts) minus 0.6 Volts used by the stabilization circuit. This voltage can be set for certain purposes using a zener diode between pin 15 and ground (pin 8, 13 or 14). Again, the circuit uses 0.6 Volts and this voltage has to be deducted from the zener-diode voltage. Example: we'd like to get an output voltage of 5 Volts. By connecting a zener diode of 5.6 Volts (400mW) between pin 15 (cathode, indicated by a stripe on the diode) and pin 14 (ground connection, anode of diode) the stabilization circuit of the TECI-3 will generate a 5 Volts output at the pins 12 & 16. Note that the maximum current that can be delivered by this circuit is limited at 100 mA and drawing higher current from the circuit or shorting the output might cause damage to the TECI!

The 'open collector' trigger outputs are also related to this settable voltage. The 'open collector source' trigger output will switch to the settable voltage during the trigger pulse (default set to 200ms). The 'open collector sink' trigger output will switch to ground during the trigger pulse. These 'open collector' outputs can deliver 100 mA maximum!
Usage of the TTL falling (TTL low) or TTL rising (TTL hi) triggering outputs is subject to voltage and current limitations! The voltage outputted here is 5 Volts for a logical 1, and 0 Volts for a logical zero. The maximum current may not be higher than 10 mA! The falling edge pulse is a pulse that drops from 5 Volts to zero Volts (logical 1 to 0) during the trigger pulse. The rising edge pulse is a pulse that jumps from zero Volts to 5 Volts (logical 0 to 1) during the trigger pulse.

******** The auxiliary output is used as an extender signaling line for some camera types. This signal is also TTL leveled and therefore subject to the same voltage and current limitations as described above!

The Extension Connection: (purple label)

This connector provides a special form of serial communication lines with optional external devices. These devices can be used for showing data (CDI) or controlling (PAV-) mounts or receiving data (compass interfacing). Only connect suitable Track'Air devices to this connector. If no external device is used, the connector should be protected using a protection-cap.

The signals at the DB9 female Extension connector are described here:

Pin 1	EXTOUT – next µP out	Pin 6	Not connected
Pin 2	EXTOUT - I²c data input	Pin 7	'DTR' – Data Transmit Ready buffered status line
Pin 3	EXTOUT - I²c data output	Pin 8	Input 'rising edge' M.E.P., same as pin 11 DB25f
Pin 4	EXTOUT - I²c data with/without [control+_] input	Pin 9	Input voltage, not protected, direct to red banana +
Pin 5	Ground (GND, housing TECI)	-	-

The GPS Connection: (blue label)

This connector is used for inputting external and internal GPS data to the TECI. If an external GPS receiver is used for navigation, the serial GPS data is inputted here. If the internal Garmin 25 or Garmin 15 GPS receiver is used for navigation a loop back plug is used to connect the internal generated GPS data to the data input from the TECI. The PPS pulse from the internal receiver is outputted at the MEP-connection! The GPS inside can be programmed to output the data in such a format that the TRACKER system can deal with it. If needed the GPS can also be reprogrammed, using this connector, to send different data formats.

The signals at the DB9 male GPS connector are described here:

Pin 1	Not connected	Pin 6	Serial DGPS/RTCM data input for internal GPS
Pin 2	Serial GPS data input to TECI	Pin 7	Serial Phase-data output from internal GPS
Pin 3	Serial input for programming internal GPS	Pin 8	Not connected
Pin 4	Serial GPS data output from internal GPS	Pin 9	Not connected
Pin 5	Ground (GND, housing TECI)	-	-

The GPS Antenna Connection:

This is a standard BNC female connector mounted directly at the back of the TECI to be able to connect the GPS antenna. This antenna is standard delivered with the internal GPS equipped TECI-box, and has to be a GA27C-compatible type. Please note that the internal GPS receiver starts sending PPS pulses as soon it 'sees' satellites. So if you're using your external GPS receiver be sure that you do also use the PPS output from this same receiver and input this pulse at the MEP connector. If done different the GPS data and the PPS might come from different sources!

The information in this publication is subject to change without notice.

3 - TECI-3 'DEFAULT' COMPONENTS

Default the TECI-3 is delivered with a few 'standard' components. Per camera the components will differ and also some clients have received on request special cabling for specific GPS receivers or external devices. The following components are very likely to be present in your TECI-3 system-kit:

- Computer cable (already connected to the TECI, fastened with heat shrink)
- GPS loop-back plug (connected with a chain to the GPS connector to prevent loosing it)
- GPS connection cable, standard basic connection cable for GPS data
- M.E.P.-out adaptor plug, standard TTL falling edge output with a BNC connection
- BNC-BNC cable for connecting the mid exposure pulse to an external GPS receiver
- GPS antenna on a stand, including the 4m TNC-BNC cable to connect it to the TECI
- The Track'Air power break box for temporary power connection (3 +&- banana sockets)
- An adaptor cable to allow connection of the break box to the lighter connection
- A standard USB to serial cable for clients with a laptop without serial DB9 connection
- Default a TECI has the extension port protected with a plastic cap, not every client needs the extension port.

Below the standard components are shown and described a little more:

COMPUTER CABLE

The computer cable is a simple 1 to 1 cable; the pins connected are 2, 3, 4 & 5. The gland is there to protect the cable from damage by bending at the back of the (laptop-) computer. Default the computer cable is connected to the TECI box on delivery.

GPS LOOP BACK PLUG

The GPS loop back plug is connected via the chain to the GPS inlet cable of the TECI. The loop back plug simply loops the GPS data from the internal GPS receiver back into to TECI by connecting pin 4 (output of the internal GPS receiver) to pin 2 (input GPS data into the TECI).

GPS CONNECTION CABLE

The standard GPS cable is provided to connect to most GPS receivers without any problems. The TECI receives the data for the GPS receiver at pins 2 (data) and pin 5 (ground), also at the receiver side pin 2 is data and pin 5 is ground. At the receiver side a few loops are provided to make sure the GPS receiver knows something is connected. These loops are the CTS and RTS loops, pins 1, 4 & 6 to each other and pins 7 & 8 to each other. Without these loops some GPS receivers refuse to send data! Default the receiver side has screw connections but to make sure the system is universal we also provide 2 busses loose with it to be able to change the screws to busses if needed.

MID EXPOSURE PULSE OUTPUT ADAPTOR PLUG

The various leveled mid exposure pulses coming from the TECI are easily connected to an external GPS receiver using the TTL Low plug as provided with the TECI. The plug connects correctly to the corresponding pin (pin 3 for TTL low) at the DB9 connector of the TECI. Also the plug contains some electronics to protect both the GPS receiver and the TECI for any wrong-connection and/or over-power. Another important feature of this plug is the PPS pulse loop, which loops back the PPS pulse from the internal GPS receiver into the TECI. If this plug is not used, the PPS pulse from the internal GPS receiver cannot be used! There are more versions available; TTL high (rising edge), open collector to ground and open collector to power. Please contact us if you want to know more about these options.

BNC-BNC CABLE FOR THE MID EXPOSURE PULSE CONNECTION

The BNC-BNC cable is delivered for easy connection to the event input of your external GPS receiver. Connect it to the TTL of open collector output of your mid exposure pulse adaptor plug and set the GPS receiver accordingly. ***If the GPS receiver is not set properly all events might end up being recorded shifted!!***

GPS ANTENNA, STAND AND THE CONNECTION CABLE

The GPS antenna is provided with a stand for testing, but should of course be placed on the roof of the plane in actual use, best right above the camera to receive an accurate photo position. The cable delivered with it is a standard 4m TNC-BNC cable, which is thin and therefore easily positioned inside the plane.

POWER BREAKBOX AND ADAPTOR

The break box and the cigarette-plug adaptor-cable should only be used for testing purpose. A professional technician should carry out the final installation to your airplane power connection.

USB TO SERIAL CABLE

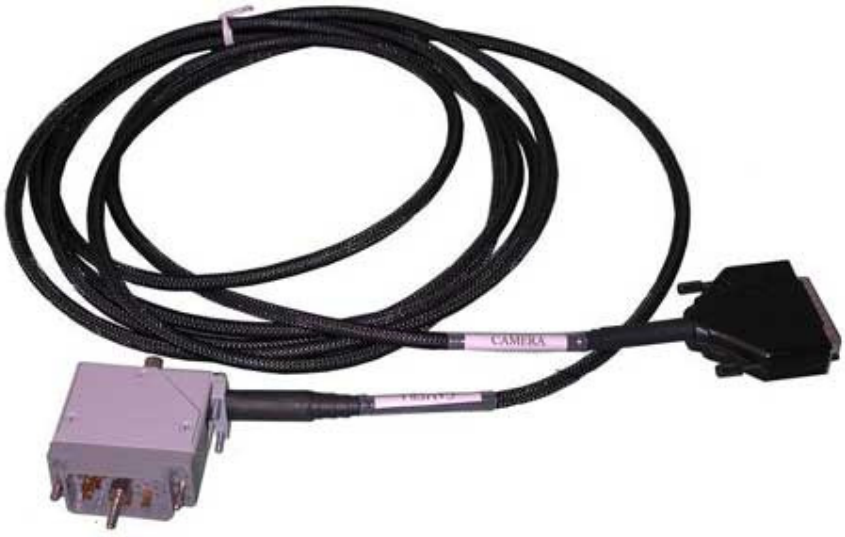
The USB to serial cable is a standard part including manual and software. The DB9 to DB25 adaptor plug is not used with the TRACKER system. The cable is an alternative for laptops that do not have a serial port but do have a USB port. Further in this manual the installation and usage of the USB to serial cable will be explained.

4 - TECI-3 CAMERA CONNECTIONS

In this chapter the more common camera connection cables will be described and the instructions how to install the system in such a way that the best results will be achieved.

RC30 (ALSO RC10A & RC20) CAMERA CONNECTION

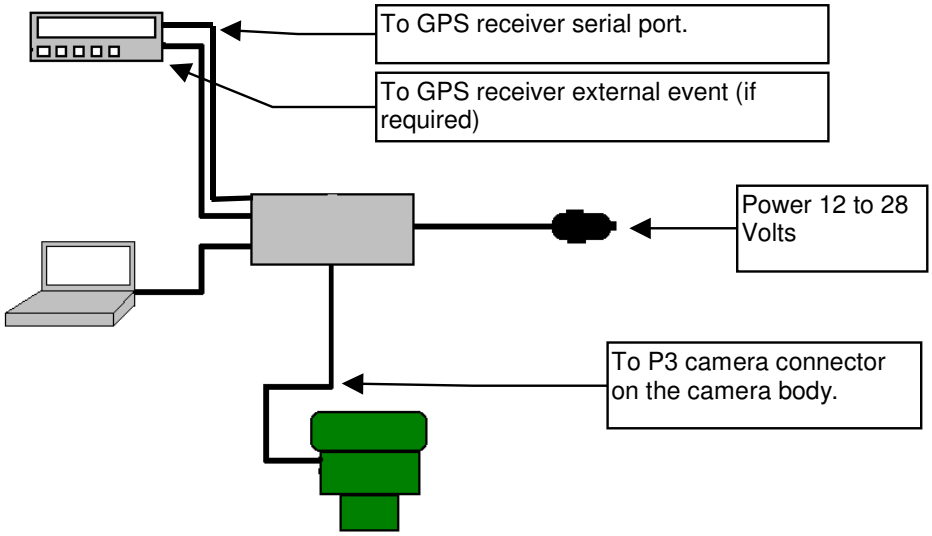
The cable to connect the TECI to the RC30 camera looks like this:



CONNECTION INSTRUCTIONS:

This cable connects to the DB25 CAMERA connector of the TECI and triggers the camera, reads the pulse back from the camera and provides the lines for serial data communication.

Set the camera to spiral 0%. This will cause the camera to report an error. Ignore this message. Do not set the camera on single because surprisingly the FMC does not work in this mode. Regarding the FMC, if your camera is not fitted with the Leica extended EDI interface, then our system cannot send v/h information to the camera and the operator has still to set the spiral manually. An overview:

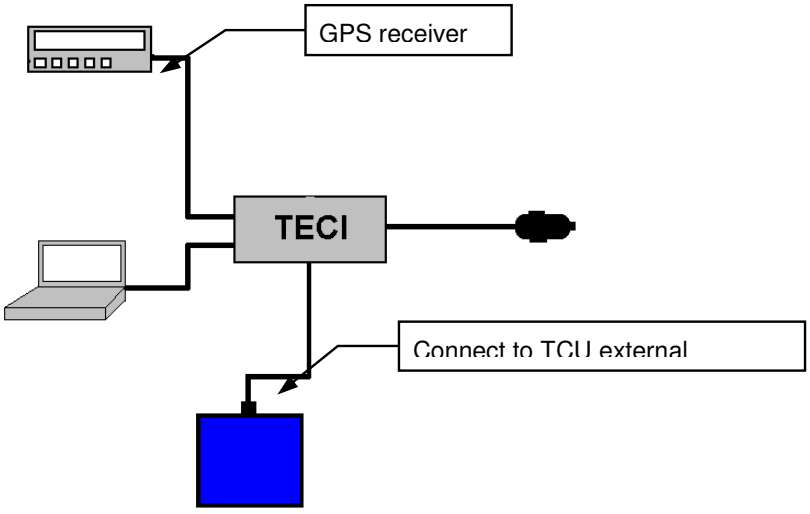


ZEISS TOP CAMERA CONNECTION, STANDARD TYPE, NO T-AS CONTROL

The cable to connect the TECI to the Zeiss TOP camera looks like this:

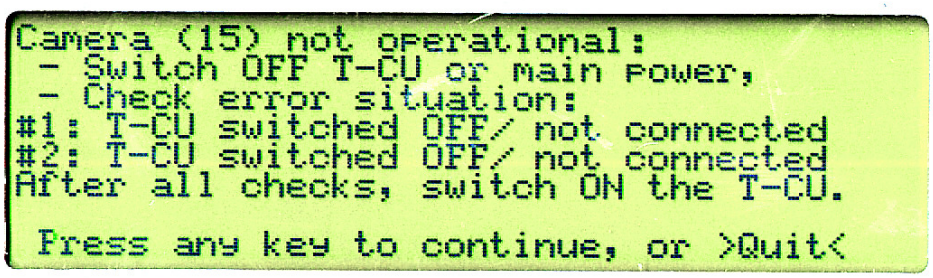
CONNECTION INSTRUCTIONS:

This cable connects directly to the DB25 CAMERA connector on the TECI and triggers the camera, reads the pulse back from the camera and provides the lines for serial data communication. **The TCU External Interface should be set to send a TTL HI mid exposure pulse to the TECI!** An overview:

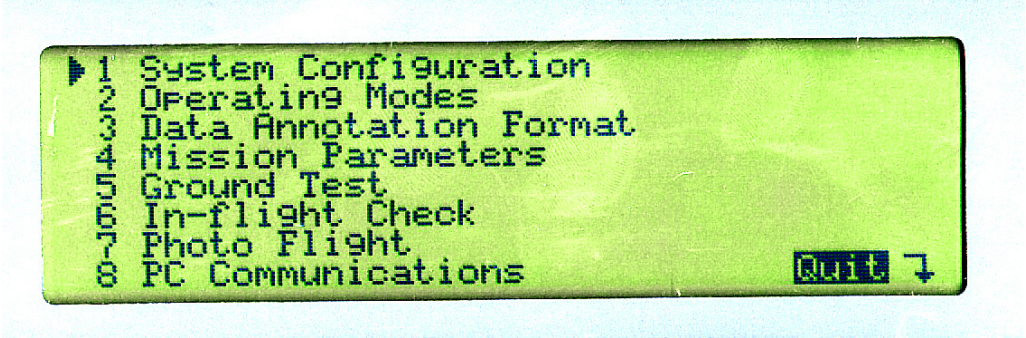


RMK TOP TTL CONFIGURATION:

1) Start the camera

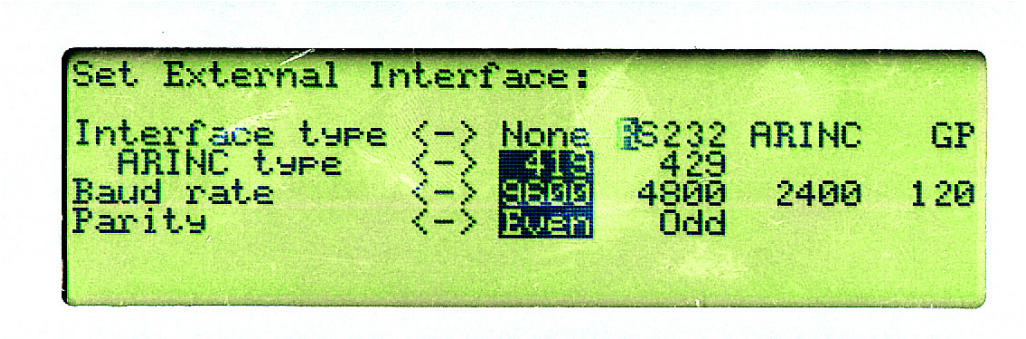


2) Select system configuration



3) Select External interface

4) Configure as follow (RS232 must be selected)

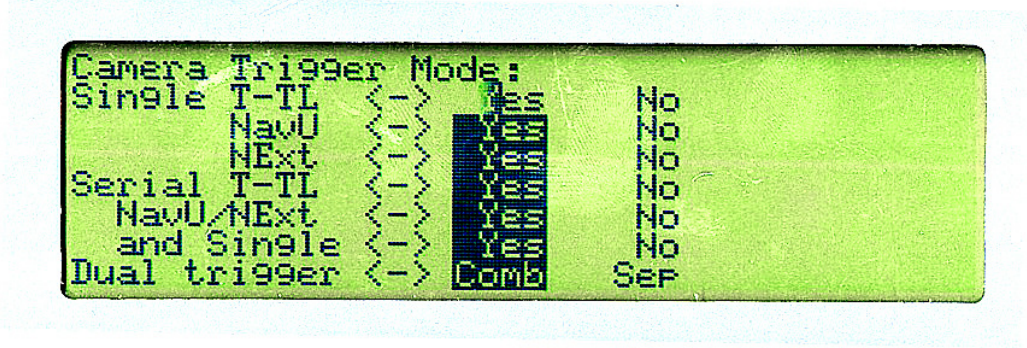


5) Select operating mode menu then select :

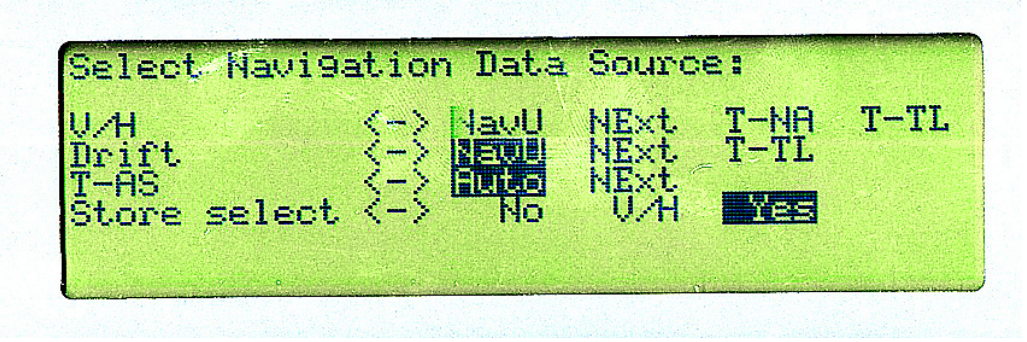
1 General operating mode
> 2 Camera trigger mode
3 Function key mode

4 Navigation data source
5 Exposure profile RMK TOP 15
6 Exposure profile RMK TOP 30

6) Select Camera Trigger mode and configure as follows (Single TTL YES)

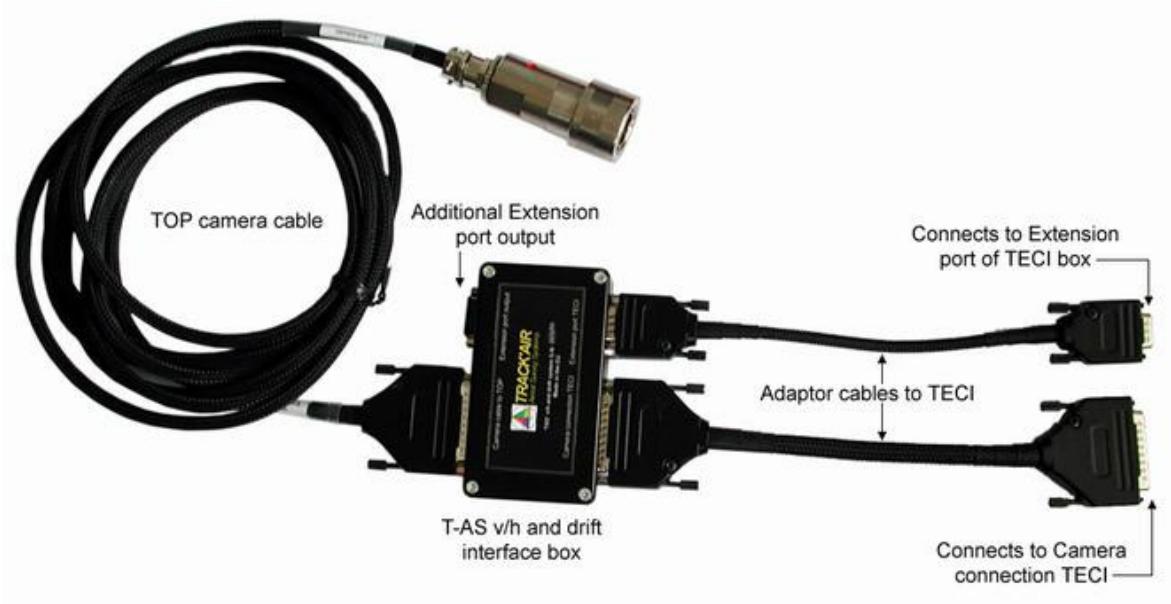


7) Select Navigation data source and configure as follows (V/H should be NavU)



ZEISS TOP CAMERA CONNECTION, T-AS CONTROL SYSTEM

The system that connects the TECI box to the Zeiss TOP camera:



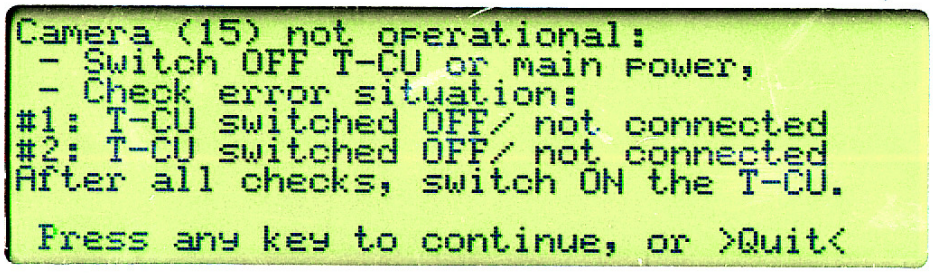
The T-AS interface box does the following:

1) Route the trigger pulse and data annotation from the TECI to the camera and receive the pulse back from the camera and route it to the TECI. This is identical to the standard TOP configuration.
2) Receive serial data via the TECI Extension port and convert this data to analogue v/h and drift data for the T-AS mount.
3) Allow the user to connect an additional device to the Extension port. By default this port is protected with a plastic cap.

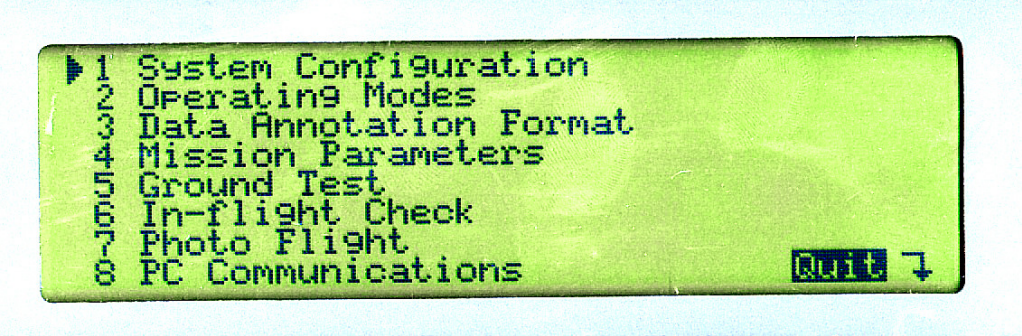
The configuration of the TOP TTL should be different compared to the standard configuration:

RMK TOP TTL CONFIGURATION:

1) Start the camera

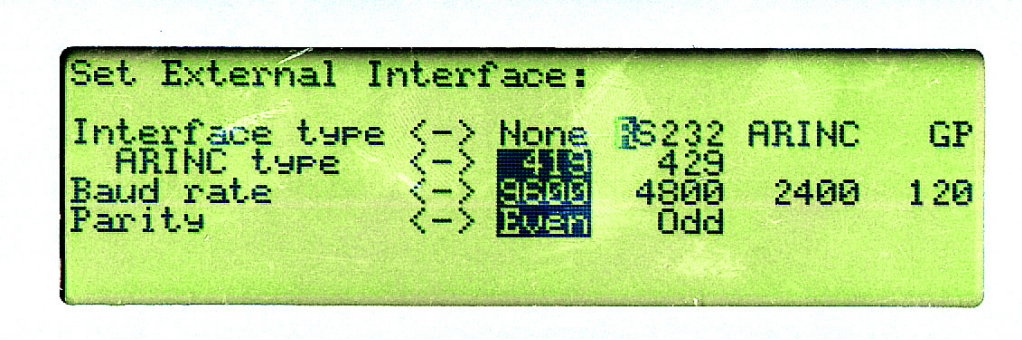


2) Select system configuration



3) Select External interface

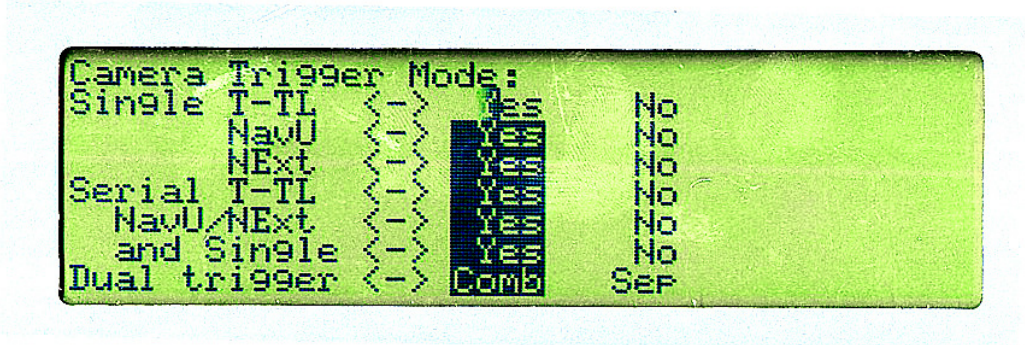
4) Configure as follow (RS232 must be selected)



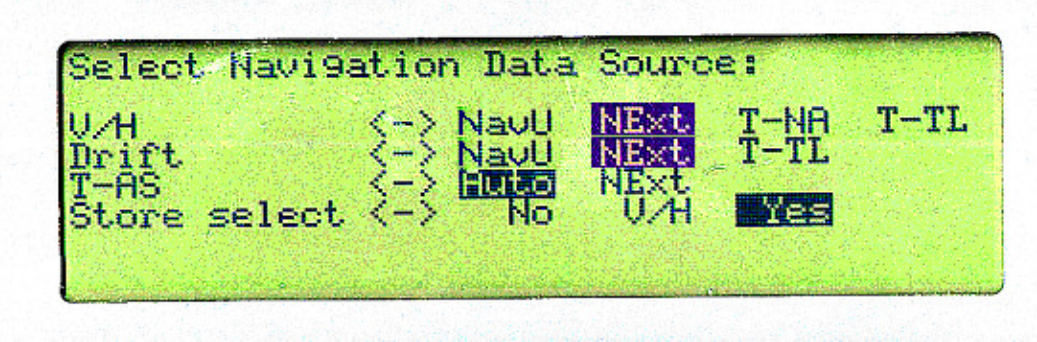
5) Select operating mode menu then select:

1 General operating mode
> 2 Camera trigger mode
3 Function key mode
4 Navigation data source
5 Exposure profile RMK TOP 15
6 Exposure profile RMK TOP 30

6) Select Camera Trigger mode and configure as follows (Single TTL YES)



7b) This system is equipped with the v/h and drift control box and the settings should be set to receive v/h and drift information from an external source (NExt):

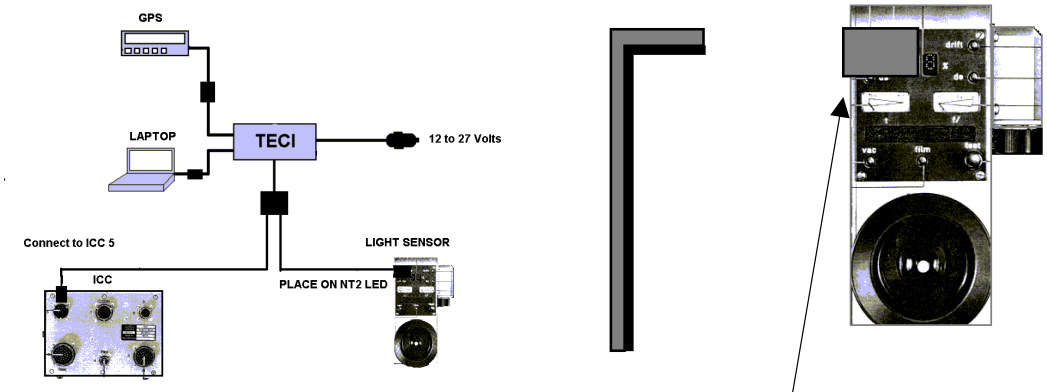


RMK A (ICC) CAMERA CONNECTION

The cable to connect the TECI to the ICC box of the RMK-A camera looks like this:

CONNECTION INSTRUCTIONS: WITH EXTERNAL SENSOR

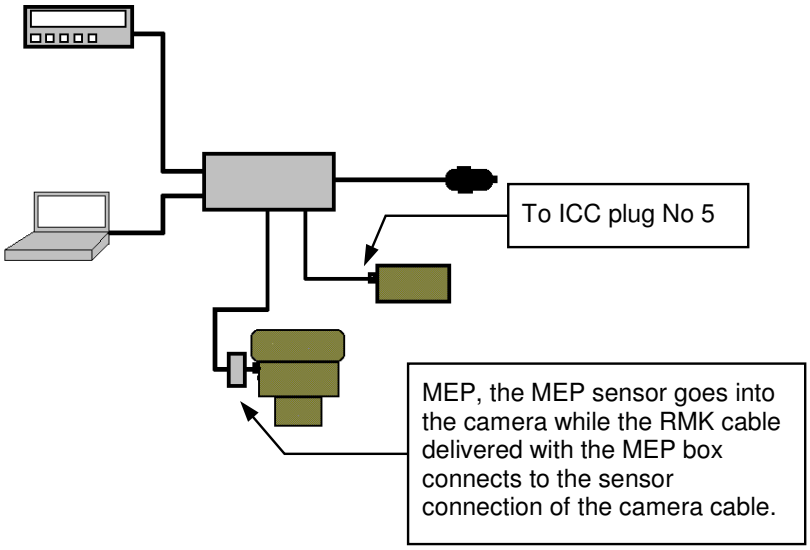
This cable connects to the DB25 CAMERA connector of the TECI and triggers the camera and reads the pulse back from the camera. There are two ways to detect if the camera made a photo. Both ways connect to the DB9 connector of the Y cable shown above. The first, standard, option is using the 'RMK external sensor'; a sensor including a small amplifier placed on top of the NT2 LED indicating that the camera is making a photo. The sensor amplifier is placed between the sensor cable and the sensor connection of the camera cable. Default the sensor amplifier will already be connected to the sensor cable. See installation instructions below:



RMK external sensor:
Place the Velcro on the NT2 and stick the sensor bracket on it, so that the sensor faces exactly the impulse LED.

CONNECTION INSTRUCTIONS: WITH MEP GENERATOR

The second option is using the Track'Air MEP (mid exposure pulse) generator for creating a pulse back from the camera. This option is for sure the best option since the MEP generator creates an exposure pulse in the exact middle of the exposure of the camera, using a microprocessor-controlled system together with a sensor, which is placed in the core of the camera. The RMK connection cable delivered with the MEP connects directly to the DB9 sensor connector of the camera cable. In the MEP manual (also delivered with the MEP) the installation instructions for the RMK type MEP are described. A global overview:



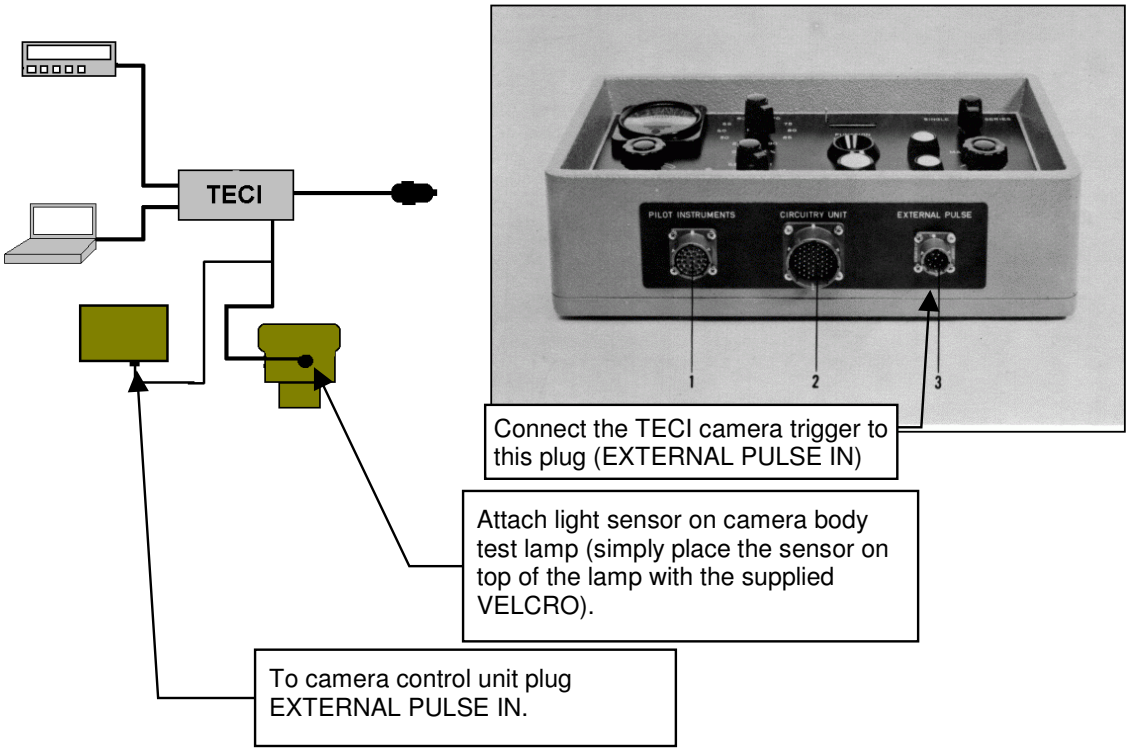
For further details we'd like to refer to the MEP manual or please contact us if you have any questions.

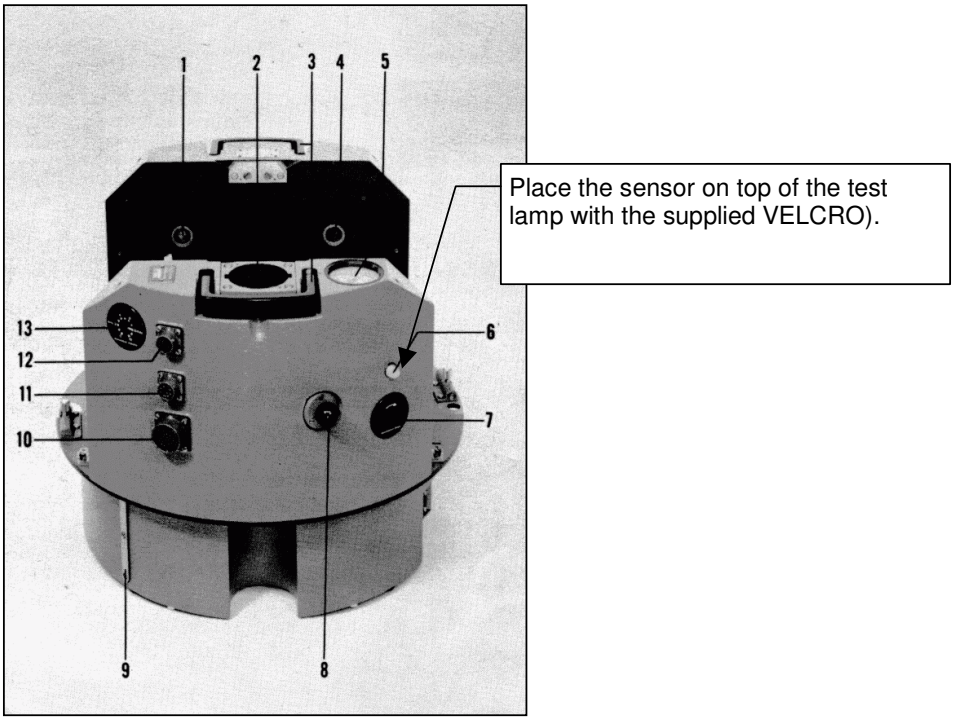
RC10 CAMERA CONNECTION

The cable to connect the TECI to the RC10 camera looks like this:

CONNECTION INSTRUCTIONS: WITH EXTERNAL SENSOR

This cable connects to the DB25 CAMERA connector of the TECI and triggers the camera and reads the pulse back from the camera. There are two ways to detect if the camera made a photo. Both ways connect to the DB9 connector of the Y cable shown above. The first, standard, option is using the 'RC10 external sensor'; a sensor including a small amplifier placed on top of the light bulb indicating that the camera is making a photo. The sensor amplifier is placed between the sensor cable and the sensor connection of the camera cable. Default the sensor amplifier will already be connected to the sensor cable. See installation instructions below:





CONNECTION INSTRUCTIONS: WITH MEP GENERATOR

The second option is using the Track'Air MEP (mid exposure pulse) generator for creating a pulse back from the camera. This option is for sure the best option since the MEP generator creates an exposure pulse in the exact middle of the exposure of the camera, using a microprocessor-controlled system together with a sensor, which both are placed inside the camera. The wiring of the MEP generator will be attached to the inner wiring of the RC10 camera. RC10 connection cable delivered with the MEP connects directly to the HORIZON plug of the camera and the other side to the DB9 sensor connector of the camera cable. In the MEP manual (also delivered with the MEP) the installation instructions for the RC10 type MEP are described. For further details we'd like to refer to the MEP manual or please contact us if you have any questions.

NOTE:

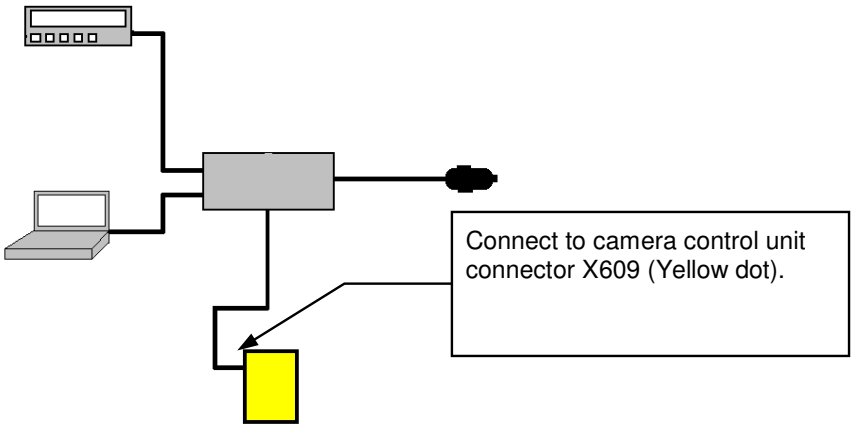
Always set the camera to single mode for automatic camera triggering!
Always power the TECI with the same voltage as the camera (24-28 Volts)

LMK1000 CAMERA CONNECTION

The cable to connect the TECI to the LMK1000 camera looks like this:

CONNECTION INSTRUCTIONS:

This cable connects to the DB25 CAMERA connector of the TECI and triggers the camera & reads the pulse back from the camera. An overview:



LMK2000 CAMERA CONNECTION

The LMK2000 connection to the TRACKER system requires a special interfacing box. This box deals with the conversion from the TECI box 'pulses' to serial communication with the camera. The interface box is attached to the TECI box with special clips (see image). It has the same size as the TECI box and has to be connected to the TECI as follows:

1) The DB25 female CAMERA connection of the TECI box is connected to the DB25 male cable on the LMK2000 box, which is marked with a "to CAMERA connection TECI" label.
2) The DB9 female EXTENSION PORT connection of the TECI box is connected to the DB9 male cable on the LMK2000 box, which is marked with a 'to EXTENSION connection TECI' label.
3) The LMK2000 camera cable (see image) is connected to the DB25 female 'LMK2000 CAMERA' connection, which is situated on the back of the LMK2000 box.
4) The DB9 female connector of the box is the 'EXTENSION' connection, which is looped trough the LMK2000 box. It allows users to connect additional interface boxes or the 'CDI' display (out of production). This connector is protected with a plastic cap.

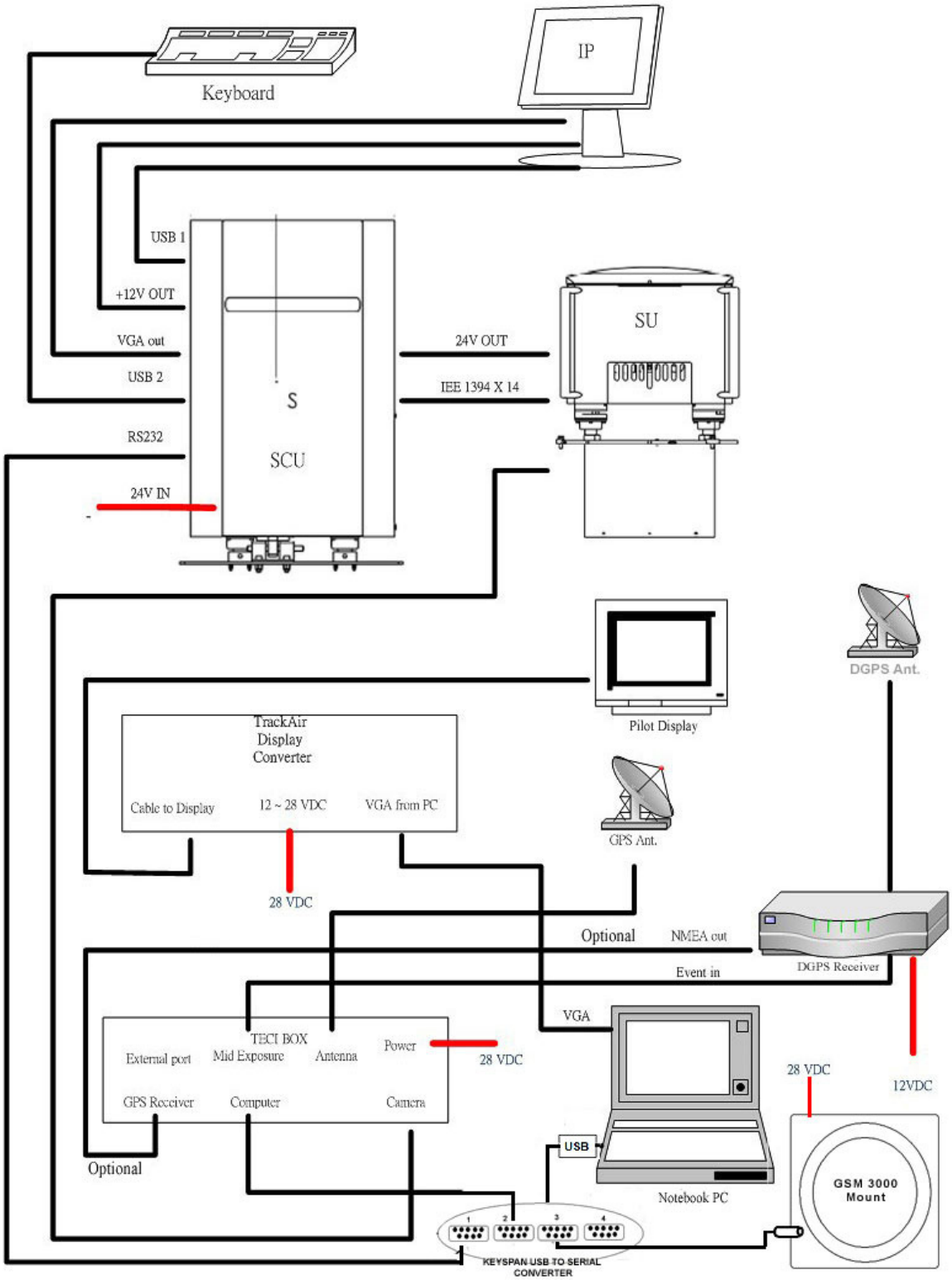
NOTE: The LMK2000 box can only be used for controlling LMK2000 cameras. All other camera systems have to be connected directly to the CAMERA connection of the TECI box!

Image of LMK2000 interfacing box attached to the TECI system:

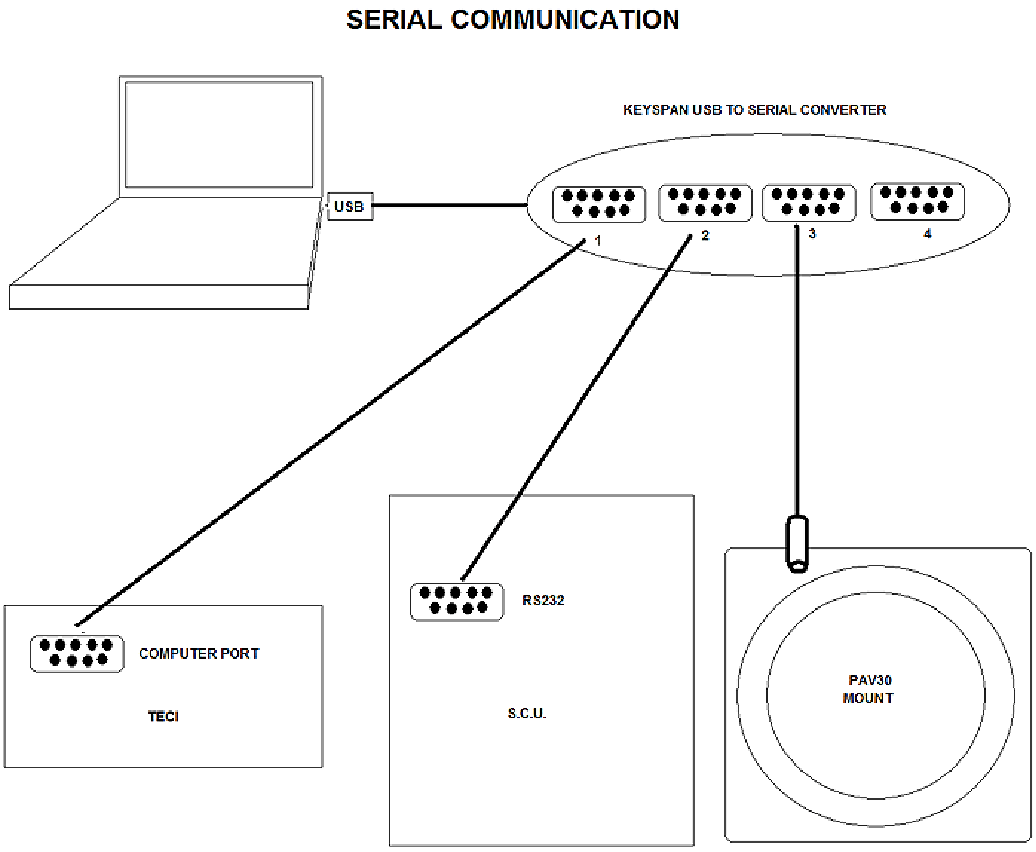
Image of the LMK2000 camera cable, to be attached to the LMK2000 CAMERA connection on the LMK2000 interface box:

VEXCEL ULTRACAM CONNECTION

Connect the hardware according to the wiring diagram:



Connections to the KEYSPAN USB to serial converter (or other multiple serial port system):



Connection to the VexCel Storage & Computing Unit:

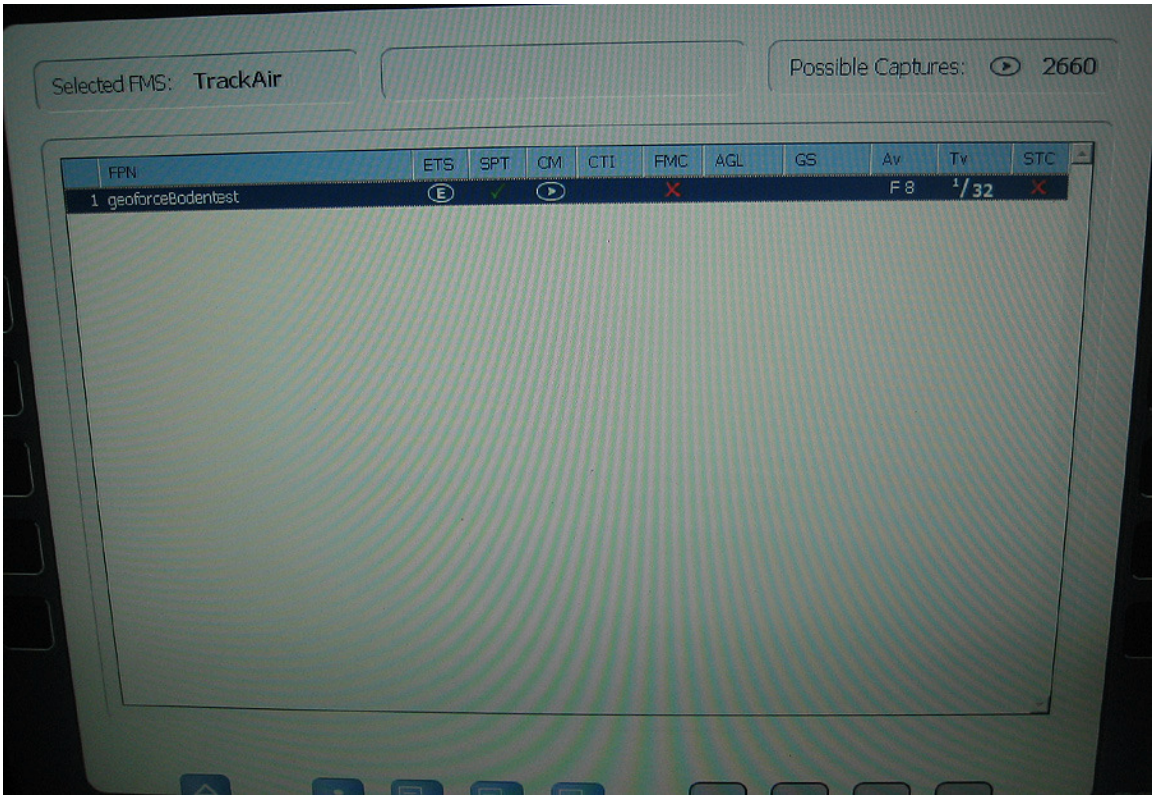
Connection to the VexCel SU:

Procedure for VexCel UltraCam:

Switch on SCU and wait for starting screen on the VexCel Monitor:

- Select Prepare
- Select FMS > TrackAir
- press escape to go back to Prepare

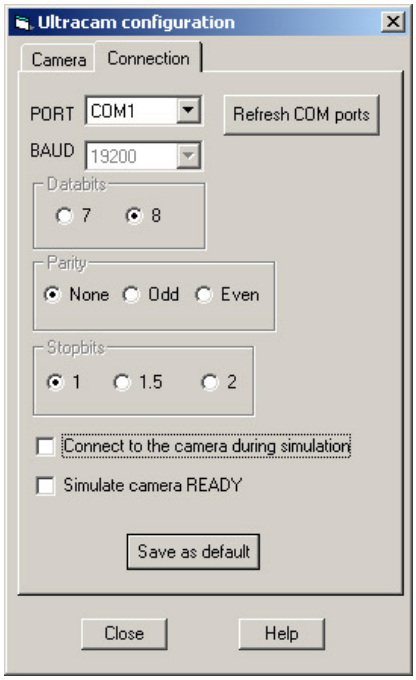
On the Monitor use F6 and Tools to create a new FPN:



- press escape
- select FPN

  UltraCam is searching for TrackAir

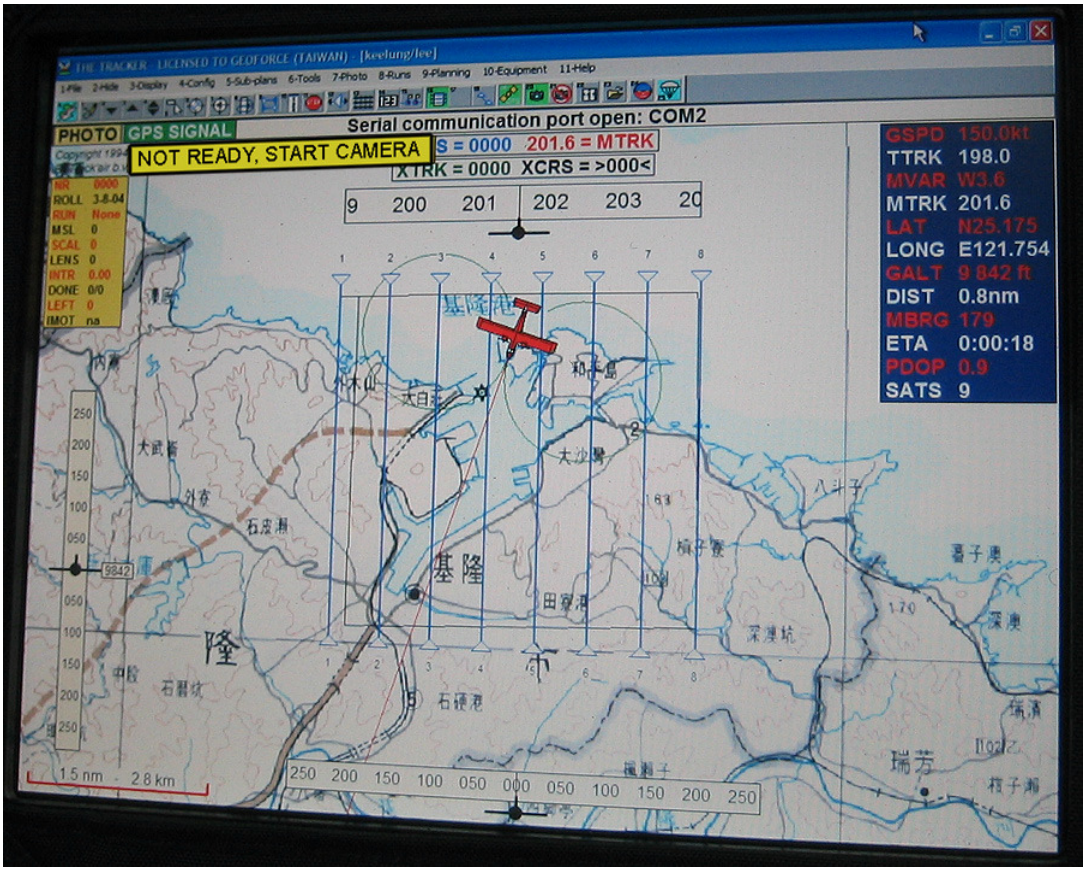
  in XTRACK



- Start snapSHOT
- Detect and view COM-port assignments
  (Menu 6-Tools > 6-Locate COM ports)
- configure the right port for the UltraCam in snapshot Ultracam configuration
  (Menu 10-Equipment > 5-Vexcel ULTRACAM)
- start GPS Connection (snapSHOT Icon 19)

  Now the communication should take place and the red 'Warning (ULTRACAM NOT CONNECTED)' should disappear.

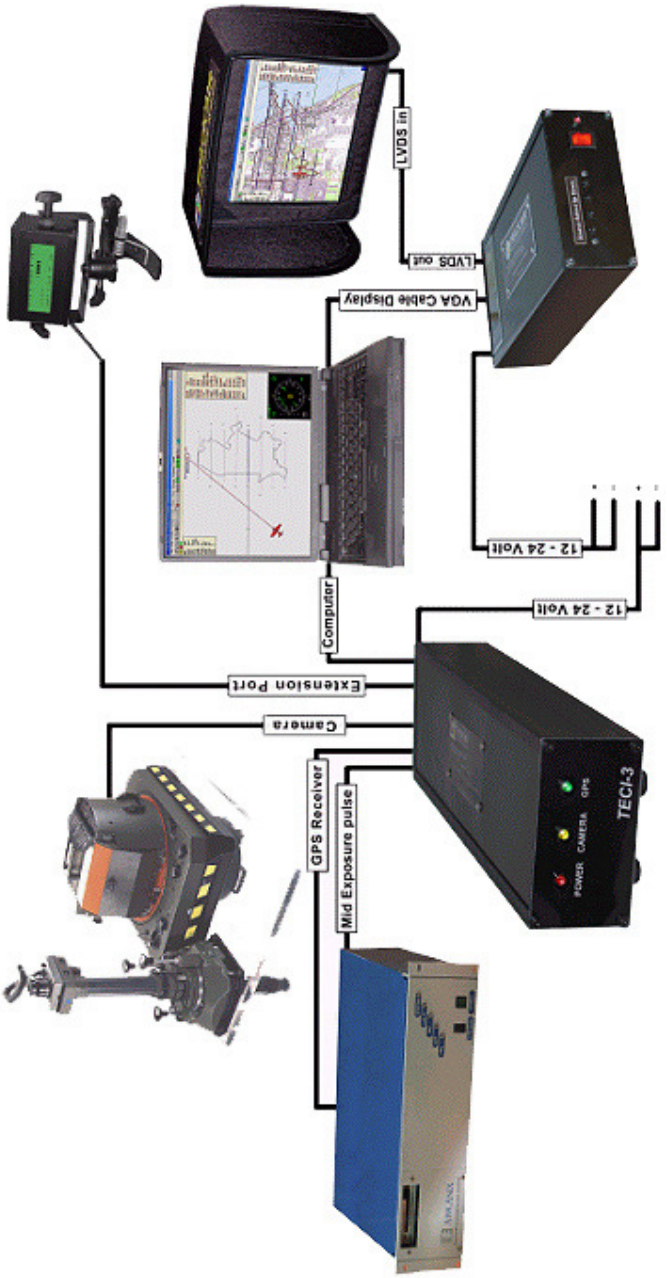
Now start the VexCel UltraCam.

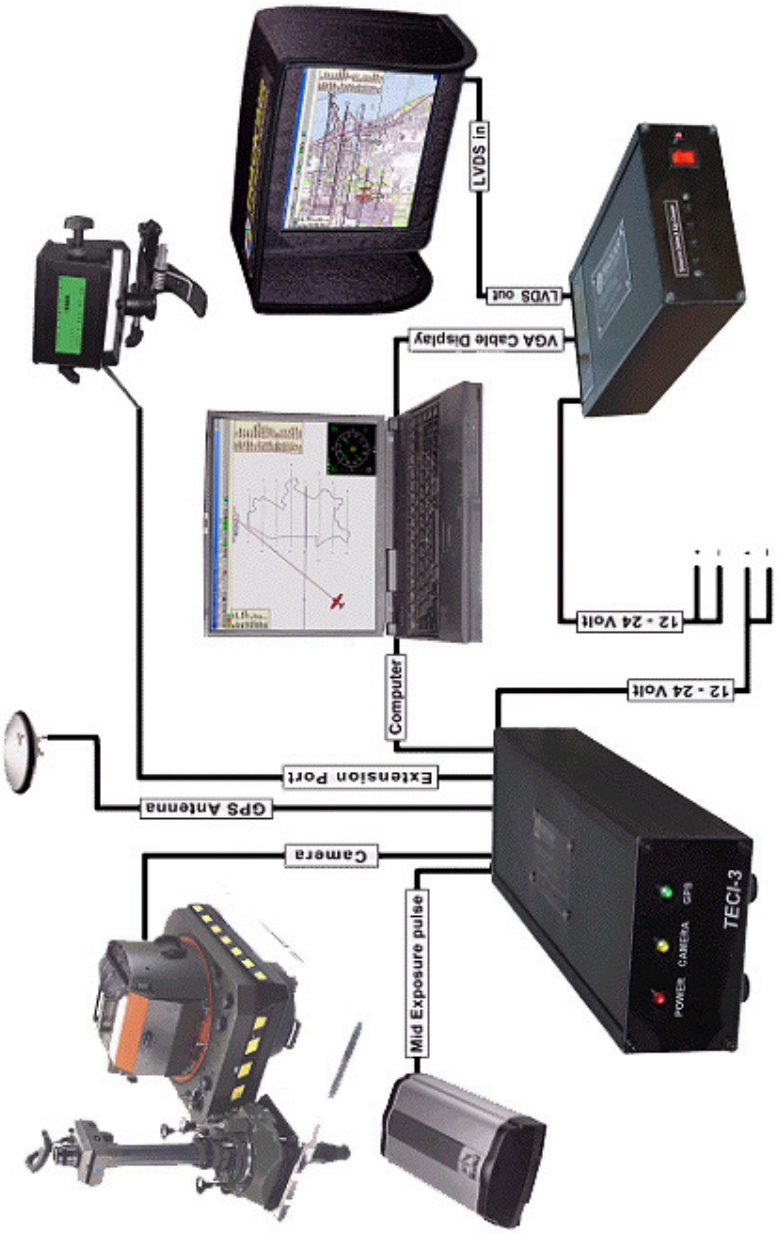


Other camera connections

There are many more cameras that can be triggered by the TRACKER system. It would make this manual enormous bulky if all camera kits ever made for the TRACKER system would be described here. Per camera connection kit that is not described here we'll provide a small description how to connect it to the TECI-3 system, but most kits are pretty obvious and can be connected easily. Always make sure that while (dis) connecting cables both the camera (GPS receiver, computer and so on) as the TECI are switched off.

EXAMPLE CONNECTION DIAGRAMS

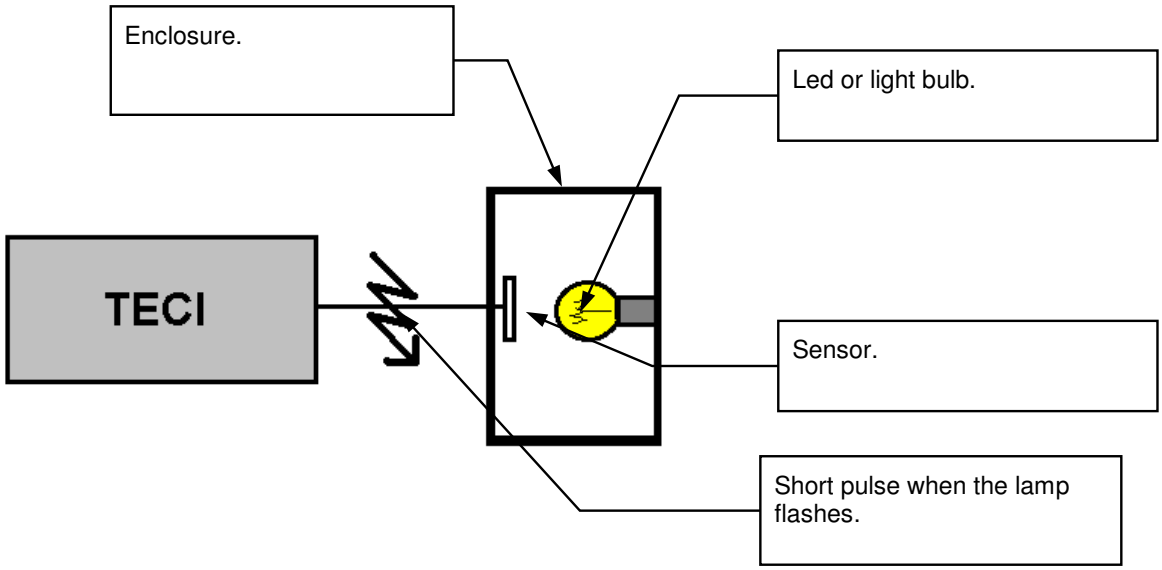



LVDS in
LVDS out
VGA Cable Display
12 - 24 Volt
12 - 24 Volt
Computer
Extension Port
GPS Antenna
Camera
Mid Exposure pulse
TECH-3
POWER
CAMERA
GPS

5 - EXTERNAL EXPOSURE PULSE SENSOR

For the purpose of creating a mid exposure pulse for camera which do not have a built in pulse, the TECI is delivered with a external light sensor which can be conveniently placed on the camera 'exposure' light-bulb or LED. Most cameras have a visual indicator showing that the exposure is taking place. These indicators, which generally flash at the same time as the fiducial lamps, are very reliable and quite accurate. Tracker uses this feature to create a pulse, which is accurate enough to generate a good index. Note that the pulse is not as accurate as a mid exposure pulse generator inside other cameras or the Track'Air mid exposure generator!

PRINCIPLE



RC10
Place the sensor above the white bulb on the camera body. To check the fiducial marks, the red LED on the TECI should flash each time a photo is fired. Make sure that absolutely no light reaches the sensor (use black tape).

RMK
Place the sensor on the navigation telescope, directly above the red LED marked pulse. This is the most accurate pulse available with this camera. Make sure that absolutely no light reaches the sensor (use black tape).

RC8/9

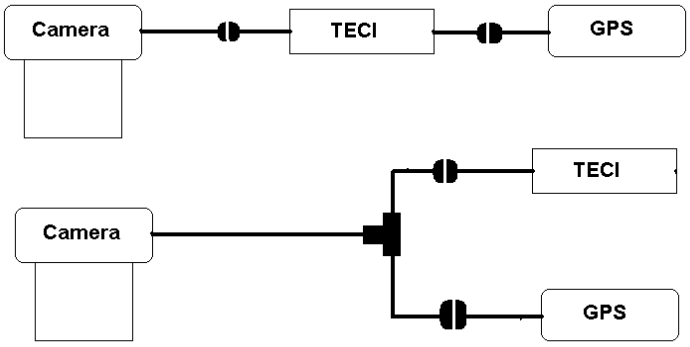
Place the sensor over the green lamp on the control unit. Make sure that absolutely no light reaches the sensor (use black tape).

6 - MID EXPOSURE ACCURACY

Last updated 11 February 2002

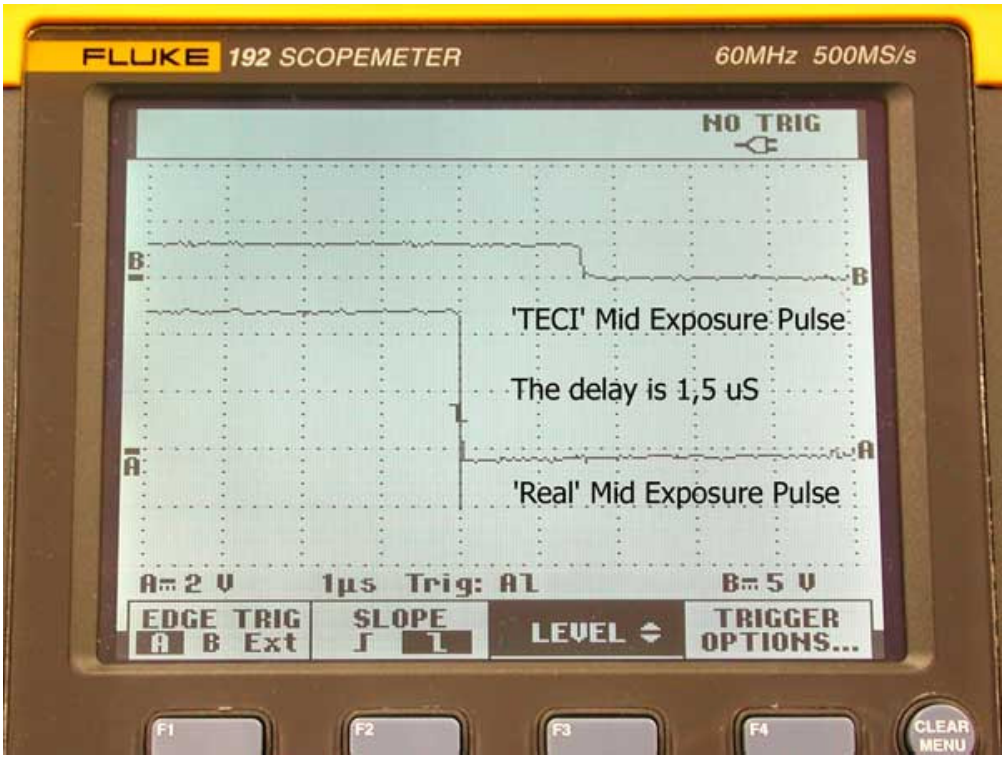
ROUTING THE CAMERA MID EXPOSURE PULSE

In order to log the camera mid exposure pulse in a geodetic GPS receiver, it is either possible to route the camera mid exposure pulse through the TECI box or to connect the GPS receiver directly to the camera by using a cable splitter. The results are practically identical.



DELAY INTRODUCED BY THE TECI

In case the pulse is routed via the TECI, the issue of how much delay is caused by the TECI is often raised. Basically, the TECI does not introduce any significant delay besides the normal slow down caused by cable length and electronic components. The following image shows an oscilloscope comparison of the original pulse and of the pulse after the TECI with 4 meters of coax cable. The lag introduced by the TECI circuit is 1.5 microsecond, which for our purposes is considered as being negligible.



7 - TECI - GPS RECEIVER CONNECTIONS

On delivery your TECI system is already equipped with a Garmin GPS receiver inside the TECI box. Using this GPS receiver is quite simple and convenient. The signal of the internal GPS receiver is outputted at the GPS connector of the TECI and in use looped back to pin 2 of the same connector to input the data into the TECI. The GPS receiver is fully tested and pre-programmed to output the correct data. Just place the GPS loop back plug on the connector, connect the GPS antenna and put it in place. Inside the snapshot program configure the software to expect a Garmin 25 message and off you go. Starting end summer 2003 all TECI's will be equipped with the WAAS enabled Garmin 15 GPS receiver. Until then the TECI is equipped with the Garmin 25 GPS. Both GPS receivers (Garmin 15 & 25) allow the user to input (RTCM-)DGPS data for a more accurate positioning. Please contact us about the possibilities.

The TECI can be connected to any GPS receiver providing it output a position message, which can be decoded by our software. Default Track'Air delivers a 'standard' GPS data connection cable, but in some cases a special cable is required. Be aware that the signal should eventually be inputted at pin 2 of the GPS cable of the TECI. Pin 5 is ground. On request Track'Air might be able to deliver the corresponding GPS data connection cable and/or the cabling needed to receive PPS pulses from the GPS receiver or input event marks into the GPS receiver. Note that Track'Air cannot keep a stock of all cables that might be required, so keep in mind that a longer delivery time might apply on order.

A few GPS configurations are described below:

GARMIN 16 ADAPTOR & CABLE & PROGRAMMING

Last updated April 07, 2003

Since the introduction of the WAAS system in the U.S.A. a number of clients have been asking us to implement a WAAS enabled GPS-receiver to the TRACKER system. Garmin offers a GPS receiver (Garmin 15) that could replace the Garmin 25 inside the TECI; this requires an adaptation of the hardware and clients then need to return their equipment to change the GPS receiver inside, which might turn out to be very costly. There is also an option to use a WAAS enabled *external* GPS receiver. We've done some testing on the Garmin 16 GPS receiver and figured that this might be the quickest and easiest solution for this problem. Track' Air has developed an adaptor and a cable to connect the Garmin 16 to the TECI. To be able to use the GPS receiver as it comes from the factory (default configuration) you should **set the Snapshot GPS configuration** to the **Garmin195** receiver, the data send by the Garmin 16 is identical to this GPS receiver. It is possible to reprogram the receiver to send a different type of string if required or in case of faulty programming to reset it to send proper data again. Please contact us to learn more about the possibilities to reprogram your Garmin16 GPS receiver.

Below a few other GPS receivers are described.

GARMIN 100

Setup
IMPORTANT!
Set the receiver to send NMEA 183 messages.
Set the ellipsoid to WGS 84.
Refer to the manual to how this done,

Garmin 100 GPS cable.
The system is delivered with 1 special cable for the Garmin 100 which allows you to use the system with the GPS outside of its aviation panel rack. To do so, pull the GPS and connect it to the cable. Connect the cable to the airplane power supply and to the computer. Use the antenna extension to connect the Garmin to the antenna connector inside the rack.

For a permanent installation in the rack you should have your avionics engineer connect the GPS cable which comes out of the TECI to the rack. The connections are as follows:

GPS DATA: PIN 2
GROUND: PIN 5

TRIMBLE 4000SSE

Without NMEA
Set the receiver to send the cycle printout message. Please refer to the receiver manual.
The only required message is the **POSITION CALCULATION**, disable all the others.
From the control menu, select CYCLE PRINTOUTS
Format [ASCII]
Enable [port 2]

Baud rate 9600, no parity, 8 bits, 1 stop bit.
All flow control protocol disabled.

Warning. If your laptop is not powerful enough, you might have problem with 2 messages per seconds. In this case you can set snapSHOT to ignore each other message. Please contact us to find out how this is done.

Select the T4SSE GPS receiver from the snapSHOT CONFIG>GPS CONNECTIONS CONFIGURATION menu.

With NMEA.
Set the receiver to send the NMEA message. Please refer to the receiver manual.
The only required messages are VTG and GGA, disable all the others.

Baud rate 9600, no parity, 8 bits, 1 stop bit.
All flow control protocol disabled.

Warning. If your laptop is not powerful enough, you might have problem with 2 messages per seconds. In this case you can set snapSHOT to ignore each other message. Please contact us to find out how this is done.

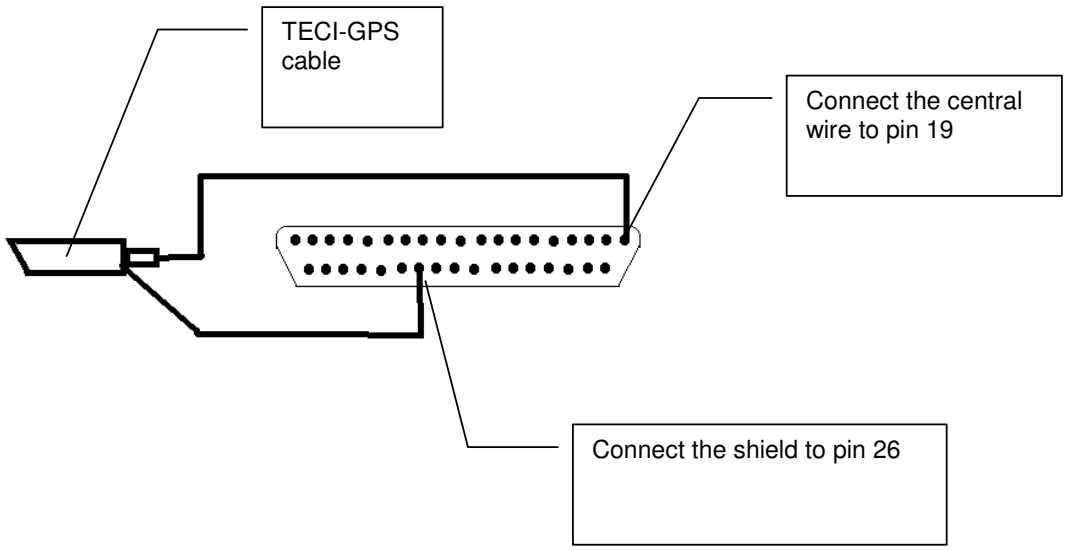
Select the T4000 GPS receiver from the snapSHOT CONFIG>GPS CONNECTIONS CONFIGURATION menu.

GARMIN 150

A) Set the receiver to send NMEA position messages

1) Turn OFF the receiver
2) While pressing and holding down the ENTER key, turn the receiver ON
3) The receiver is now in TEST mode
4) Turn the outer knob until the I/O CHANNEL 2 page is displayed
5) Hit the CRSR cursor key
6) The screen will flash
7) Turn the outer knob until the field next to OUTPUT is flashing
8) Turn the small knob until the word PLOTTING appears.
9) Hit the ENTER key
10) To the right a number will be displayed. Turn the small knob until number 4800 is displayed.
11) Turn OFF the receiver and turn it back ON

Connections



Start snapshot, select the GARMIN 100 (not Garmin 155) and try the system.

MID EXPOSURE PULSE

If you wish to send the mid exposure pulse to a geodetic receiver, you must connect the TECI mid exposure pulse connector to the GPS external event connector. Unless otherwise indicated, the serial cable, which is only used for the GPS positions, never transmits the pulse mark, so you will need a second connection between TECI and the GPS. Please read more about it in the description of the 'default' components delivered with the TECI system.

TRIMBLE 2000 GPS RECEIVER

Set the receiver on 9600 baud, no parity, 8 bits, 1 stop bit.
Select the **X1** (X RAY ONE) output format.

The displayed message should precisely match the format below, including a carriage return and line feed after each item:

□GDA
AN 49 5773
BE 008 3835
C352
D000
E000507
F----
GL0002
HL0002
I3303
J21
KEDDF
L3305
M 0
P000
QE000
c005
T----------
d---
e---
i15/04/94
j10:19:07
s020000
tA

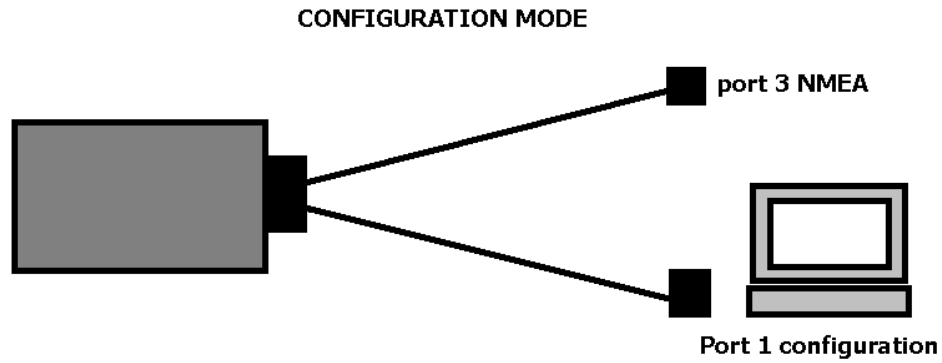
kN 51 50.51227 W 003 37.31128 209.5
l18113.8 ------- -------
m090.00 330.29 L 0.01573 L 0.18
n -0.0 ---- ---- ----
o   5.06587 330.468 --:--:--
p10:19:07.00 +1.0
qR000 0#
r10:19:07.564
u0 .565
zG GPS-3D:0 LOR:0
TGT7175578

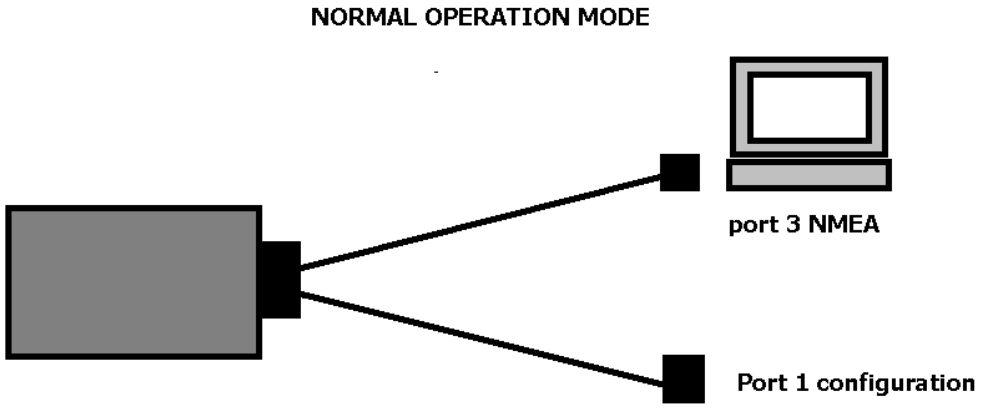
LEiCA MX9212

Setting the MX9212 requires a bit of patience. Please refer to the GPS manual for more information

The GPS is to be configured via a computer.

- Connect the “Y” cable to the GPS multiport connector. Power the GPS
- Connect the “Y” cable marked PORT1 to a computer serial port
- Start the CDU406.EXE program
- Let the computer establish communication with the CDU program

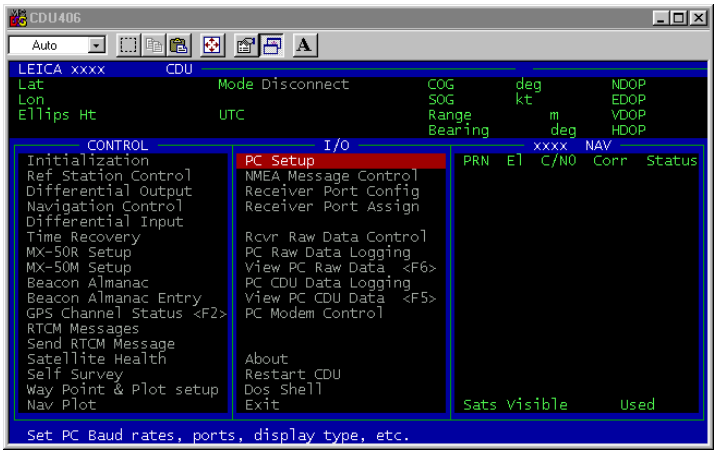


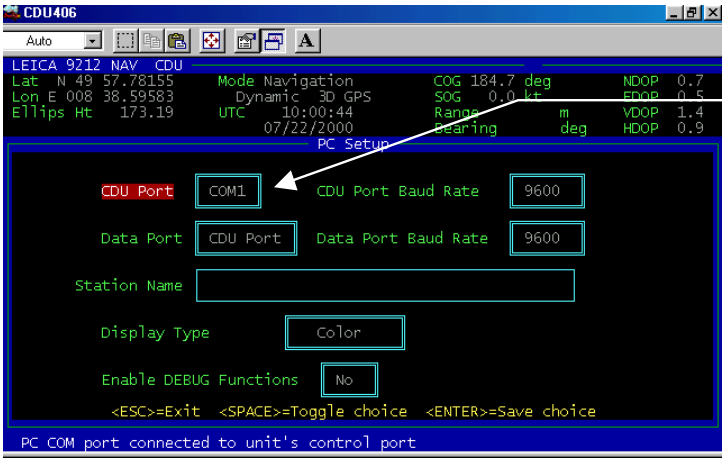


If the computer cannot establish communication, make sure that all the parameters; COM-port, baud-rate, etc. are matching.

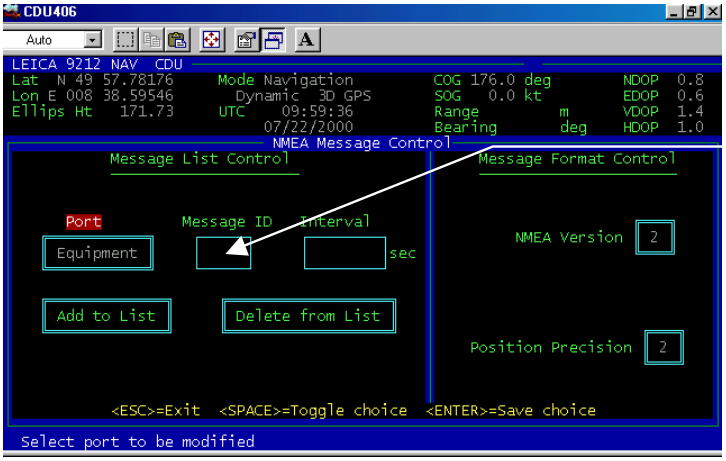
MX9212 configuration

The following screen will be shown. You have to go through the first 4 I/O configuration menu and set them as follows:



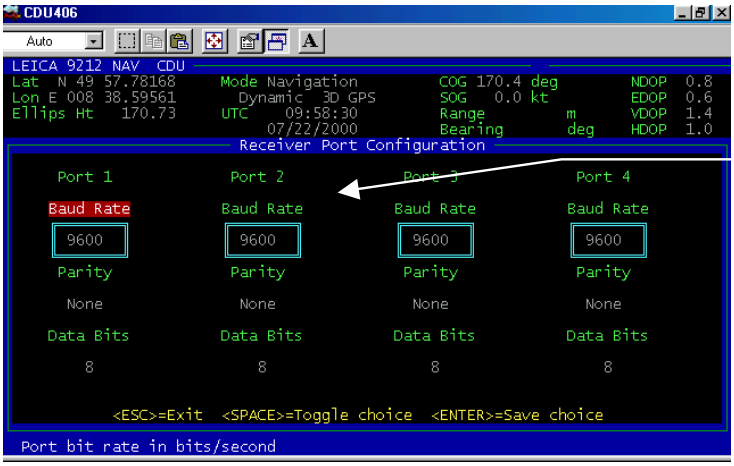


Set the CDU port to COM1 and the Data port to CDU port
Baud rate 9600

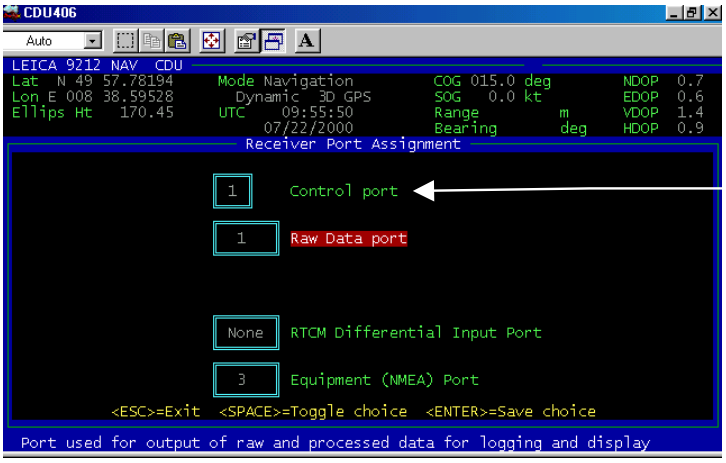


Type GGA then select add to list
Type VTG then select add to list
If other messages are output, then delete them.

Select MEA version 2
Select Position precision 2



Set all ports to
9600
no parity
8 data bits



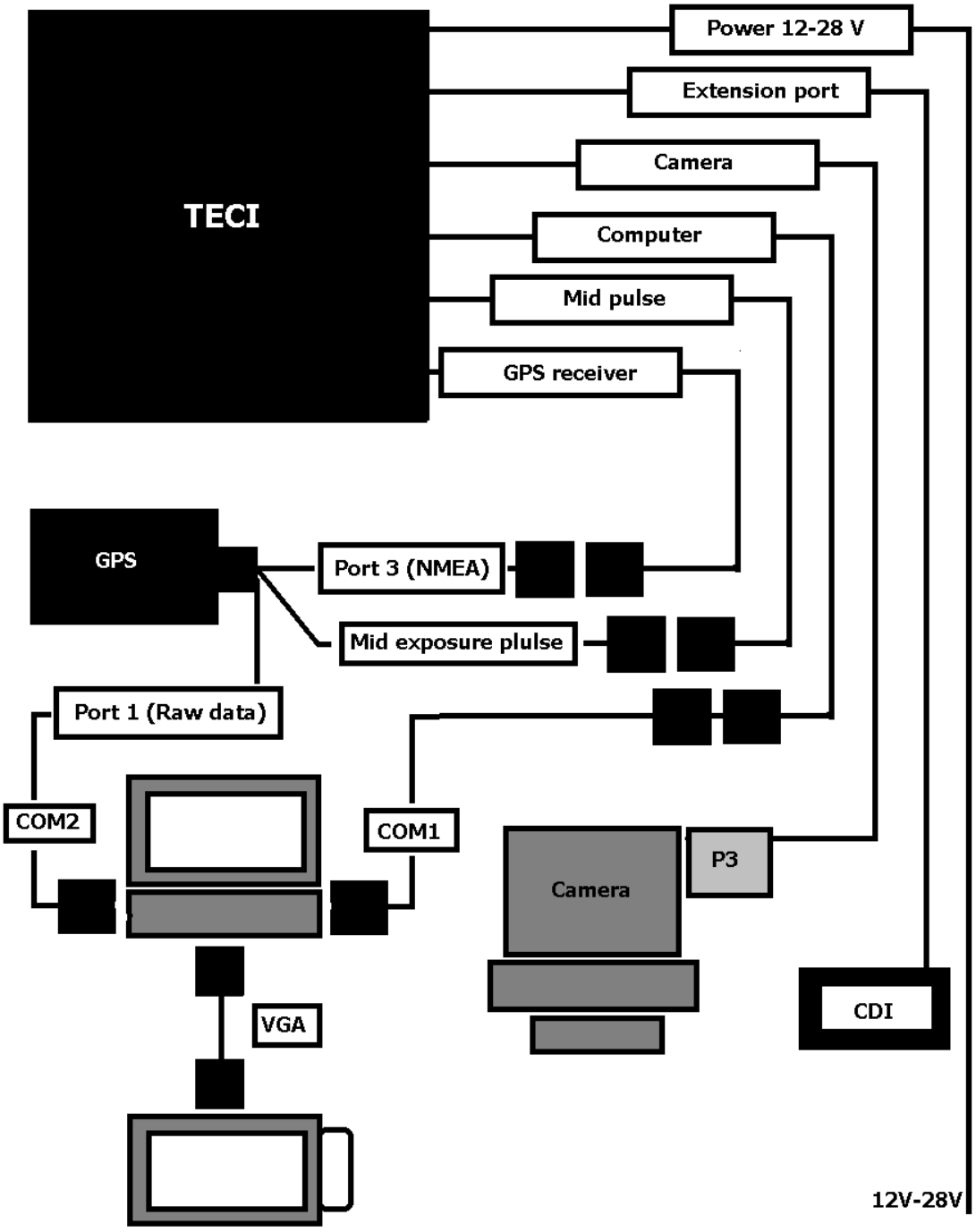
Assign control port to port 1
Assign raw data to port 1
Assign RTCM to none
Assign NMEA to port 3

Once this done, close the CDU, disconnect the port1 from the computer.
To operate with tracker

1. Connect the “Y” cable marked port 3 to the TECI GPS input. The pot 1 is not used for normal operation
2. Start snapSHOT and select the MX9212 GPS if it is not already selected.
3. Open the com port and proceed as usual.

For recording of raw data and logging of photo position, use port 3 cable and an additonal PCMCIA serial port installed in the laptop. Ask Track’air for more information.

Connection of an RC30 and MX9212 Leica receiver with raw data recording



WARNING: GPS RECEIVERS AND WGS84 ISSUE

WARNING:

- ***ALLWAYS CONFIGURE YOUR GPS TO SEND COORDINATES BASED ON THE WGS84 ELLIPSOID.***
- ***SNAPSHOT EXPECTS TO RECEIVE GPS COORDINATES IN WGS84 ONLY!***
- ***SOME GPS RECEIVER ARE ABLE TO OUPUT COORDINATES BASED ON LOCAL ELIPSOIDS, USING THESE ELIPSOIDS WILL RESULT IN A SHIFTED PHOTO FLIGHT!***

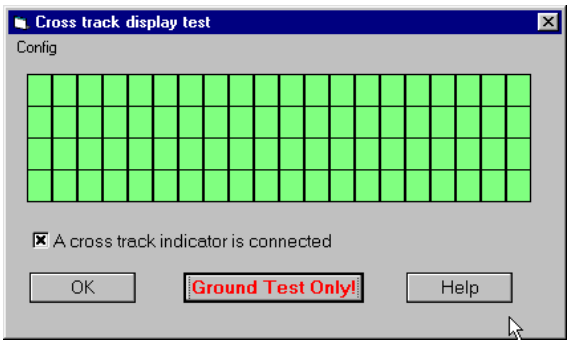
8 - PILOT CROSS TRACK DEVIATION INDICATOR

Last updated 18 June 2003

If the system is not delivered with a pilot screen we usually deliver the system with a small CDI display. This display is not considered being an ideal solution as the system is designed for usage with a full graphic pilot display, but it does the trick.

To connect the display, simply attach it to the EXTENSION port of the TECI box, this port usually is protected with a plastic cap; remove this cap to connect the CDI.

To use the display, you must first activate it via software. In snapSHOT, select the ***Tools*** menu, then the ***Show cross track LCD form*** menu. Check the option ***A cross track indicator is connected***



9 - USB TO SERIAL ADAPTOR INSTALLATION

Last updated 18 April 2003

Since the introduction of the USB communication port more and more laptops are not anymore supplied with one or more RS232 serial ports, but with (a) USB port(s) instead. Since the current TECI-3 uses a RS232 port to communicate with the computer it might be necessary to use a USB to serial converter. Track' Air has decided, starting January 1st 2003, to supply every TRACKER/TECI-3 system with a standard USB to serial cable, which has proven to work properly with our system. This 'Sitecom' cable is a simple replacement for our computer cable, which connects directly to the USB connection of your computer. Remove the standard cable (*cut the heat shrink and un-screw the cable, although it also works with the standard serial cable still there and the USB top serial cable connected to the end*) and replace it with the USB to serial cable. The manual supplied with the USB to serial cable explains clearly how to use the also supplied CD to install the proper drivers for this USB to serial device. After connecting and software installation the TECI can be controlled via this now created COM-port.

Note that the drivers for the USB-serial adapter cable might have been updated by the manufacturer, please check the 'drivers' folder on the TRACKER CD (latest as known by us at the time of shipment of your system) or check the Sitecom ® website; http://www.sitecom.com.

Please note that the corresponding port number has to be found and set in the TRACKER software first!

It might be, due to the auto-setting of this device, that the COM port number changes after un- and re plugging or re-installation of the software! If any problems with communication occur please check first if the COM port number is set correctly!

Checking this is fairly easy:

1. *Via the 'Start' button go to Settings -> Control Panel*
2. *Click 'System'*
3. *Go to the tab 'Device Control'*
4. *Find 'Ports (COM & LPT)' and click it to open*

Now you'll see the serial and parallel ports available to your system and if the device drivers are installed properly and the USB to serial cable is connected, one of them is called "*USB to Serial Port (Com x)*", the 'x' is the correct COM-port number. Use this communication port number in the SNAPSHOT program to configure the correct port the software should use to communicate with the TECI (*3-Config; 4-GPS and TECI configuration; [tab] Connections; select correct COM port*).

10 - DONGLE KEY INSTALLATION

Last updated 28 January 2002

Do this only if you have received a Key (dongle).

1. Attach the key to the parallel (printer)-port

2. Start "Windows Explorer"

3. Go to folder (directory) "\KEY" on the TRACK'AIR cd-rom.

   (PS. In case the computer on which you want to run SNAPSHOT has no cd-rom drive you have to copy the contents of the folder "\KEY" to one floppy disk, ONLY THE CONTENTS, NOT THE FOLDER "\KEY" ITSELF.)

4. Run the sentinel.exe.

5. Close all applications that are currently running and restart your computer.

Remarks:

The key protection is only there for the SNAPSHOT software.

11 - NOTES