USER GUIDE

Trimble® TS635 Construction Total Station

Trimble

Inside cover page

USER GUIDE

Trimble® TS635 Construction Total Station

Version 1.00
Revision A
June 2009

Trimble

Corporate Office

Construction Division
5475 Kellenburger Road
Dayton, Ohio 45424-1099
USA
800-538-7800 (toll free in USA)
+1-937-245-5600 Phone
+1-937-233-9004 Fax
www.trimble.com

Legal Notices

Copyright and Trademarks

© 2006-2009, Nikon-Trimble Co. Limited. All rights reserved.

© 2007-2009, Trimble Navigation Limited. All rights reserved.

Trimble and the Globe & Triangle logo are trademarks of Trimble Navigation Limited registered in the United States and in other countries. Nikon is a registered trademark of the Nikon Corporation.

All other trademarks are the property of their respective owners.

Release Notice

This is the June 2009 release (Revision A) of the *Trimble TS635 Construction Total Station User Guide*. It applies to version 1.00 of the TS635 construction total station.

Manufacturer

Nikon-Trimble Co., Ltd.
Technoport Mituiseimei Bldg.
16-2, Minamikamata 2-chome, Ota-ku
Tokyo 144-0035 Japan

Product Limited Warranty Information

For applicable product Limited Warranty information, please refer to the Limited Warranty Card included with this Trimble product, or consult your local Trimble authorized dealer.

Notices

Class B Statement – Notice to Users. This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communication. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Changes and modifications not expressly approved by the manufacturer or registrant of this equipment can void your authority to operate this equipment under Federal Communications Commission rules.

WARNING - This equipment has been certified to comply with the limits for a Class B personal computer and peripherals, pursuant to Subpart B of Part 15 of FCC Rules. Only peripherals (computer input/output devices, terminals, printers, etc.) certified to comply with the Class B limits may be attached to this equipment. Operation with non-certified personal computer and/or peripherals is likely to result in interference to radio and TV reception. The connection of a non-shielded equipment interface cable to this equipment will invalidate the FCC Certification of this device and may cause interference levels which exceed the limits established by the FCC for this equipment. You are cautioned that changes or modifications not expressly approved by the party responsible for compliance could void your authority to operate the equipment.

Canada

This digital apparatus does not exceed the Class B limits for radio noise emissions from digital apparatus as set out in the radio interference regulations of the Canadian Department of Communications.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de Classe B prescrites dans le règlement sur le brouillage radioélectrique édicté par le Ministère des Communications du Canada.

Europe

This product has been tested and found to comply with the requirements for a Class B device pursuant to European Council Directive 2004/108/EC on EMC, thereby satisfying the requirements for CE Marking and sale within the European Economic Area (EEA). These requirements are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential or commercial environment.

Representative in Europe

Trimble GmbH
Am Prime Parc 11
65479 Raunheim, Germany

Australia and New Zealand

This product conforms with the regulatory requirements of the Australian Communications Authority (ACA) EMC framework, thus satisfying the requirements for C-Tick Marking and sale within Australia and New Zealand.

Taiwan Battery Recycling Requirements

The product contains a removable Ni-MH battery. Taiwanese regulations require that waste batteries are recycled.

涝揹珍悬瓨澗

Notice to Our European Union Customers

For product recycling instructions and more information, please go to: www.trimble.com/environment/summary.html.

Recycling in Europe

To recycle Trimble WEEE, call: +31 497 53 2430, and ask for the "WEEE associate," or mail a request for recycling instructions to:

Trimble Europe BV
c/o Menlo Worldwide Logistics
Meerheide 45
5521 DZ Eersel, NL

For the Bluetooth unit

USA

FCC Part 15 Subpart C/RSS-210, OET bulletin 65 supplement C satisfied

CAUTION: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

***NOTE**: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:*

-Reorient or relocate the receiving antenna.

-Increase the separation between the equipment and receiver.

-Connect the equipment into an outlet on a circuit different from that to which the

receiver is connected.

-Consult the dealer or an experienced radio/TV technician for help.

Canada

RSS-210 Low Power Device

Operation is subject to the following two conditions: (1) This device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

European Union countries, Iceland, Norway, Liechtenstein, Turkey, Switzerland

EN300 328v17.1, EN50360 satisfied

Hereby, Nikon-Trimble Co., Ltd., declares that this instrument is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC.

Declaration of Conformity available at http://www.nikon-trimble.com/.

RF exposure compliance

1. To comply with FCC/IC RF exposure compliance requirements, a separation distance of at least 20 cm must be maintained between the antenna of this device and all persons.

2. This transmitter must not be co-located or operated in conjunction with any other antenna or transmitter.

Contents

Safety 7

Warnings and Cautions 7
- Rechargeable Lithium-ion (Li-ion) batteries 7
- Warnings 8
- Cautions 9

Laser safety 10
- Specifications for laser emission 11
- Conforming standards 11
- Labels 11

1 Introduction 13

System diagram 14
Care and maintenance 15
- Storage 15
- Environmental conditions 15
- Cleaning 16
- Adjusting and tightening 16

Related information 17

2 Setting up the Instrument 19

Unpacking and repacking the instrument 20
Charging the battery pack 20
- Applying power 22
- Charging the battery 22
- Conditioning / calibrating a battery 23
- Detaching the battery pack 23
- Attaching the battery pack 24

Setting up the tripod 25
Centering the instrument 26
- Centering with the optical plummet 26
- Centering with the laser plummet 26
- Centering with a plumb bob 27

Leveling the instrument 28
Focusing the telescope 29
Setting the measurement mode and preparing the target 30
- Measurement with a prism 30
- Measurement in reflectorless (N-Prism) mode 31

Viewing and changing the measurement settings 32
- Target field 32
- Prism constant 32

3 Getting Started 33

Instrument keyboard and display 36
- Instrument keyboard 36
- Status bar 37

LCD backlight, laser pointer, beep sound, and contrast adjustment . . . 39
[DSP] button . . . 40
[MODE] button . . . 41
[HOT] key . . . 42
Bubble indicator . . . 42
Laser plummet . . . 43
Turning on the instrument . . . 44
Turning off the instrument . . . 44
Sleep mode . . . 44
Regional configuration . . . 45
List available jobs or data . . . 46
Entering data . . . 46
Entering a point name or number . . . 46
Entering a code . . . 49
Entering values in feet and inches . . . 51
Creating or opening a job . . . 51
Creating a new job . . . 52
Creating a control job . . . 52
Measuring distances . . . 53
Sighting a prism reflector . . . 53
Taking a distance measurement . . . 53
Viewing and changing the measurement settings . . . 54

4 Applications . . . 55

HA reset and angle operations . . . 56
Setting the horizontal angle to 0 . . . 56
Entering the horizontal angle . . . 56
Station setup . . . 56
Baseline . . . 57
Known . . . 58
Base XYZ . . . 60
Remote BM . . . 60
BS Check . . . 61
Layout menu . . . 62
L-O to Point . . . 62
L-O from Line . . . 63
L-O from Arc . . . 64
XYZ . . . 65
Programs menu . . . 67
Remote distance measurement (RDM) - overview . . . 68
RDM (Radial) . . . 69
RDM (Cont) . . . 69
REM . . . 70
V-Plane . . . 70
Cogo . . . 71
Recording measurement data . . . 83

Switching between display screens 83

5 Menu Screen 85

Job 86
Opening an existing job 86
Creating a new job 86
Deleting a job 88
Setting the control job 89
Displaying job information 89
Settings (basic job settings) 90
Angle 90
Distance 90
Coordinate 93
Communications 93
Unit 93
Power saving 94
Recording 94
Other settings 94
Data 95
Viewing coordinate data 95
UP, MP, CC, SS, and SO records 96
Deleting coordinate records 96
Editing coordinate records 96
Searching coordinate records 97
Entering coordinates 98
Communication 99
Downloading coordinate data 99
Uploading coordinate data 99
1sec-Key 101
[MSR] button settings 101
[DSP] button settings 101
Calibration 102
Time 102

6 Checking and Adjusting 103

Adjusting the electronic level 104
Checking and adjusting the circular level 104
Checking and adjusting the optical/laser plummet 104
Zero point errors of vertical scale and horizontal angle corrections 105
Checking the calibration 105
Adjusting the calibration 106
The instrument constant 107
Checking and adjusting the laser pointer 108

A Specifications 109

Main body 110

Telescope 110
Measurement range 110
Distance precision 111
Measurement intervals 111
Angle measurement 112
Tilt sensor 112
Tangent screws 112
Tribrach 112
Level 112
Optical plummet (Optional) 112
Laser plummet 113
Display and keypad 113
Connections in the base of instrument 113
Battery pack 113
Environmental performance 114
Dimensions 114
Weight 114
Environmental protection 114
Standard components 114
External device connector 115

B Transferring Coordinate Data 117

Transferring coordinate data to the total station 118
Settings 118
Record format 118
Data example 119
Transferring coordinate data from the total station 119
Settings 119
Data examples 119

C Error Messages 121

Cogo 122
Communications 122
Data 123
Job manager 123
Layout 124
Programs 124
Recording data 125
Searching 126
Settings 126
Station setup 127
System error 127

Safety

For your safety read the safety and warnings section and this manual carefully and thoroughly before using the Trimble® TS635 construction total station.

Although these products are designed for maximum safety, using them incorrectly or disregarding the instructions can cause personal injury or property damage.

You should also read the installation manual for the battery charger, and the documentation for any other equipment that you use with a Trimble TS635 construction total station.

Note – *Always keep this user guide near the instrument for easy reference.*

Warnings and Cautions

The following conventions are used to indicate safety instructions:

WARNING – Warnings alert you to situations that could cause death or serious injury.

CAUTION – Cautions alert you to situations that could cause injury or property damage.

Always read and follow the instructions carefully.

Rechargeable Lithium-ion (Li-ion) batteries

WARNING – Do not damage the rechargeable Lithium-ion battery. A damaged battery can cause an explosion or fire, and can result in personal injury and/or property damage.
To prevent injury or damage:
– Do not use or charge the battery if it appears to be damaged. Signs of damage include, but are not limited to, discoloration, warping, and leaking battery fluid.
– Do not expose the battery to fire, high temperature, or direct sunlight.
– Do not immerse the battery in water.
– Do not use or store the battery inside a vehicle during hot weather.
– Do not drop or puncture the battery.
– Do not open the battery or short-circuit its contacts.

WARNING – Avoid contact with the rechargeable Lithium-ion battery if it appears to be leaking. Battery fluid is corrosive, and contact with it can result in personal injury and/or property damage.
To prevent injury or damage:
– If the battery leaks, avoid contact with the battery fluid.
– If battery fluid gets into your eyes, immediately rinse your eyes with clean water and seek medical attention. Do not rub your eyes!
– If battery fluid gets onto your skin or clothing, immediately use clean water to wash off the battery fluid.

WARNING – Charge and use the rechargeable Lithium-ion battery only in strict accordance with the instructions. Charging or using the battery in unauthorized equipment can cause an explosion or fire, and can result in personal injury and/or equipment damage.
To prevent injury or damage:
– Do not charge or use the battery if it appears to be damaged or leaking.
– Charge the Lithium-ion battery only in a product that is specified to charge it. Be sure to follow all instructions that are provided with the battery charger.
– Discontinue charging a battery that gives off extreme heat or a burning odor.
– Use the battery only in equipment that is specified to use it.
– Use the battery only for its intended use and according to the instructions in the product documentation.

Warnings

Before using the instrument, read the following warnings and follow the instructions that they provide.

WARNING – Never look at the sun through the telescope. If you do, you may damage or lose your eyesight.

WARNING – The TS635 construction total station is not designed to be explosion-proof. Do not use the instrument in coal mines, in areas contaminated with coal dust, or near other flammable substances.

WARNING – Never disassemble, modify, or repair the instrument yourself. If you do, you may receive electric shocks or burns, or the instrument may catch fire. You may also impair the accuracy of the instrument.

WARNING – Use ***only*** the specified battery charger and AC adapter that is supplied with the instrument. Do ***not*** use any other charger or you may cause the battery pack to catch fire or rupture.

WARNING – Do not cover the battery charger and AC adapter while the battery pack is being recharged. The charger must be able to dissipate heat adequately. Coverings such as blankets or clothing can cause the charger to overheat.

WARNING – Avoid recharging the battery pack in humid or dusty places, in direct sunlight, or near heat sources. Do not recharge the battery pack when it is wet. If you do, you may receive electric shocks or burns, or the battery pack may overheat or catch fire.

WARNING – Although the battery pack has an auto-reset circuit breaker, you should take care not to short circuit the contacts. Short circuits can cause the battery pack to catch fire or burn you.

WARNING – Never burn or heat the battery. Doing so may cause the battery to leak or rupture. A leaking or ruptured battery can cause serious injury.

WARNING – Before storing the battery pack or battery charger, cover the contact points with insulation tape. If you do not cover the contact points, the battery pack or charger may short circuit, causing fire, burns, or damage to the instrument.

WARNING – The battery is not waterproof on its own. Do not get the battery wet when it is removed from the instrument. If water seeps into the battery, it may cause a fire or burns.

Cautions

Before using the instrument, read the following cautions and follow the instructions that they provide:

CAUTION – Use of controls, adjustments, or performance of procedures other than those specified herein may result in hazardous radiation exposure.

CAUTION – The tops of the tripod ferrules are very sharp. When handling or carrying the tripod, take care to avoid injuring yourself on the ferrules.

CAUTION – Before carrying the tripod or the instrument in the carry case, check the shoulder strap and its clasp. If the strap is damaged or the clasp is not securely fastened, the carry case may fall, causing personal injury or instrument damage. The shoulder strap is available as an optional extra.

CAUTION – Before setting up the tripod, make sure that no-one's hands or feet are underneath it. When the legs of the tripod are being driven into the ground, they could pierce hands or feet.

CAUTION – After mounting the instrument on the tripod, securely fasten the thumb screws on the tripod legs. If the thumb screws are not securely fastened, the tripod may collapse, causing personal injury or instrument damage.

CAUTION – After mounting the instrument on the tripod, securely fasten the clamp screw on the tripod. If the clamp screw is not securely fastened, the instrument may fall off the tripod, causing personal injury or instrument damage.

CAUTION – Securely fasten the tribrach clamp knob. If the knob is not securely fastened, the tribrach may come loose or fall off when you lift the instrument, causing personal injury or instrument damage.

CAUTION – Do not stack objects on the plastic carry case, or use it as a stool. The plastic carry case is unstable and its surface is slippery. Stacking or sitting on the plastic carry case may cause personal injury or instrument damage.

CAUTION – The system in the instrument may stop functioning in order to avoid any errors in measurements when the instrument detects strong electromagnetic wave(s). If this happens, turn off the instrument and remove the source of the electromagnetic wave(s). Then turn on the instrument to resume the work.

Laser safety

The TS635 is a Class 2 laser instrument, in accordance with IEC60825-1, Am2 (2001): *Safety of Laser Products*.

To counteract hazards, it is essential for all users to pay careful attention to the safety precautions and control measures specified in the standard IEC60825-1, (2001-08), particularly EN60825-1:1994, A11:1996, and A2:2001, as this refers to the hazard distance that is defined in this User Guide.

Note – *The* ***hazard distance*** *is the distance from the laser at which beam irradiance or radiant exposure equals the maximum permissible value to which personnel may be exposed without being exposed to health risks.*

WARNING – Only qualified and trained persons should be assigned to install, adjust, and operate the laser equipment.

WARNING – Precautions should be taken to ensure that persons do not look directly, with or without an optical instrument, into the beam.

WARNING – Wherever practicable, the laser beam path should be located well above or below eye level.

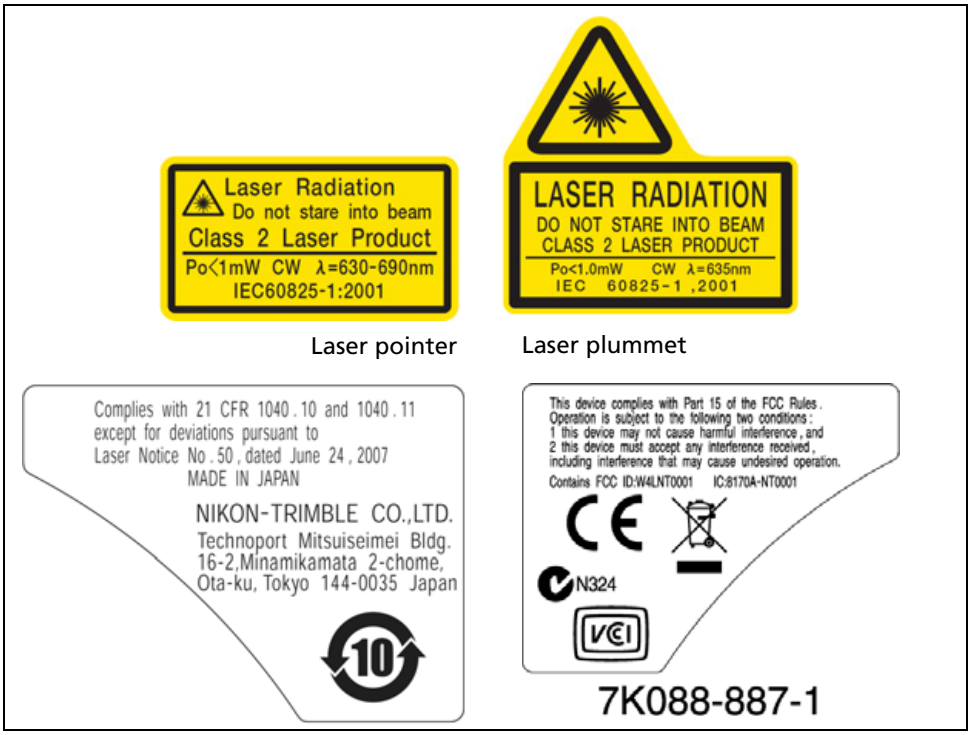
Specifications for laser emission

Laser pointer	
Wave length	630-680 nm
Output power	CW: Po ≤ 1.0 mW
Distance meter	
Wave lenght	850-890 nm
Output power	Pulse: Po ≤ 6.4 mW
Pulse width	< 5 ns
Laser plummet	
Wave length	635 nm
Output power	CW: Po < 1.0 mW

Conforming standards

EU	EN60825-1/Am.2 : 2001 (IEC60825-1/Am.2 : 2001) Laser pointer: Class 2 Distance meter: Class 1 Laser plummet: Class 2
USA	FDA21CFR Part 1040 Sec.1040.10 and 1040.11 Except for deviations pursuant to Laser Notice No.50, dated June 24, 2007.

Labels



CHAPTER

1

Introduction

In this chapter:

- System diagram
- Care and maintenance
- Related information

This user guide describes the unique capabilities and features available in the Trimble® TS635 construction total station.

The TS635 construction total station is a reflectorless EDM instrument. Reflectorless operation enables you to take measurements to points that are inaccessible with a prism.

The software for the TS635 construction total station makes it easy for you to learn to operate one model of instrument and, with little additional training, to apply that knowledge to other models.

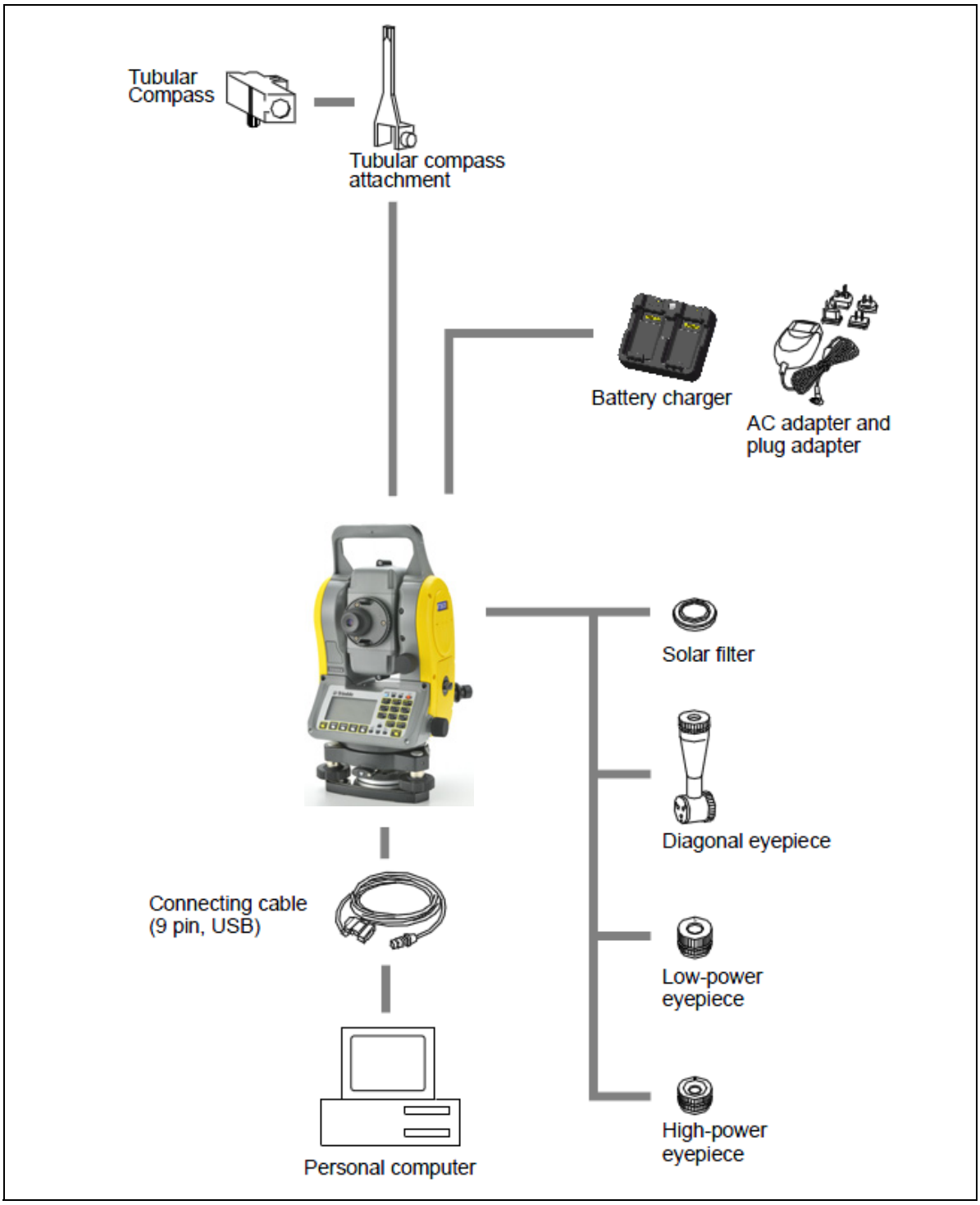
Before using the instrument, read this user guide carefully. In particular, pay attention to the warnings and cautions that appear in the Safety section.

Your comments and suggestions about the TS635 construction total station are welcome. Please contact us at the address given in the front of this manual.

In addition, your feedback about the supporting documentation helps us to improve it with each revision. E-mail your comments to sales@trimble.com.

System diagram

The system diagram shows the hardware that is used with the TS635 construction total station.



Note – *You must use the TS635 total station with tribrach W30 or W30b.*

Care and maintenance

CAUTION – The battery pack contains a Lithium-ion battery. When disposing of the battery pack, follow the environmental guidelines as determined by law and/or local regulations.

The TS635 construction total station is a precision instrument that you should store, use, and clean in an appropriate way.

Storage

- Do not store the total station in hot or humid locations. In particular, you must store the battery pack in a dry location at a temperature of less than 30 °C (86 °F). High temperature or excessive humidity can cause mold to grow on the lenses. It can also cause the electronic assemblies to deteriorate, and so lead to instrument failure.
- When storing the instrument in areas subject to extremely low temperatures, leave the carry case open.
- If you do not intend to use the tribach for an extended period, lock down the tribach clamp knob and tighten its safety screw.
- Store the battery pack with the battery discharged.

Environmental conditions

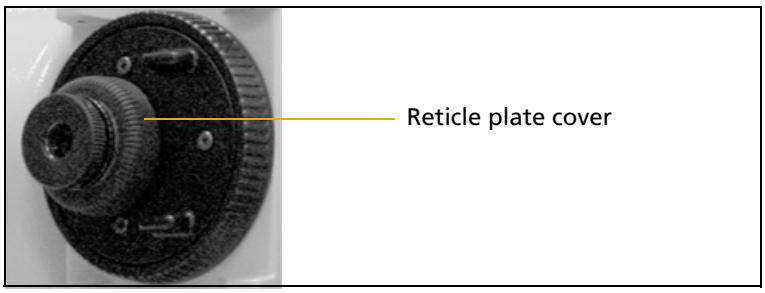
- Do not leave the instrument in direct sunlight or in a closed vehicle for prolonged periods. Overheating the instrument may reduce its efficiency.
- Sudden changes in temperature may cloud the lenses and drastically reduce the measurable distance, or cause an electrical system failure. If there has been a sudden change in temperature, leave the instrument in a closed carry case in a warm location until the temperature of the instrument returns to room temperature.
- If the total station has been used in wet conditions, immediately wipe off any moisture and dry the instrument completely before returning it to the carry case. The TS635 construction total station contains sensitive electronic assemblies which have been well protected against dust and moisture. However, if dust or moisture gets into it, severe damage could result.
- The carry case is designed to be watertight, but you should not leave it exposed to rain for an extended period. If exposure to rain is unavoidable, make sure that the carry case is placed with the Trimble nameplate facing upward.

Cleaning

- Do not use organic solvents such as ether or print thinner to clean the non-metallic parts of the instrument, such as the keyboard, or the painted or printed surfaces. Doing so could result in discoloration of the surface or in peeling of printed characters. Clean these parts only with a soft cloth or tissue that is lightly moistened with water or a mild detergent.
- To clean the optical lenses, lightly wipe them with a soft cloth or a lens tissue that is moistened with alcohol.

Adjusting and tightening

- When adjusting the leveling screws, stay as close as possible to the center of each screw's range. The center is indicated by a line on the screw.
- The reticle plate cover has been correctly mounted. Do not release it or subject it to excessive force, for example in an attempt to make it watertight.



- Before attaching the battery pack, make sure that the contact surfaces on the battery and TS635 construction total station are clean.
- Securely press the cap that covers the data output/external power input connector terminal. The instrument is only watertight if the cap is attached securely, or when the data output/external power input connector is used.
- The TS635 construction total station is not watertight when the data output/external power input connector is used.
- Static electricity from the human body, discharged through the data output/external power input connector, can damage the instrument. Before handling the instrument, touch any other conductive material once in order to remove static electricity.
- Be careful not to pinch your finger between the telescope and trunnion of the instrument.

Related information

- Contact your local Trimble dealer for more information about the support agreement contracts for software and firmware, and an extended warranty program for hardware.
- Consider a training course to help you use your total station to its fullest potential. For more information, go to the Trimble website at www.trimble.com. Alternatively, send an email to trimble_support@trimble.com.

CHAPTER

2

Setting up the Instrument

In this chapter:

- Unpacking and repacking the instrument
- Charging the battery pack
- Setting up the tripod
- Centering the instrument
- Leveling the instrument
- Focusing the telescope
- Setting the measurement mode and preparing the target
- Viewing and changing the measurement settings

This chapter describes how to prepare the TS635 construction total station before you use it in the field.

Unpacking and repacking the instrument

Note – *Handle the* TS635 construction total station *carefully to protect it from shocks and excessive vibration.*

- To unpack the instrument, grip the carry handle and then carefully remove the instrument from the carry case**.**
- To repack the instrument, refer to the following figure,

Charging the battery pack

Before charging the battery pack, read the following warnings, cautions, and notes.

WARNING – Do not damage the rechargeable Lithium-ion battery. A damaged battery can cause an explosion or fire, and can result in personal injury and/or property damage. To prevent injury or damage:
– Do not use or charge the battery if it appears to be damaged. Signs of damage include, but are not limited to, discoloration, warping, and leaking battery fluid.
– Do not expose the battery to fire, high temperature, or direct sunlight.
– Do not immerse the battery in water.
– Do not use or store the battery inside a vehicle during hot weather.
– Do not drop or puncture the battery.
– Do not open the battery or short-circuit its contacts.

WARNING – Avoid contact with the rechargeable Lithium-ion battery if it appears to be leaking. Battery fluid is corrosive, and contact with it can result in personal injury and/or property damage.
To prevent injury or damage:
– If the battery leaks, avoid contact with the battery fluid.
– If battery fluid gets into your eyes, immediately rinse your eyes with clean water and seek medical attention. Do not rub your eyes!
– If battery fluid gets onto your skin or clothing, immediately use clean water to wash off the battery fluid.

WARNING – Charge and use the rechargeable Lithium-ion battery only in strict accordance with the instructions. Charging or using the battery in unauthorized equipment can cause an explosion or fire, and can result in personal injury and/or equipment damage.
To prevent injury or damage:
– Do not charge or use the battery if it appears to be damaged or leaking.
– Charge the Lithium-ion battery only in a product that is specified to charge it. Be sure to follow all instructions that are provided with the battery charger.
– Discontinue charging a battery that gives off extreme heat or a burning odor.
– Use the battery only in equipment that is specified to use it.
– Use the battery only for its intended use and according to the instructions in the product documentation.

WARNING – To charge the battery pack, use ***only*** the battery charger and AC adapter that are supplied with the instrument. ***Do not*** use any other charger or you may cause the battery pack to catch fire or rupture. The enclosed battery pack cannot be used with other chargers.

WARNING – Do not cover the battery charger and AC adapter while the battery pack is being recharged. The charger must be able to dissipate heat adequately. Coverings such as blankets or clothing can cause the charger to overheat.

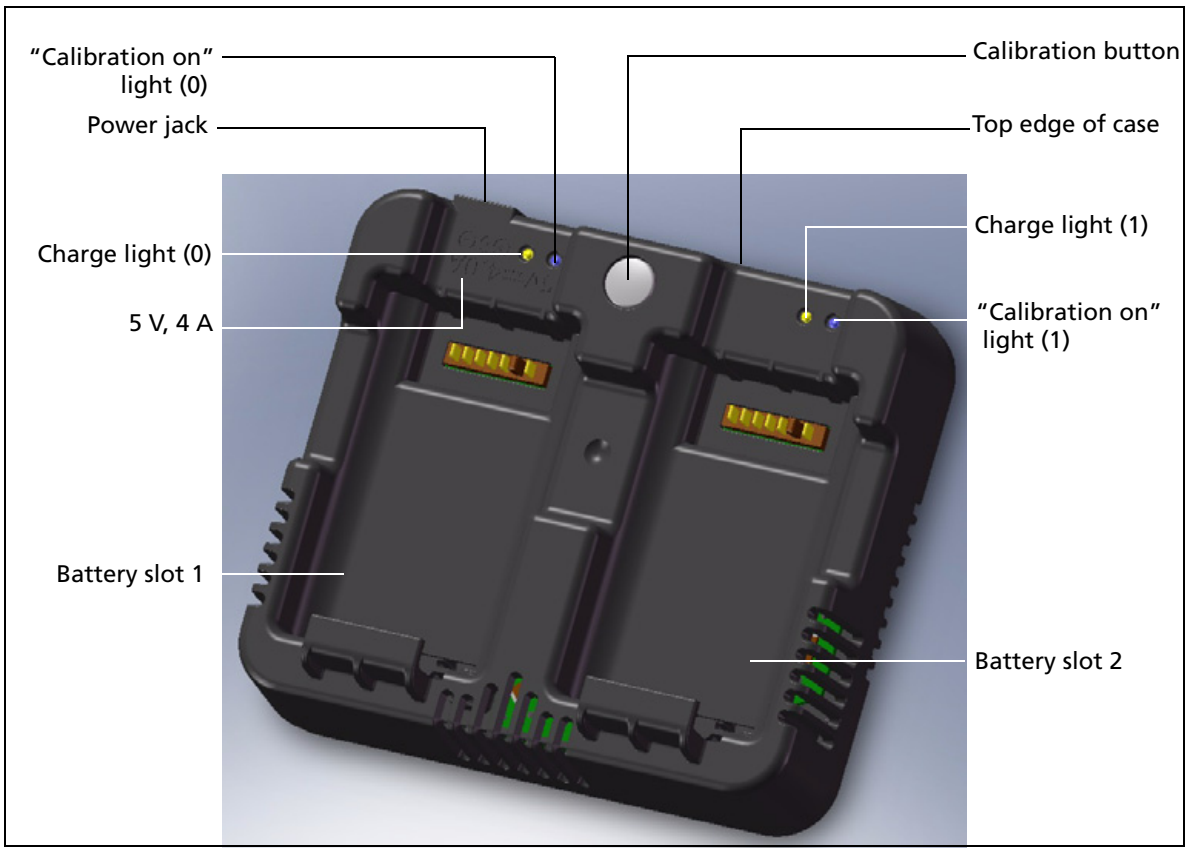
WARNING – Avoid recharging the battery pack in humid or dusty places, in direct sunlight, or near heat sources. Do not recharge the battery pack when it is wet. If you do, you may receive electric shocks or burns, or the battery pack may overheat or catch fire.

WARNING – Although the battery pack has an auto-reset circuit breaker, you should take care not to short circuit the contacts. Short circuits can cause the battery pack to catch fire or burn you.

WARNING – Never burn or heat the battery. Doing so may cause the battery to leak or rupture. A leaking or ruptured battery can cause serious injury.

WARNING – Before storing the battery pack or battery charger, cover the contact points with insulation tape. If you do not cover the contact points, the battery pack or charger may short circuit, causing fire, burns, or damage to the instrument.

WARNING – The battery is not waterproof on its own. Do not get the battery wet when it is removed from the instrument. If water seeps into the battery, it may cause a fire or burns.



Applying power

Plug in the charger to the supplied AC adapter to turn the unit on. The power input must be 5V with at least 4A of current capability. Each battery may take up to 2A while charging.

Charging the battery

- Simply slide a battery into either battery slot to begin charging. The adjacent charge indicator will illuminate yellow when charging is in progress. The charge indicator will change to green when charging is complete.
- Charger slots are completely independent so a battery may be inserted regardless of the state of the other battery slot.

- Charging may take 2-4 hours if the battery was normally discharged.
- Charging may take up to 5 hours with a completely drained battery which has been stored for several months without use.
- By design, Li-Ion batteries should not be charged above 40°C-45°C so a blinking charge light may mean the batteries are too hot for charging. Charging will resume after the batteries cool down. The charging time will be longer due to the batteries cool down when charging batteries above 40°C-45°C.
- If the charge indicator(s) are blinking and the batteries feel cool, it may indicate a problem with the battery or the charger. If the charge light is still blinking after trying several batteries which are not warm, there is a problem with the unit or the batteries themselves.

Conditioning / calibrating a battery

- Battery calibration is necessary about once every 6 months or more often if you want. Calibration insures the reported battery charge remaining is accurate.
- Hold down the calibration button on the unit and then insert a battery while holding the calibration button to begin a battery calibration. Only the battery which was inserted while the button was depressed will begin calibration. During a battery calibration the battery will be charged, discharged completely, and then recharged before finishing. Calibration should complete in roughly 17 hours and the charger vents should not be covered during a calibration cycle.
- The blue calibration indicator light(s) will blink slowly (on 1.5 sec, off 2 sec) while a calibration is in progress and the charge light(s) may be on or off during the calibration cycle.
- When a calibration cycle is completed, the calibration light will stop blinking remain on until the corresponding battery is removed.
- The bottom case temperature may continue to climb up to approximately 43°C before temperature regulation is enabled to keep the case from getting warmer. As the battery voltage drops, the case will cool down and the automatic temperature limiting will no longer be necessary which minimizes the time it takes to discharge a battery.
- If the case temperature continues to get too hot internally even after temperature regulation is enabled, there is a secondary failsafe which will abort the calibration completely. If an abort occurs, the calibration light(s) will blink rapidly and battery charging will be re-enabled.

Detaching the battery pack

CAUTION – To avoid problems with the electricity supply, do not touch the contacts on the battery pack.

1. If the instrument is turned on, press PWR to turn it off.
2. Turn the battery box release knob counterclockwise, open the battery box cover and then pull the battery pack out of the battery box.

Attaching the battery pack

1. Clear any dust or other foreign particles from the battery socket.
2. Turn the battery box release knob counterclockwise and then open the battery box cover.
3. Put the battery pack into the battery box. Connect the battery pack at the bottom with the connecting direction faced inside.
4. Close the battery box cover and then turn the knob clockwise until you hear a click sound.

CAUTION – If the battery pack is not attached securely, this could adversely affect the watertightness of the instrument.

Setting up the tripod

CAUTION – The tips of the tripod ferrules are very sharp. When handling or carrying the tripod, take care to avoid injuring yourself on the ferrules.

Note – *Do not carry the instrument while it is attached to a tripod.*

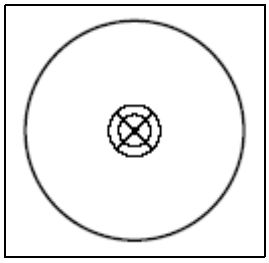
1. Open the tripod legs far enough for the instrument to be stable.
2. Locate the tripod directly over the station point. To check the position of the tripod, look through the center hole in the tripod head.
3. Firmly press the tripod ferrules into the ground.
4. Level the top surface of the tripod head.
5. Securely fasten the thumb screws on the tripod legs.
6. Place the instrument on the tripod head.
7. Insert the tripod mounting screw into the center hole of the base plate of the instrument.
8. Tighten the tripod mounting screw.

Centering the instrument

When you center the instrument, you align its central axis precisely over the station point. To center the instrument, you can use the optical plummet, the laser plummet, or a plumb bob. The plumb bob is sold separately.

Centering with the optical plummet

Note – *For high accuracy, check and adjust the optical plummet before you center the instrument.*



1. Set up the instrument on the tripod. See above.
2. Look through the optical plummet and align the reticle with the station point. To do this, turn the leveling screws until the center mark of the reticle is directly over the image of the station point.
3. While supporting the tripod head with one hand, loosen the tripod leg clamps and adjust the lengths of the legs until the air bubble is in the center of the circular level.
4. Tighten the tripod leg clamps.
5. Use the electronic level to level the instrument. See also Leveling the instrument, page 28.
6. Look through the optical plummet to make sure that the image of the station point is still in the center of the reticle mark.
7. If the station point is off-center, do one of the following:
   - If the station point is slightly off-center, loosen the tripod mounting screw and then center the instrument on the tripod. Use only direct movement to center the instrument. Do not rotate it.

     When the instrument is centered, tighten the mounting screw.
   - If there is major displacement of the station point, repeat this procedure starting with Step 2.

Centering with the laser plummet

CAUTION – Do ***not*** see the laser directly.

Note – *For high accuracy, check and adjust the laser plummet before you center the instrument.*

1. Set up the instrument on the tripod. See page 25.
2. Turn on the laser plummet.

3. Align the laser pointer to the station point. To do this, turn the leveling screws until the laser pointer is over the station point.
4. While supporting the tripod head with one hand, loosen the tripod leg clamps and adjust the lengths or the legs until the air bubble is the center of the circular level.
5. Tighten the tripod leg clamps.
6. Use the electronic level to level the instrument. See Leveling the instrument, page 28.
7. Check that the laser pointer is over the station point.
8. If the station point is off-center, do one of the following:
   - If the station point is slightly off-center, loosen the tripod mounting screw and then center the instrument on the tripod. Use only direct movement to center the instrument. Do not rotate it.

     When the instrument is centered, tighten the mounting screw.
   - If there is major displacement of the station point, repeat this procedure starting with Step 2.

Centering with a plumb bob

1. Set up the instrument on the tripod. See page 25.
2. Hang the plumb line on the hook of the tripod mounting screw.
3. Adjust the length of the plumb line so that the tip of the plumb bob is at the height of the station point.
4. Loosen the tripod mounting screw slightly.
5. Using both hands to support the outer side of the tribrach, carefully slide the instrument about on the tripod head until the tip of the plumb bob is positioned over the exact center of the station point.

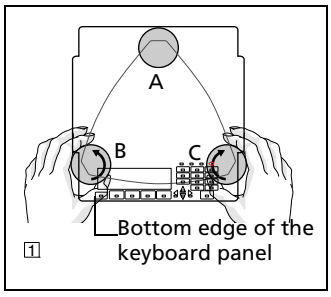
Note – *To confirm that the instrument is precisely aligned, check its position from two directions at right-angles to each other.*

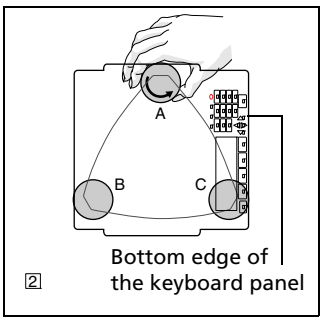
Leveling the instrument

When you level the instrument, use th electronic level to you make the vertical axis of the instrument exactly vertical. During leveling, always set the instrument in the Face 1 direction. See Figure 3.1, page 34.

To level the instrument:

1. Move the bubble into the circle on the circular level and then turn on the power.
2. Rotate the alidade until the bottom edge of the keyboard panel is parallel to the two of the leveling screws (B and C).
3. Use leveling screws B and C to move the bubble into the center of the electronic level.
4. Rotate the alidade approximately 90°.
5. Use leveling screw A to move the bubble into the center of the electronic level.
6. Repeat Step 1 through Step 5 to center the bubble in both positions.
7. Rotate the alidade 180°.



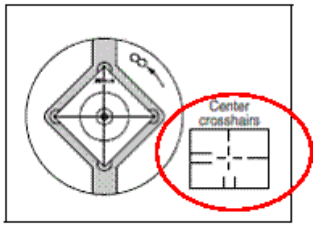


If the bubble in the electronic level remains centered, the instrument is level. If the bubble moves off center, adjust the electronic level. For detailed instructions, see Adjusting the electronic level, page 118.

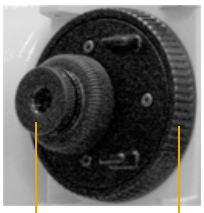
Focusing the telescope

WARNING – Never look at the sun through the telescope. If you do, you may damage or lose your eyesight.

When you sight the instrument, you aim the telescope at the target, bring the target image into focus, and align the image with the center cross-hairs of the reticle.



To sight the instrument:



1. Adjust the diopter:
   a. Aim the telescope at a blank area, such as the sky or a piece of paper.
   b. Looking through the eyepiece, rotate the diopter ring until the reticle cross-hairs are in sharp focus.
2. Eliminate parallax:
   a. Aim the telescope at the target image.
   b. Rotate the focusing ring until the target image is in sharp focus on the reticle cross-hairs.
   c. Move your eye vertically and laterally to check whether the target image moves relative to the reticle cross-hairs.
   – If the target image does not move, there is no parallax.
   – If the target image does move, rotate the telescope focusing ring and repeat Step 2c.
3. Rotate the tangent screw. The final turn of the tangent screw should be in a clockwise direction, to align the target accurately on the center cross-hairs.

Setting the measurement mode and preparing the target

The TS635 construction total station has two measurements modes: Prism mode (Prism) and Reflectorless mode (N-Prism). To change the mode at any time from any observation screen, hold down MSR1 or MSR2.

Set the measurement mode depending on the target you want to measure, as shown here.

Target	Target settings	Indicator on status bar
Prism, reflector sheet	Prism mode	No sign
Other, reflective materials	Reflectorless mode	N

In some cases, you can measure to another target that is not appropriate to the set measurement mode.

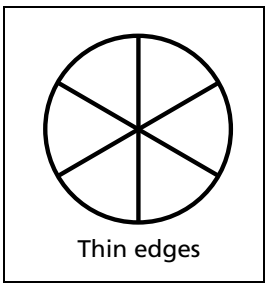
Note – *The TS635 Total Station is Laser Class 1 in the measurement function, and Laser Class 2 in the Laser Pointer function. Do not sight the prism when the Laser Pointer is on.*

Measurement with a prism

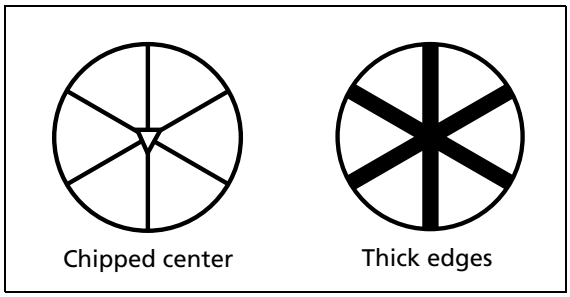
As the TS635 construction total station is extremely sensitive, multiple reflections on the prism surface can sometimes cause a significant loss in accuracy.

To maintain the accuracy of your measurements:

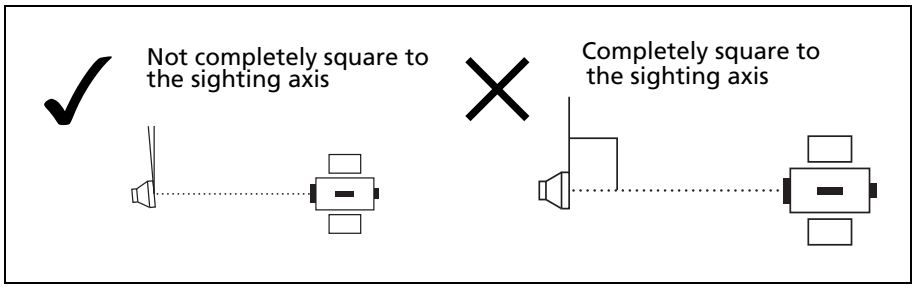
- Use a prism with thin edges.



Do not use a prism with scratches, a dirty surface, a chipped center, or thick edges.



- When measuring a short distance, incline the prism slightly so that the EDM can ignore unnecessary reflections on the prism surface, as shown below.



- Hold the prism securely in place and do not move while taking measurements.

In Prism mode, to avoid false measurements on objects other than the prism or reflector-sheet, targets that are less reflective than the prism or reflector sheet are not measured. Even if you start a measurement, measured values are not displayed. To measure less reflective objects, use the N-Prism (Reflectorless) mode.

Measurement in reflectorless (N-Prism) mode

The TS635 Construction Total Station enables reflectorless measurements up to 300 m (984 feet).

The intensity of the reflection from the target determines the distance the TS635 can measure in this mode. The color and condition of the target surface also affect the measurable distance, even if the targeted objects are the same. Some less-reflective targets may not be measured.

The following table describes some examples of targets and approximate measuring distances:

Target	You can measure approximately ...
Traffic signs, reflectors	500 meters (1640 feet)
Paper (white), veneer (new)	300 meters (990 feet)
Wall (brightly painted), brick	100 to 200 meters (330 to 660 feet)

Measurable distances may be shorter or measurement intervals may be longer if either of the following conditions apply:

- the angle of the laser against the target is small
- the surface of the target is wet

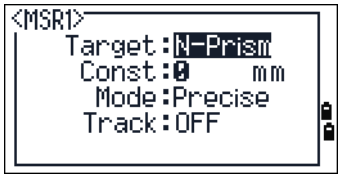
In direct sunlight, the measurable distance may be shorter. In this case, try to throw a shadow on the target.

Targets with completely flat surfaces, such as mirrors, cannot be measured unless the beam and the target are perpendicular to each other.

Make sure there are no obstacles between the instrument and the target when taking measurements. When you need to take measurements across a road or a place where vehicles or other objects are frequently moving, take several measurements to a target for the best result.

Viewing and changing the measurement settings

Hold down MSR1 or MSR2 for one second.



- To move the cursor between the fields, press ^ or v.
- To change the value in the selected field, press < or >.

The available values are:

Field	Values
Target	Prism mode N-Prism mode
Constant (prism constant)	-999 mm through 999 mm
Mode	Precise Normal
Track	Track (continuous MSR) ON Track (continuous MSR) OFF

Target field

If the measurement is started with the *Target* field set to Prism mode, there is a dash in front of the prism constant, for example –18 mm.

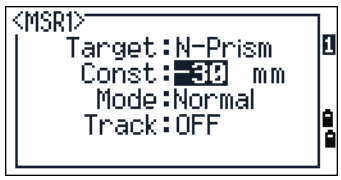
If the measurement is started with the *Target* field set to N-Prism (Reflectorless) mode, there is square bracket in front of the prism constant, for example]18 mm.

The displayed symbol will continuously move from left to right over the prism constant in the display.

Prism constant

The factory default of the prism constant value of the TS635 construction total station is -30 mm.

Change the prism constant to match the constant value of the prism you are using.



Once you have set up the instrument, you can turn on the TS635 construction total station, change the instrument settings, and start a job. See also Getting Started, page 33.

CHAPTER

3

Getting Started

In this chapter:

- Parts of the instrument
- Instrument keyboard and display
- Turning on the instrument
- Turning off the instrument
- Regional configuration
- List available jobs or data
- Entering data
- Creating or opening a job
- Measuring distances

After you set up the instrument, see page 19, you can start using the TS635 Construction Total Station.

This chapter describes the basic features of the instrument, how to turn it on, change the instrument settings, and start a job.

Parts of the instrument

Figure 3.1 and Figure 3.2 show the main parts of the TS635 Construction Total Station.

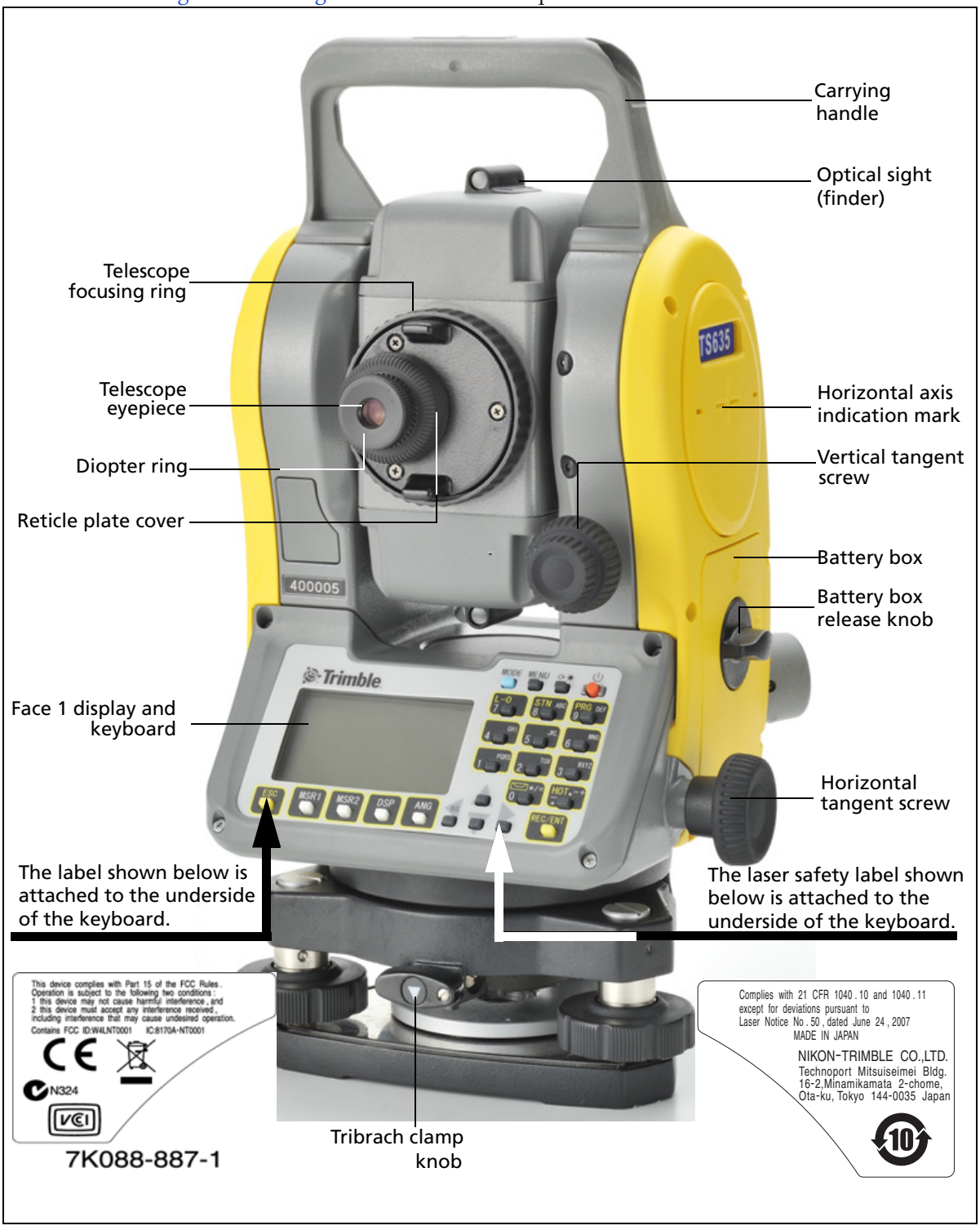


Figure 3.1 Back view of the TS635 Construction Total Station

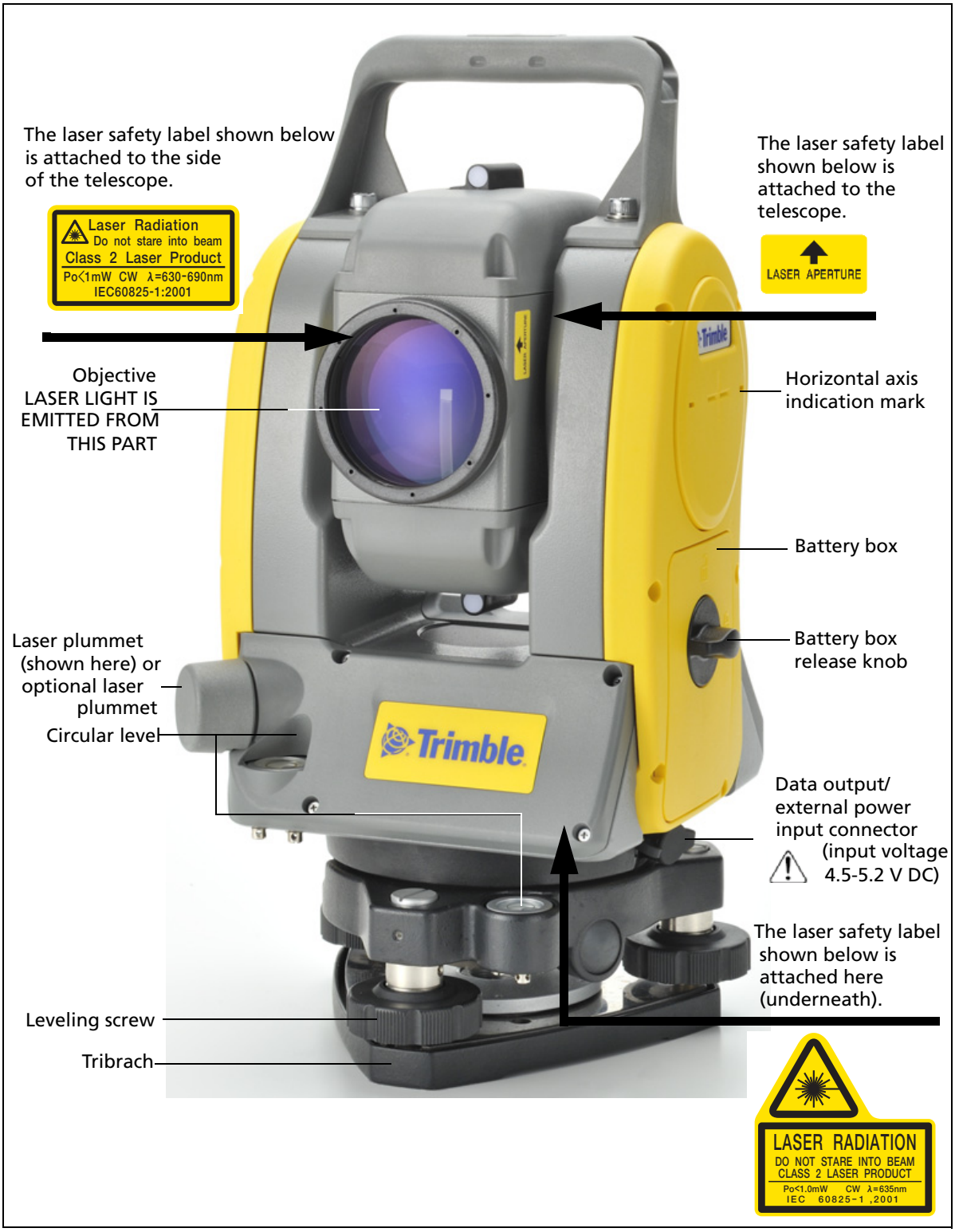
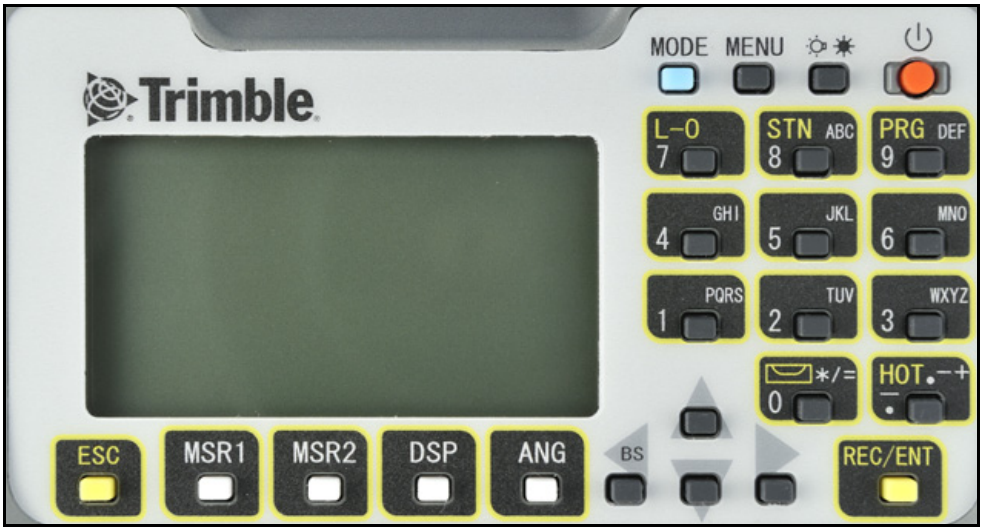


Figure 3.2 Front view of the TS635 Construction Total Station

Instrument keyboard and display



Instrument keyboard

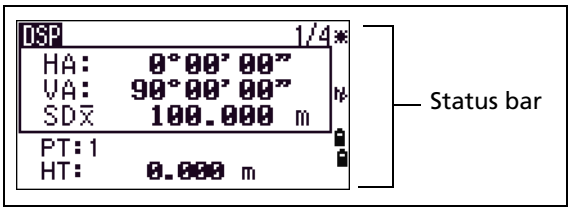
Use the buttons on the instrument keyboard to carry out the following functions:

Button	Function	See ...
	Turns the instrument on or off.	page 44
	Illumination button. Turns the backlight on or off. Provides access to the switch window if held down for one second.	page 39
	Displays the MENU screen.	page 91
	Changes the button input mode between alphanumeric and numeric if pressed when you are in a PT or CD field.	page 41
	Records measured data, moves on to the next screen, or confirms and accepts the entered data in input mode.	page 89
	Returns to the previous screen. In numeric or alphanumeric mode, deletes input.	
	Starts distance measurement, using the measure mode settings for the MSR1 button. Displays measurement mode settings, if held down for one second.	page 53
	Starts distance measurement, using the measure mode settings for the MSR2 button. Displays measurement mode settings, if held down for one second.	page 53

Button	Function	See ...
	Moves to the next available display screen. Changes the fields that appear on the DSP1, DSP2, and DSP3 screens, if held down for one second.	page 40
	Displays the Angle menu.	page 60
	Displays the Layout function menu. In numeric mode, enters 7.	page 60
	Displays the Station Setup menu. In numeric mode, enters 8. In alphanumeric mode, enters A, B, C, or 8.	page 60
	Displays the Programs menu. In numeric mode, enters 9. In alphanumeric mode, enters D, E, F, or 9.	page 75
	Displays the (HOT) menu, which includes Height of Target and Temp-Press settings. In numeric mode, enters – (minus). In alphanumeric mode, enters. (period), – (minus), or + (plus).	page 42
	Displays the Bubble indicator. In numeric mode, enters 0. In alphanumeric mode, enters *, /, =, or 0.	page 42

Status bar

The status bar appears on the right of every screen. It contains icons that indicate the status of various system functions.



Laser pointer indicator

The icon appears as you turn on the laser pointer. When the icon appears on the screen, the emitting power is laser class 2:

Laser pointer ON.

If there is no icon, the laser pointer is off.

Input mode indicator

The input mode indicator appears only when you are entering points or coordinates. It shows the data input mode:

1	Input mode is numeric. Press a button on the number pad to enter the number printed on the button.
A	Input mode is alphabetic. Press a button on the number pad to enter the first letter printed beside the button. Press the button repeatedly to cycle through all the letters assigned to that button. For example, to enter the letter O in alphabetic mode, press 5 three times.

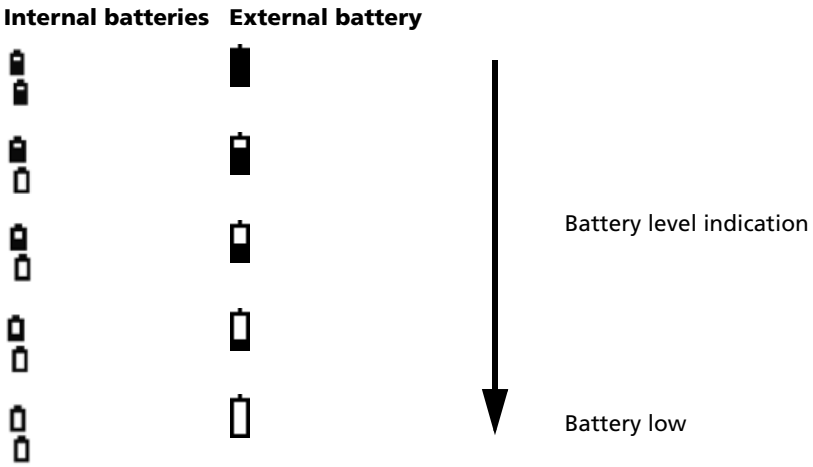
Battery indicator

Shows each voltage level of the right and left internal batteries individually. When the external battery is connected with the instrument, its voltage is shown.

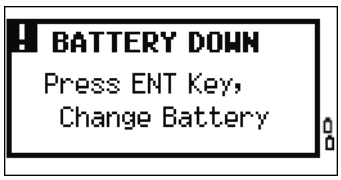
Internal batteries:

- Top: left battery
- Bottom: right battery

External battery



If the battery level is critically low, a message appears.



EDM measurement status

When you are taking measurements, the EDM measurement status shows the mode that is being used.

When you display observation data, the EDM measurement status shows the mode that was used when the data was collected.:

Reflectorless mode

If there is no icon, Prism mode is being used.

LCD backlight, laser pointer, beep sound, and contrast adjustment

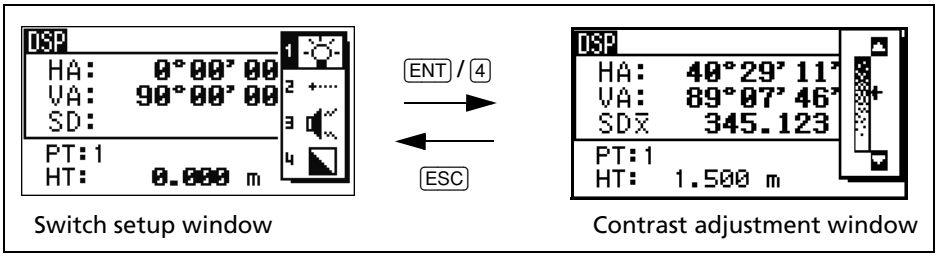
Press the illumination key to open the the 4-switch window and then press:

1 to turn the LCD backlight on/off

2 to turn the laser pointer on /off

3 to turn the beep sound on /off

4 to open the contrast adjustment window.



Switch setup window

Contrast adjustment window

Do the following:

- To turn on/off each function, press ENT when the option 1, 2, 3 or 4 is selected or directly press the 1, 2, 3, or 4 key. Holding down the illumination key for one second also turns on/off the LCD backlight.
- To move the cursor up and down, press ^ or v.
- To adjust the constrast, in the contrast adjustment window, press > or < .

To close the window, press ESC.

Switch 1: Turning on/off the LCD backlight

LCD backlight is on

LCD backlight is off

Switch 2: Turning on/off the laser pointer

Laser pointer is on

Laser pointer is off

The icon appears while turning on the laser pointer. When the icon is on the screen, the emitting power is Laser Class 2.

Switch 3: Turning on/off the sound

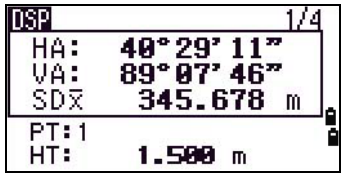
Sound is on

Sound is off

DSP button

Use the DSP button to change the current display screen or to change display settings.

Switching between display screens

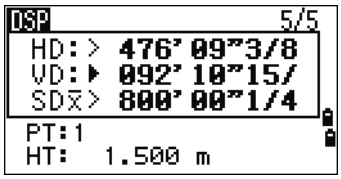


When several display screens are available:

- the DSP indicator appears at the top left of the screen
- the screen indicator (for example, 1/4) appears at the top right

To move to the next available screen, press DSP.

For example, if you are currently in the second display screen, press DSP to move to the third display screen. The screen indicator changes from 2/4 to 3/4.



When the secondary distance unit is set, an additional screen is available. It shows the HD, VD, and SD values. See also Other settings, page 94.

The smallest unit of display for distances measured in feet-and-inches is 1/16 in. Smaller units are impractical in the field.

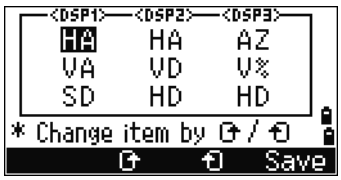
When the actual value is greater than 99999'11"15/16, the > symbol appears. If the actual distance is less than –9999'11"15/16, the ▶ (solid triangle) symbol appears. This does not affect calculations. The precise value is used internally in all cases.

Customizing items in the Basic Measurement Screen (BMS)

To customize the items that are displayed on the DSP1, DSP2, and DSP3 screens:

1. Hold down DSP for one second.
2. Use the arrow buttons ^, v, <, and > to highlight the item that you want to change:
3. Press the → or ← softkey to scroll through the list of items that can be displayed for this item.

   The items that you can choose from are HA, AZ, HL, VA, V%, SD, VD, HD, Z, and (none).



4. To save your changes, press the Save softkey.

   Alternatively, highlight the last item for DSP3 and press ENT. The DSP screens show the items you have selected.

   Except for the (none) item, you cannot display the same item on more than one line of the same screen.

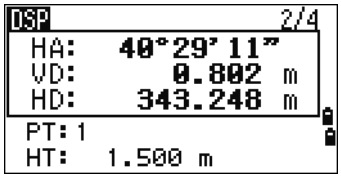
   The items displayed in the DSP1, DSP2, DSP3, and DSP4 screens are also used in the corresponding Layout screens (LO2, LO3, LO4, and LO5).

   You can also customize the displayed items in Layout.

Header characters

The following header characters appear in DSP screens:

- Colon (:) indicates that tilt correction is applied to the value.
- Hash symbol (#) indicates that tilt correction is off.
- Underscore (_) under the tilt correction character indicates that Sea Level Correction or Scale factor is applied.



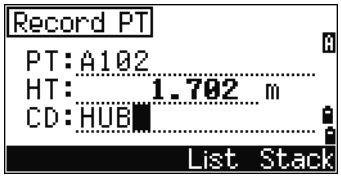
MODE button

The MODE button is on the top row of the TS635 keypad. Use it to change the keyboard mode for the current screen.

Changing the input mode while entering points or codes

When the cursor is in a point (PT) or code (CD) field, press MODE to change the input mode between alphanumeric (A) and numeric (1).

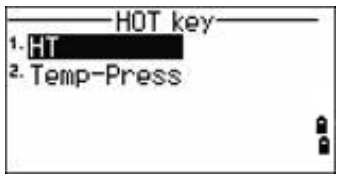
The input mode indicator in the status bar changes to show the current input mode.



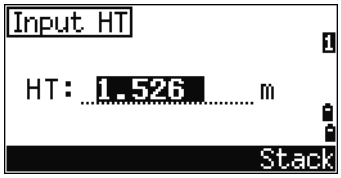
When the cursor is in a height (HT) field, only numeric input mode is available. Pressing MODE has no effect when the cursor is in a HT field.

HOT key

The HOT key menu is available from any observation screen. To display the HOT key menu, press HOT.



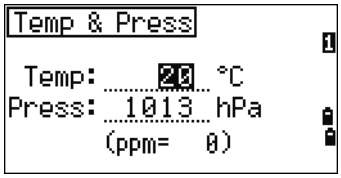
Changing the height of the target



1. Press HOT to display the HOT menu.
2. Do one of the following:
   - Press 1.
   - Select HT.
3. Press ENT.
4. Enter the target height or select the height from the HT stack.

Note – *To display the HT stack, press the* `Stack` *softkey. The HT stack stores the last 20 HT values entered.*

Setting the current temperature and pressure



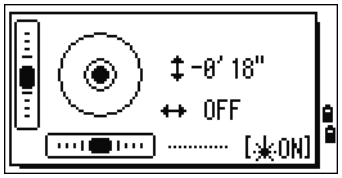
1. Press HOT to display the HOT menu.
2. Do one of the following:
   - Press 2.
   - Select `Temp-Press`.
3. Press ENT.
4. Enter the ambient temperature and pressure.
   The ppm value is updated automatically.

Bubble indicator

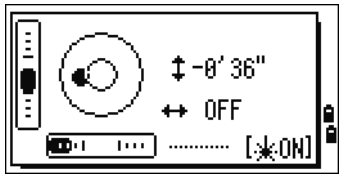
The bubble indicator appears if the instrument goes out of level while the compensator is turned on. It also appears directly after the start up screen.

To display the bubble indicator in an observation screen at any other time, press .

The TS635 Construction Total Station has a two-axis level compensation. To turn the leveling compensators on or off, press < or >. When the levelling compensators are turned off, the text OFF appears on the screen.



If the instrument is more than ±3'30" out of level, the text OVER appears on the screen.



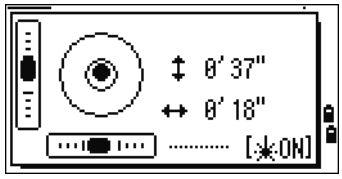
To return to the observation screen, press ESC or ENT.

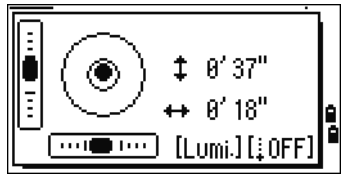
Laser plummet

Laser plummet on / off

Do one of the following:

- To turn the laser plummet switch on, press [✱ ON] .
- To close the bubble indicator window, press ESC.
- To turn the laser plummet switch off, press [⋮ OFF].
- To open the luminance adjustment window, press Lumi.
- To turn the laser plummet switch off and close the bubble indicator window, press ESC.

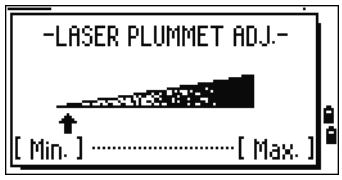




Laser luminance adjustment

Laser luminance can be set to 4 levels.

- To set the luminance brighter by one level, press Light once.
- To set the luminance darker by one level, press Dark once

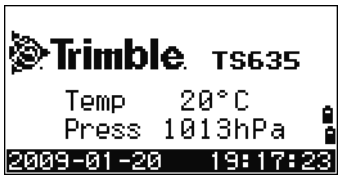


To return to the bubble indicator window, press ESC or ENT.

The current setting of leveling compensators is indicated by header characters (:, #, :, and #) after field labels (such as HA, VA, SD, and HD) in observation screens. For more information, see *Header characters, page 41*.

Turning on the instrument

Press the PWR button. The start-up screen appears. It shows the model name, current temperature, pressure, date, and time. The display automatically changes to the electronic level after two seconds.



If you entered your name or your company's name in the Owner's detail field, the text from this field appears on the start-up screen. To set the Owner's detail field, press MENU and then select `Settings / Other`. See also Other settings, page 94.

Turning off the instrument

1. Press PWR and ENT.
2. Do one of the following:

Press...	To...
ENT again	turn off the instrument
the `Reset` softkey	reboot the software and re-start the instrument access the Basic Measurement Screen (BMS) without an open job.
the `Sleep` softkey	put the instrument into power-saving mode
ESC	cancel the power-off process and return to the previous screen

Sleep mode

To put the instrument into sleep mode, do one of the following:

- In the Press ENT → OFF screen, press the `Sleep` softkey.
- Enable the Power Save setting. See also Power saving, page 94.

The instrument wakes up if any of the following events occur:

- You press a button
- The instrument receives a remote control command
- You rotate the alidade
- You tilt the telescope

Regional configuration

To provide easier configuration for common regional settings, you can quickly configure the TS635 Construction Total Station to a pre-set combination of default regional settings. The *Regional Configuration* screen appears only after the language configuration is complete and the instrument has rebooted.

1. Follow the steps in the language section on ***page 95***.

   Once the instrument reboots, the *Regional Configuration* screen appears.

2. Press ^ or v to highlight the required regional settings and then press ENT.
3. If you do not want to change the current settings, press ESC and quit. The instrument will continue to use the last settings that were configured.

The settings affected by the *Regional Configuration* screen are:

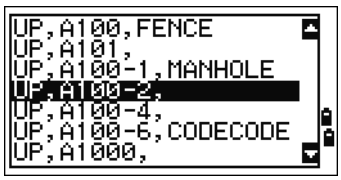
Category	Setting	Europe	International	United States
Angle	VA zero	Zenith	Zenith	Zenith
	Resolution	5"	5"	5"
Distance	Scale	1.000000	1.000000	1.000000
	T-P Corr.	On	On	On
	Sea Level	Off	Off	Off
	C&R corr.	0.132	0.132	0.132
Coordinates	Order	ENZ	ENZ	NEZ
	Label	ENZ	ENZ	NEZ
Power Save	Main Unit	Off	Off	Off
	EDM Unit	Off	Off	Off
	Sleep	5 minutes	5 minutes	5 minutes
Communication	Ext. Comm	Nikon	Nikon	Nikon
	Baud	4800	4800	4800
	Length	8	8	8
	Parity	None	None	None
	Stop bit	1	1	1
Units	Angle	GON	DEG	DEG
	Distance	meters	meters	US-ft
	Temp	°C	°C	°F
	Press	mm Hg	mm Hg	In Hg
Rec	Rec Data	ON	ON	ON
	CD Field	ON	ON	ON
	Add Const	1000	1000	1000
Others	XYZ disp	Fast	Fast	Fast
	2nd Unit	None	None	None
	CD Input	<ABC>	<ABC>	<ABC>

The default regional configuration pre-set is “Europe” settings. See also Settings (basic job settings), page 90.

List available jobs or data

The TS635 Construction Total Station lists available jobs or data when you do any of the following:

- view or edit data (Press MENU then select Data)
- open the Job Manager (Press MENU then select Job)
- search for points or codes



The current cursor position is shown in inverted colors (it appears as white text on a black background).

Press ^ to move the cursor one line up, or press v to move the cursor one line down.

If the Page Up icon appears, there are more pages before the current page. Press < to move up one page.

If the Page Down icon appears, there are more pages after the current page. Press > to move down one page.

To select an item from the list, move the cursor onto the item and press ENT.

Entering data

You can enter the following into the TS635 Construction Total Station:

- A point name or number, see page 46
- A code, see page 49

Entering a point name or number

You can use numeric or alphanumeric names up to 20 characters long to identify points.

The default name for a new point is the last point name entered, with the last digit incremented. For example, if the last point name was A100, the default name for the next point is A101.

If the last character of the previous point name is alphabetic, the default point name is identical to the last point name.

When the cursor is in a PT (point) field, there are several ways to specify a point, or to enter coordinates. You can:

- Enter an existing point, see page 47

- Enter a new point, see page 47
- Press ENT without a point name, see page 47
- Specify a wildcard, see page 48
- Record an instant measurement, see page 48
- Enter a point from a point stack, see page 49
- Enter a point from the point list, see page 49

Entering an existing point

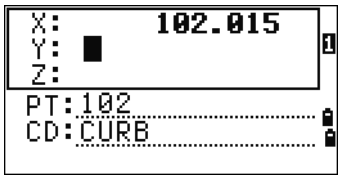
When you enter a known point name or number, the coordinates of that point are briefly displayed. A short beep sounds before the next screen appears or the next field is selected.

To adjust the duration of the coordinate window display, press MENU then select `Settings / Others`. To leave the window open until you press ENT, set the *XYZ disp* field to +ENT. See also page 94.

Entering a new point

When you enter a new point name or number, a coordinate input screen appears. Enter the coordinates for the point in NE, NEZ, or elevation-only (Z) format.

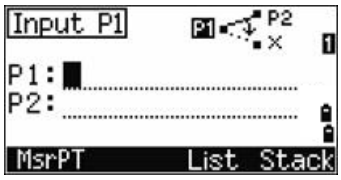
To store the point in the current job, press ENT on the last line (the CD field).



Pressing ENT without a point name

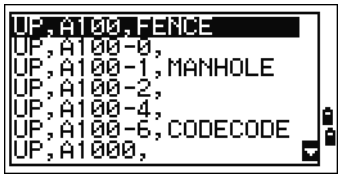
To use a point without recording the coordinates, press ENT in a PT field, without entering a point name.

The input coordinates are used in the calculation but they are not saved in the database. The message This PT will not be recorded appears.



Specifying a wildcard (*)

If you include an asterisk (for example, A100*) when you enter a point or code name, a list of points that match the entered text appears.



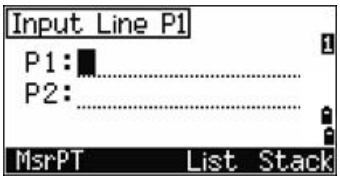
Use ^ or v to move the cursor to the point that you want to use. Then press ENT.

If the Page Up icon appears, you can use it to move up one page on the list. You can also use <.

If the Page Down icon appears, you can use it to move down one page. You can also use >.

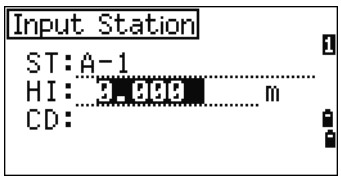
When you select a point from the list, its coordinates are displayed and a beep sounds.

Entering a point by recording an instant measurement

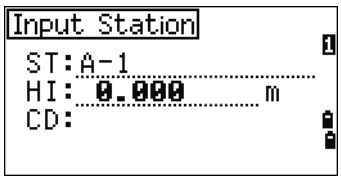


1. Press the MSR softkey:

   An observation screen appears.
2. To start a measurement, press MSR1 or MSR2.
3. To change the height of the target, select the HT softkey.
4. When you have finished the measurement, press ENT to go to the point recording screen.
5. Enter the point or code name and then press ENT.



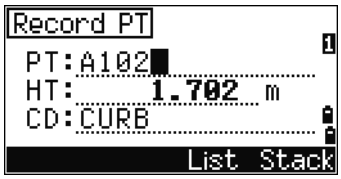
When you move the cursor to a field, the current or default value appears in inverted colors. (It appears as white text on a black background). This is the default Replace All input mode.



To change the input mode to Overwrite and highlight the first character, press >. To move the cursor to the end of the string, press <.

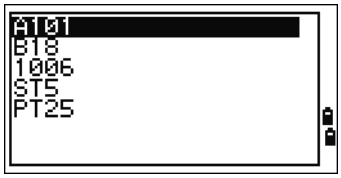
Entering a point from the point stack

The point stack is a list of the last 20 point names used, in chronological order from last used to first used. To enter a point from the point stack:



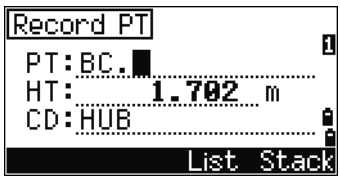
1. Select the `Stack` softkey when the cursor is in the PT field. The stack appears.
2. Press ^ or v to move the cursor to the point that you want to use.
3. Press ENT.

When you return to the point input screen, the selected point name is entered in the PT field, incremented by one. For example, if you selected the A101 point, A102 appears in the PT field.

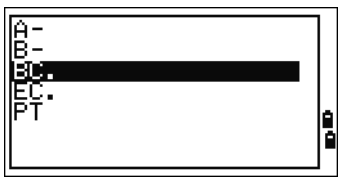


Entering a point from the point list

1. Select the `List` softkey when the cursor is in the PT field. A list of existing points appears.
2. Press ^ or v to move the cursor to the point that you want to use.
3. Press ENT.



When you return to the point input screen, the selected point name is entered in the PT field. Add numeric or alphabetic characters if required.



Entering a code

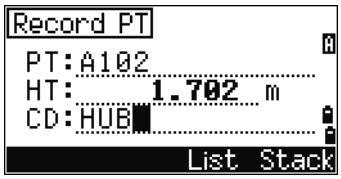
The CD (Code) field defaults to the last code used. You can select a different code in the input point screen.

Codenames can be numeric or alphanumeric, and up to 16 characters long.

There are several ways to enter a code:

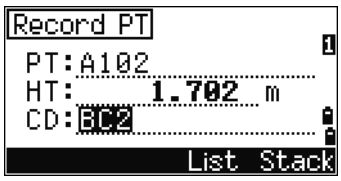
- Enter a code directly, see page 50
- Enter a code from the code stack, see page 50
- Enter a code from the code list, see page 50

Entering a code directly



1. To change the input mode to alphanumeric or numeric, press MODE.
2. Use the keypad to enter the code.

Entering a code from the code stack



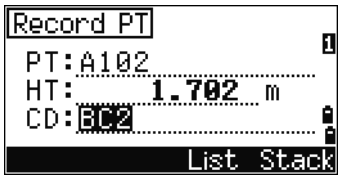
The code stack is a list of up to 20 recently used codes. When you reboot the TS635 Construction Total Station, the code stack is cleared.

To enter a code from the code stack:

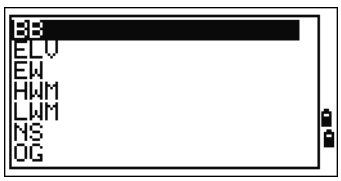
1. Select the `Stack` softkey when the cursor is in the CD field. The stack appears.
2. To move the cursor to the code that you want to use, press ^ or v.
3. Press ENT.

The selected code is copied to the CD field.

Entering a code from the code list



1. Select the `List` softkey when the cursor is in the CD field. A list of existing codes appear.
2. Press ^ or v to highlight the feature code that you want to use.
3. Press ENT.

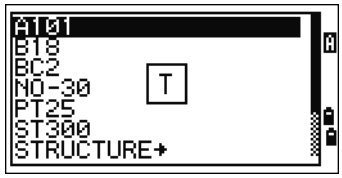


A layer has an arrow at the end of the code label. If you highlight a layer in the list and then press ENT, the codes and layers in that layer are displayed.

When you return to the input screen, the selected code is entered in the CD field.

Advanced feature: Searching for a code using the first character

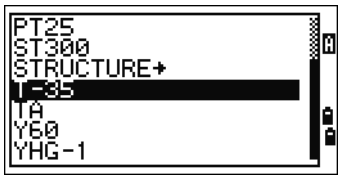
Items are shown in alphabetic order. To find a code quickly when the code list appears, use the first-character search. For example, to see feature codes that begin with T, use the keypad to enter the letter T (press 1 twice).



After each button press, the input mode field displays the selected letter. For example, if you press 1, `S` appears. If you quickly press 1 again, `T` appears. If you do not press the 1 button again, the letter T is selected.

Once you select a letter, the cursor moves to the feature code beginning with that letter.

If there is no code beginning with that letter, the cursor moves to the next available letter.



Entering values in feet and inches

If US Survey Feet (US-Ft) or International Feet (I-Ft) is selected as the distance unit, you can enter and display distances, HIs, HTs, and coordinate values in decimal feet or in feet and inches. See also Unit, page 93, and Other settings, page 94.

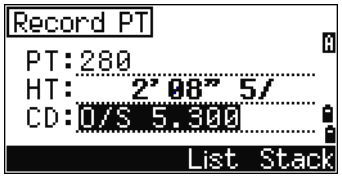
To enter values in feet and inches in an input screen, enter the elements, separated by periods (.), in the following format:

<Feet> . <Inches> . <Numerator> . <Denominator> ENT
(0–11) (0–15) (0–99)

The default denominator is 16. If the denominator is 16, you do not have to enter it, and it is not displayed on the screen.

For example, if you enter 2 . 0 8 . 5 . ENT, it appears as 2' 08" 5/ (2 feet, 8 and 5/16ths inches).

The following examples show how to enter various values:



To enter...	Key in...
65' 5 3/8"	6 5 . 5 . 3 . 8 ENT
65'	6 5 ENT
65' 5"	6 5 . 5 ENT
65' 5 3/8"	6 5 . 5 . 6 ENT
5 3/8"	0 . 5 . 3 . 8 ENT or 0 . 5 . 6 ENT

The numerator and denominator that you enter are automatically converted to the closest value from the following list: 0, 1/8, 1/4, 3/8, 1/2, 5/8, 3/4, 7/8, 1/16, 3/16, 5/16, 7/16, 9/16, 11/16, 13/16, 15/16.

If the denominator is 16, it is not shown on the screen.

Creating or opening a job

To record data on the TS635 Construction Total Station, you must create or open a job.

Note – *Before using the TS635 Construction Total Station for the first time, check that you are using the required job settings.*

Creating a new job

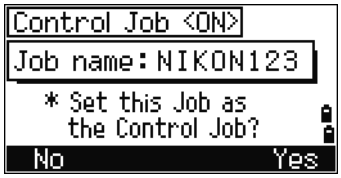
1. Press MENU. The MENU screen appears.
2. Press 1. The Job Manager appears.
3. Select the Creat softkey. The Create Job screen appears.
4. Enter the job name.
5. To check the job settings, select the Sett softkey. You cannot change the settings for a job once you have created the job.
6. Press ENT in the last field of the Job Sett screen. The new job is created.

Note – *You can only have a maximum of 32 jobs.*

Creating a control job

A control job, or common file, stores coordinate data that is used by several field jobs. To create a control job in the office:

1. Press MENU. The MENU screen appears.
2. Press 1 or select Job. The Job Manager appears.
3. Move the cursor to the job to use as the control job.
4. Select the Ctrl softkey.
5. Select the Yes softkey.



When you enter a point name or number, the system searches in the current job first. If the point is not found in the current job, the search is automatically extended to the control job. If the point is found in the control job, the selected point is copied to the current job as a UP record.

Measuring distances

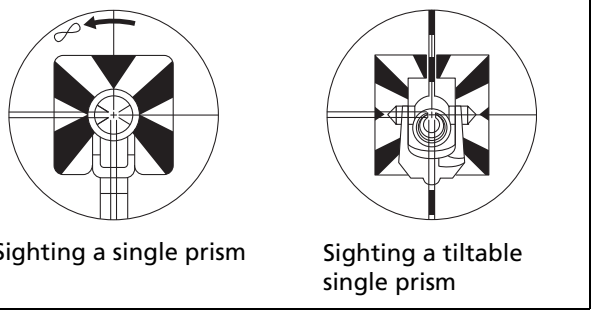
WARNING – Never look at the sun through the telescope. If you do, you may damage or lose your eyesight.

WARNING – Precautions should be taken to ensure that persons do not look directly, with or without an optical instrument, into the beam.

WARNING – Laser beam path should be located well above or below eye level wherever practicable.

Sighting a prism reflector

Sight the telescope until you see cross-hairs at the center of the prism reflector.



Sighting a single prism

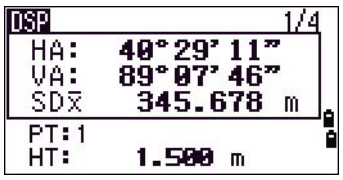
Sighting a tiltable single prism

Taking a distance measurement

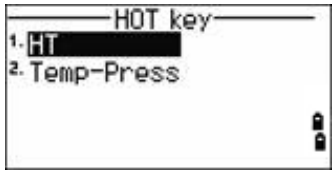
To take a distance measurement, press MSR1 or MSR2 in the Basic Measurement Screen (BMS) or in any observation screen.

While the instrument is taking a measurement, the prism constant appears in a smaller font.

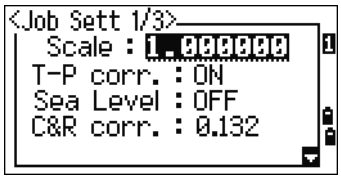
If tracking is set to ON, measurements are taken continuously until you press MSR1, MSR2, or ESC. Each time a measurement is taken, the distance is updated.



To change the height of target (HT), temperature, or pressure, press HOT. See also HOT button, page 42.

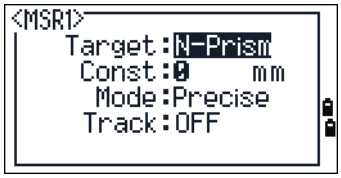


Settings that relate to corrections (T-P corr, Sea Level, C&R corr., and Map projection) are included in the job settings and are job-specific. To change any of these settings, you must create a new job. See also Job, page 86, and Settings (basic job settings), page 90.



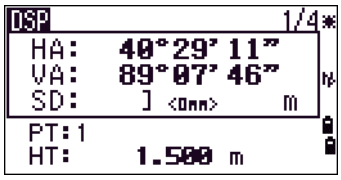
Viewing and changing the measurement settings

1. Hold down MSR1 or MSR2 for one second.
2. To move the cursor between the fields, press ^ or v.
3. To change the value in the selected field, press < or >.



Field	Values
Target	Prism
	N-Prism
Const (prism constant)	–999 mm through 999 mm
Mode	Precise
	Normal
Track	Track (continuous MSR) ON
	Track (continuous MSR) OFF

Target field



- If the measurement is started with the Target field set to Prism, there is a dash "–" in front of the prism constant.
- If the measurement is started with the Target field set to N-Prism, there is a right square bracket "]" in front of the prism constant.

  The symbol then continuously moves from left to right over the prism constant in the display.

The Target setting is used by the TS635 Construction Total Station to apply better cyclic-error adjustment in distance measurement. The target setting efficiently eliminates multipath reflection.

An incorrect Target setting may result in measurements outside the precision and intervals specified for the instrument.
If you aim a prism target in the N-prism mode, the warning message `Signal High!→Try Prism Mode` appears because of the excessive light reflection.
A measurement made immediately after changing the target setting may take a longer time than usual.

CHAPTER

4

Applications

In this chapter:

- HA reset and angle operations
- Station setup
- Layout menu
- Programs menu
- Recording measurement data
- Switching between display screens

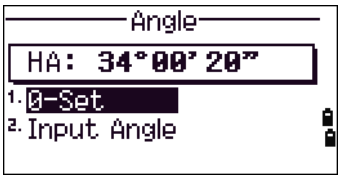
This chapter describes the menu and display screens, and TS635 Construction Total Station applications.

Use the following keystrokes when working in the display screens and when you use the applications:

To switch between display screens	Press DSP. See also page 83.
To change HT	Press HOT
To record points	Press ENT

HA reset and angle operations

To access the *Angle* menu, press ANG in the Basic Measurement Screen (BMS). To select a command from the *Angle* menu, press the corresponding number key. Alternatively, press ^ or v to highlight the command and then press ENT.

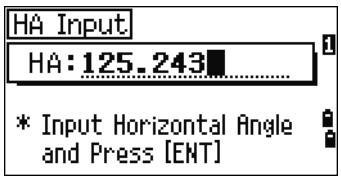


Setting the horizontal angle to 0

Press 1 or select `0-Set` in the Angle menu. The display returns to the BMS.

Entering the horizontal angle

1. Press 2 or select `Input` in the Angle menu. The HA Input screen appears.
2. Use the numeric keys to enter the horizontal angle.
3. Press ENT.



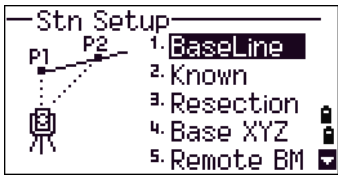
To enter 123°45'50", key in 1 2 3 . 4 5 5 0.

The displayed value is rounded to the minimum angle increment.

Station setup

To access the Stn Setup menu, press STN in the BMS.

To select a command from the Stn Setup menu, press the corresponding number key. Alternatively, press ^ or v to highlight the command and then press ENT.



The last function used is highlighted.

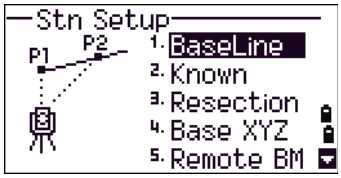
The station setup options are:

- Baseline, page 57
- Known, page 58
- Base XYZ, page 60
- Remote BM, page 60
- BS Check, page 61

Baseline

Select this option for a two-point resection along a known line.

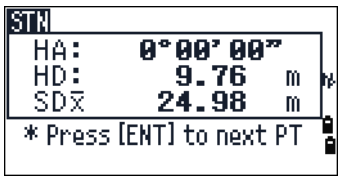
1. Press 1 or select BaseLine from the Stn Setup menu.



2. Enter a known point as P1.

   If you enter a new point name, a coordinate input screen appears.

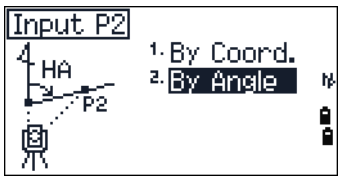
   Sight P1 and press MSR1 or MSR2 to take a measurement. Press ENT.



3. Choose how you want to define a known line:

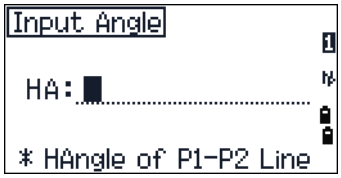
   – To define the line by entering P2 coordinates, press 1 or select By Coord.

   – To define the line by entering the azimuth, press 2 or select By Angle.



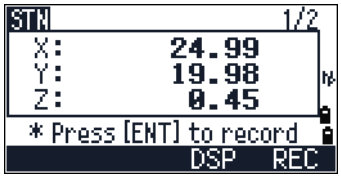
   a. If you select By Angle, the azimuth input screen appears: Enter the angle value and press ENT.

   A measurement screen appears.



   b. Sight P2 and press MSR1 or MSR2 to take a measurement. Press ENT.

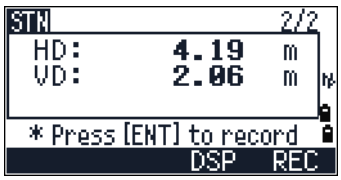
   After the measurement to P2 is completed, press ENT. The coordinates of the station are calculated.

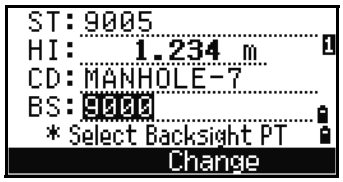


4. To record the station, press ENT or the REC softkey.

5. To check the measurement, press the DSP softkey. If you defined the line by entering its azimuth, the HD and VD between P1 and P2 are displayed.

   If you defined the line by entering the P2 coordinates, the difference of HD (dHD) and VD (dZ) between your measurement data and input coordinate data are displayed.

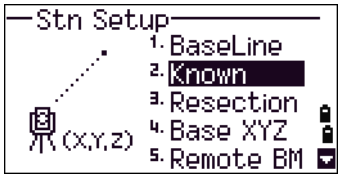




6. Enter the station name, the height of instrument (HI), and a feature code (CD) if required. The station name defaults to the last recorded PT + 1.
7. Backsight (BS) defaults to the first point (P1). To change the selected point, highlight the BS field and then select the Change softkey.
8. To finish the setup and record the station, press ENT in the BS field.

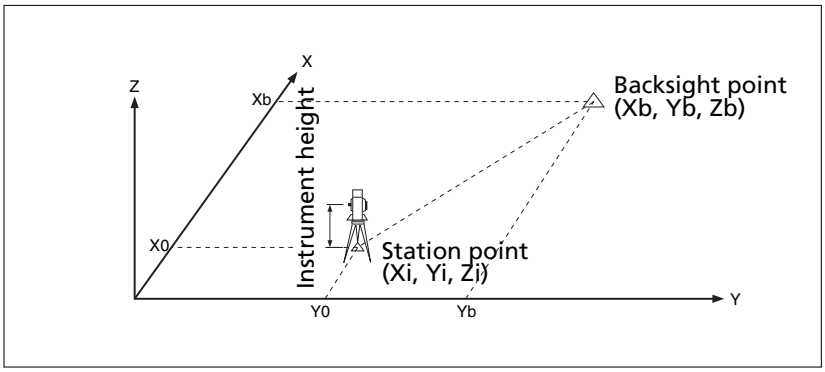
Known

Select this option to set up a station with known coordinates or azimuth.



1. Press 2 or select Known in the Stn Setup menu.
2. Enter a point name or number in the ST field.
   - If the input point number or name is an existing point, its coordinates are displayed and the cursor moves to the HI (Height of instrument) field.
   - If the point is new, a coordinate input screen appears. Enter the coordinates for the point. Press ENT after each field. When you press ENT in the CD field, the new point is stored.
   - If the specified point has a code, the code appears in the CD field.
3. Enter the instrument height in the HI field and then press ENT.
4. In the Backsight screen that appears, select an input method for defining the backsight point:
   - To sight the backsight by entering coordinates, see the following section.
   - To sight the backsight by entering the azimuth and angle, see page 59.

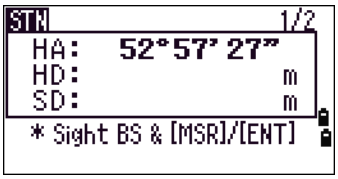
Sighting the backsight by entering coordinates



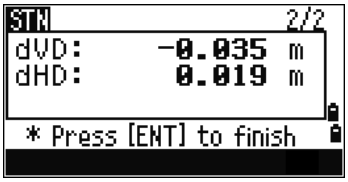
1. To enter coordinates for the backsight point (BS), press 1 or select Coord from the Backsight screen.

2. Enter the point name. If the point exists in the job, its coordinates are shown.
3. If you intend to take a distance measurement to the BS, enter the height of target in the HT field.
4. Sight the BS, and then press ENT to complete the setup.

HA	Azimuth calculated by coordinates

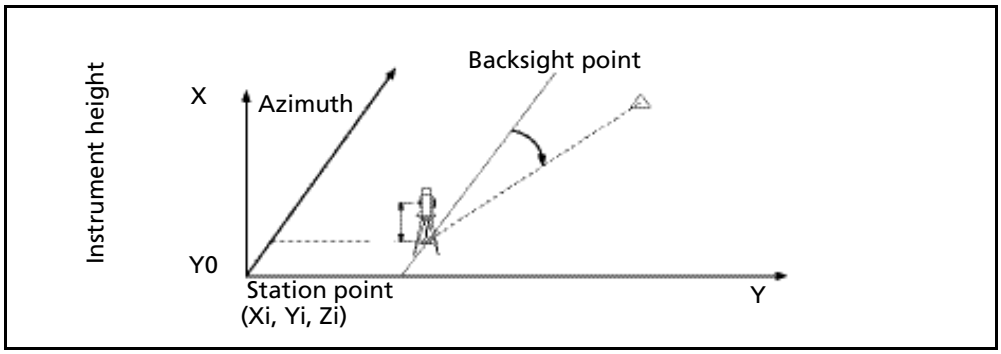


If measuring to a known coordinate BS, press DSP to display a QA screen. The QA screen shows the dHD and dVD values, which indicate the difference between the measured distance and the distance calculated from the known coordinates.

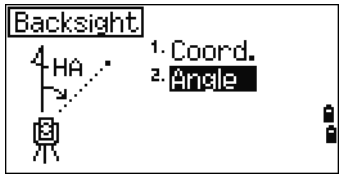


5. To record the station, press ENT.
6. To finish the station setup after taking a distance measurement, press ENT.

Sighting the backsight by entering the azimuth angle



1. To enter the azimuth angle to the backsight point, press 2 or select Angle from the Backsight screen.

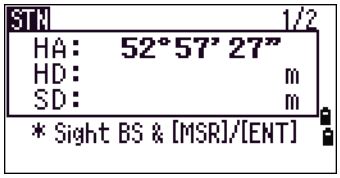


2. If there is no point name for the BS, press ENT on the BS field.

3. In the HA field, enter the azimuth angle to the BS point.

   If you press ENT without entering a value in the HA field, the azimuth is automatically set to 0°00'00".

4. Sight the BS point and press ENT.



Base XYZ

Select this option to change the instrument XYZ values.

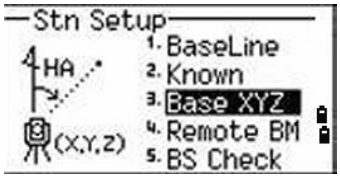
Base XYZ does not store an ST record in the job, so the BS Check cannot check the backsight if you enter a station using the Base XYZ option.

You can use this function without an open job.

1. Press 3 or select `Base XYZ` from the Stn Setup menu.

   The current instrument XYZ values are shown as the default.

2. Enter the new instrument XYZ values and then press ENT.



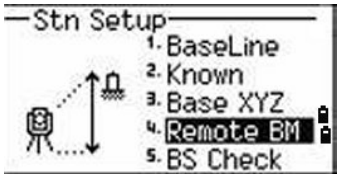
3. Do one of the following:
   - To reset the horizontal angle, enter a value in the HA field and then press ENT.
   - If you do not need to reset the horizontal angle, leave the HA field blank and then press ENT.

   The Stn Setup menu appears.

Remote BM

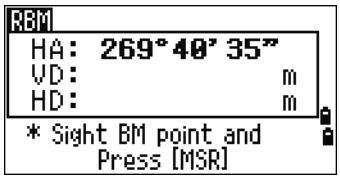
Select this option to determine the station elevation.

1. Press 4 or select `Remote BM` from the Stn Setup menu.
2. Enter the BM point and press ENT. The point appears briefly. The cursor then moves to the HT field.

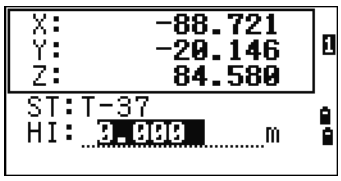


3. Enter the HT and then press ENT.

4. Sight the Bench Mark point and then press MSR1 or MSR2.



The updated station coordinates are displayed. You can change the HI in this screen.



5. To record the updated STN, press ENT.

When the HI setting is changed, the Z coordinate is updated before the station is recorded.

You must complete a station setup before you use the Remote Benchmark function.

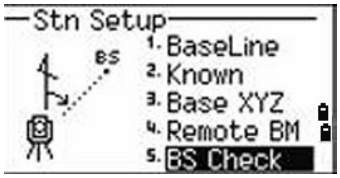
BS Check

Select these options to check and reset the backsight direction.

Note – *Complete a station setup before using the BS check function.*

This function always refers to the backsight point from the last station (ST) record stored in the current open job.

1. Press 5 or select `BS Check` in the Stn Setup menu.



The HA field refers to the current HA reading, and the BS field refers to the BS in the last station setup. Enter station coordinates for observations without recording data.

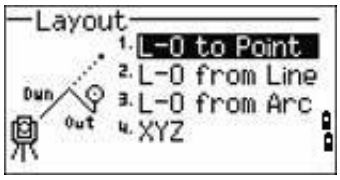
2. Do one of the following:

   – To reset the horizontal angle to the HA set in the last station setup, sight the BS and then select the `Reset` softkey or press ENT.

   – To cancel the process and return to the BMS, select the `Abrt` softkey or press ESC.

Layout menu

To access the Layout menu, press L-O in the BMS.



To select a command from the Layout menu, press the corresponding number key. Alternatively, press ^ or v to highlight the command and then press ENT.

The last function used is highlighted.

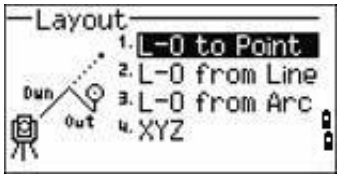
There are four layout options:

- L-O to Point, page 62
- L-O from Line, page 63
- L-O from Arc, page 64
- XYZ, page 65

L-O to Point

Use this method to lay out a point based on the down, out, and dZ location to a specified line.

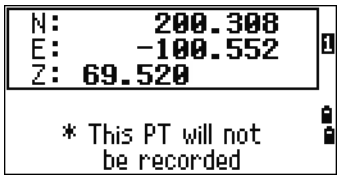
1. Press 1 or select `L-O to Point` from the Layout menu.



2. Enter the first point (P1) along the line.

   Alternatively, select the `MSR` softkey to measure a point.

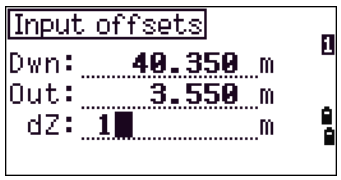
   If you press ENT without entering a PT name, you can enter temporary coordinates. Temporary coordinates are not recorded in the job.



3. Enter the second point (P2) along the line.
4. Enter offsets to the line.

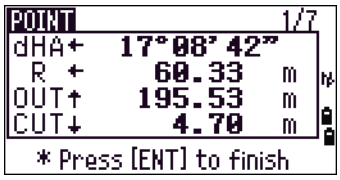
   To enter the value 0.0000, press ENT in a blank field.

Sta	Distance from P1 along the line
O/S	Distance perpendicular to the line
(+)	Right side of the P1—P2 line
(-)	Left side of the P1—P2 line
dZ	Difference in height from the line



5. Rotate the instrument until the dHA is close to 0°00'00".
6. Sight the target, and then press MSR1 or MSR2.

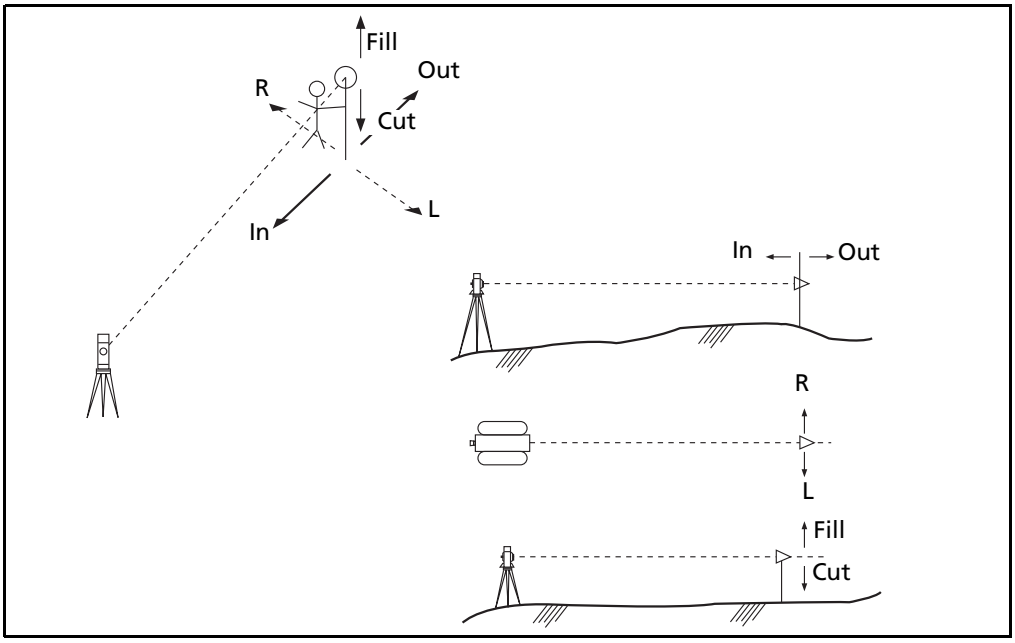
When a distance measurement is taken, the difference between the measured point and the design point appears.



7. To record the point as an SO record, press ENT.

Note – *Press DSP to switch between display screens. See also page 83.*

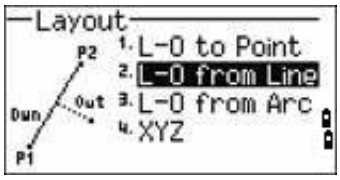
The following figure shows the terminology used to guide you to the required point.



L-O from Line

Select this option to measure distance and offset values along a specified line.

1. Press 2 or select `L-O from Line` from the Layout menu.



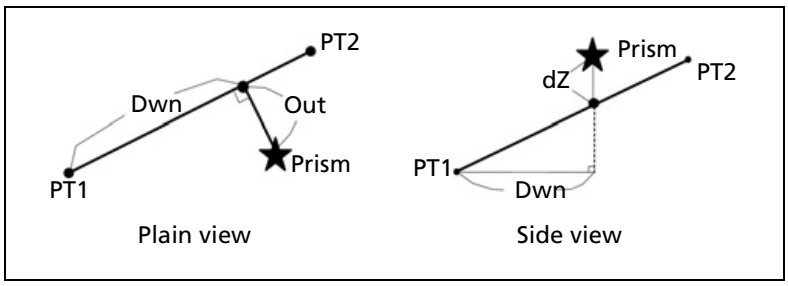
2. Enter the first point for the reference line.

   Alternatively, select the `MSR` softkey to measure a point.

   If you press ESC in the Record PT screen, the measured point is used but not recorded in the job.

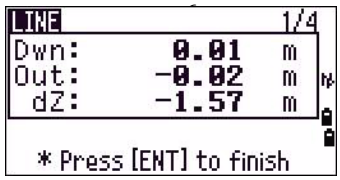
3. Enter the second point for the reference line.
4. Enter an asterisk (for example, A*) in the PT field to perform a wildcard search. A list of matching points appears. Highlight a point in the list and then press ENT.

The following figure shows how to determine or input a location relative to a line used for Layout.



5. Sight the prism or reflective sheet and press MSR1 or MSR2.

Dwn	Horizontal distance from P1 to the measured point along the P1-P2 line
Out	Horizontal offset from the P1-P2 line to the measured point
dZ	Vertical offset from the P1-P2 line to the measured point

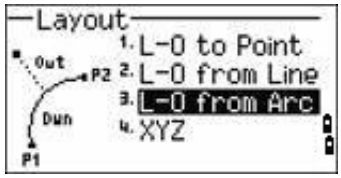


Note – *Press* DSP *to switch between display screens. See also page 83.*

L-O from Arc

Select this option to measure distance and offset values on the arc-curve.

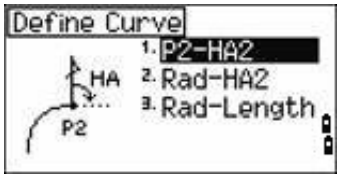
1. Press 3 or select `L-O from Arc` from the Layout menu.



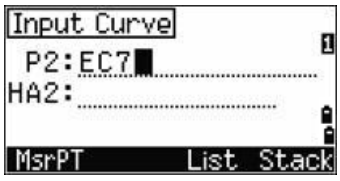
2. Enter the start of the curve point (P1) and the azimuth of its tangent line (HA1).

   Alternatively, to enter P1 by direct measurement, select the `MSR` softkey.

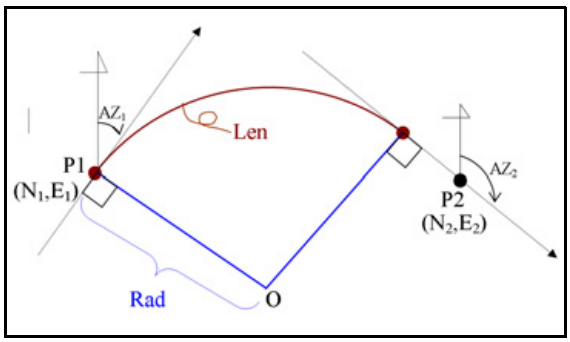
3. Choose a method to define the curve.



   P2 can be any point on the tangent line that is to exit the curve.



4. In the radius (Rad) field, enter a positive value for a clockwise curve. Enter a negative value for a counter-clockwise curve.



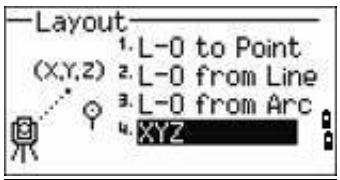
Once you entered all factors, the TS635 Construction Total Station calculates the curve. If the curve length (Len) is too large for a circle of the given radius, the curve is shortened.

Note – *Press* DSP *to switch between display screens. See also page 83.*

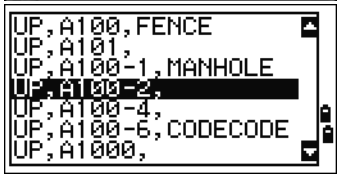
XYZ

Select this option to specify the layout point by coordinates.

1. Press 4 or select XYZ in the Layout menu.

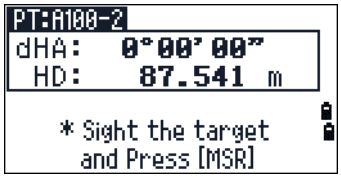


2. Do one of the following:
   - Enter the point name that you want to establish and then press ENT.
   - Specify the point by code or radius from the TS635 Construction Total Station. If several points are found, they are displayed in a list. Press ^ or v to move up and down the list. Use < to move up one page, or > to move down one page.



3. Highlight a point in the list and then press ENT.

   The delta angle and the distance to the target are shown.

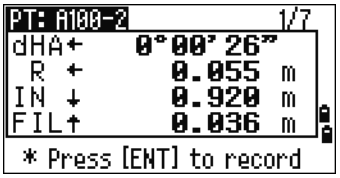


4. Rotate the instrument until the dHA is close to 0°00'00". Press MSR1 or MSR2.

dHA	Difference in horizontal angle to the target point
HD	Distance to the target point

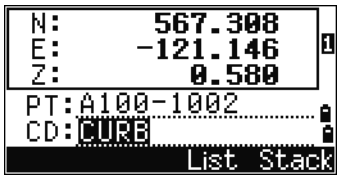
5. Ask the rod person to adjust the target position. When the target is on the intended position, the displayed errors become 0.000 m (0.000 ft).

dHA	Difference in horizontal angle to the target point
R/L	Right/Left (Lateral error)
IN/OUT	In/Out (Longitudinal error)
CUT/FIL	Cut/Fill



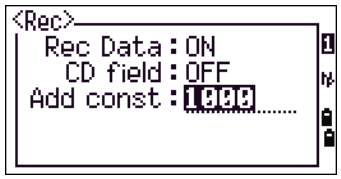
Once a measurement is taken, the Cut/Fill value and Z coordinate are updated as the VA is changed.

6. To record the point, press ENT. The PT field defaults to the specified PT + 1000.

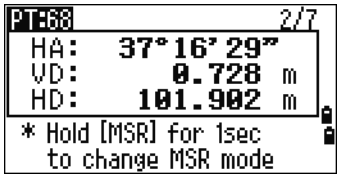


Press MENU and then select `Settings / Rec.`

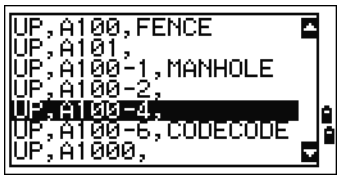
Use the Add Constant field to specify an integer. The integer is added to the point number that is being laid out to generate a new number for recording the layout point. The default value is 1000. For example, when you stake out PT3 with an Add Constant of 1000, the default value in the SO field (layout record) is 1003.



The display then returns to the observation screen. Press ESC. The display returns to the PT/CD/R input screen. If you entered the stakeout point using a single point name, the PT defaults to the last PT + 1.

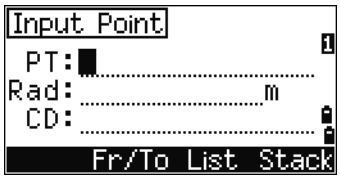


7. If you selected a point from the list, the display returns to the list, unless all points have been selected. Press ESC to return to the point input screen.

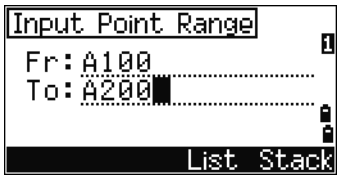


Advanced feature: Specifying a layout list by inputting points by range

1. Select the Fr/To softkey when the PT field is selected.

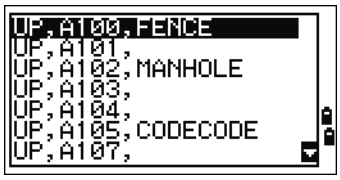


2. Enter the start point (Fr) and the end point (To). The range between Fr and To must be less than 1001 points.

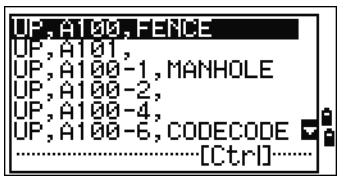


   – If existing points are found between Fr and To, a point list appears.

     To highlight a point in the list, press ^ or v. To go to the layout observation screen, press ENT.

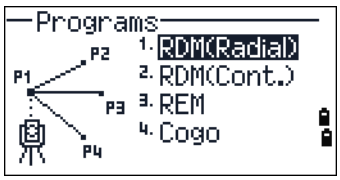


   – If you have assigned a control job, and additional points are found in the control job, the Ctrl softkey appears under the list.



Programs menu

To access the Programs menu, press PRG in the BMS.



To select a command from the Programs menu, press the corresponding number key. Alternatively, press ^ or v to highlight the command and then press ENT.

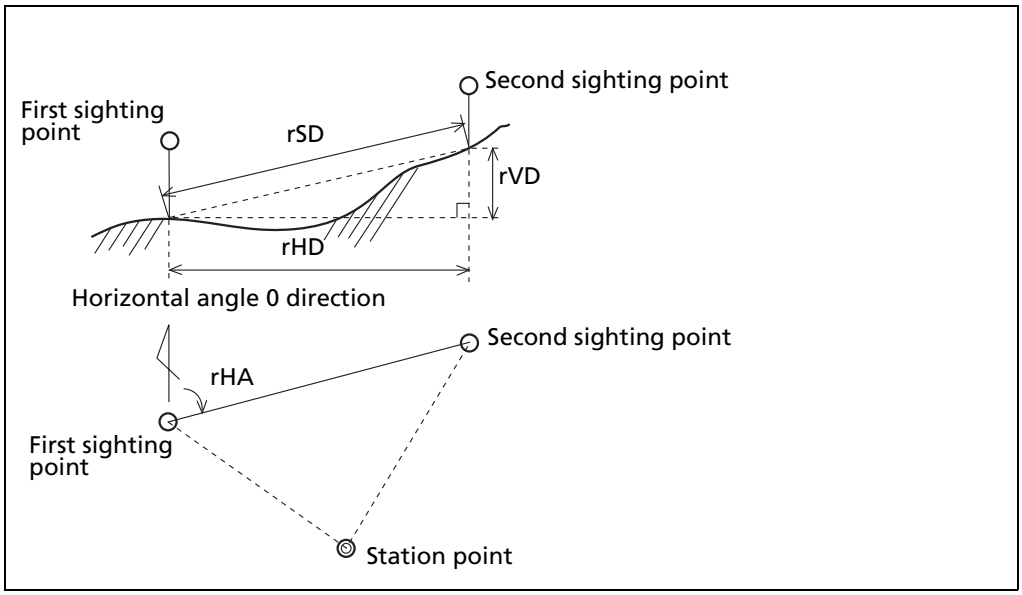
The last function used is highlighted.

The Programs menu has the following options:

- RDM (Radial), page 69
- RDM (Cont), page 69
- REM, page 70
- V-Plane, page 70
- Cogo, page 71

Remote distance measurement (RDM) - overview

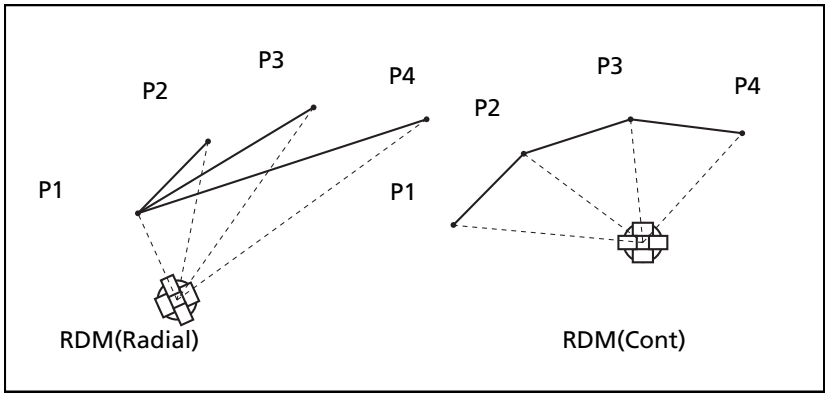
RDM or “Remote distance measurement” measures the horizontal distance, vertical distance, and slope distance between two points.



rSD	Slope distance between two points
rVD	Vertical distance between two points
rHD	Horizontal distance between two points
rV%	Percentage of grade (rVD/rHD) × 100%
rGD	Vertical grade (rHD/rVD):1
rAZ	Azimuth from first point to second point

Difference between RDM (Radial) and RDM (Cont) measurement methods

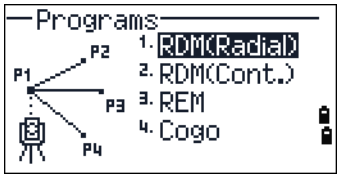
RDM (Radial) calculations are made with reference to the first point. RDM (Cont) calculations are made with reference to the two preceding points.



RDM (Radial)

Choose this option to measure between the current point and the first point measured.

1. Press 1 or select RDM(Radial) in the Programs menu.

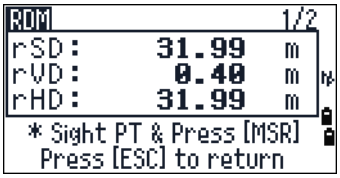


2. Sight the first point and press MSR1 or MSR2.

   The distance from the station point to the first point appears.

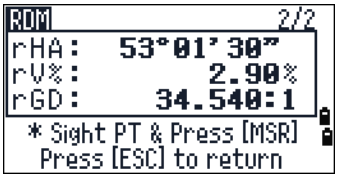
3. Sight the second point and press MSR1 or MSR2. The distances between the first and second point are displayed.

rSD	Slope distance between two points
rVD	Vertical distance between two points
rHD	Horizontal distance between two points



4. To change display screens, press DSP.

rHA	Azimuth from first point to second point
rV%	Percentage of grade (rVD/rHD) × 100%
rGD	Vertical grade (rHD/rVD): 1

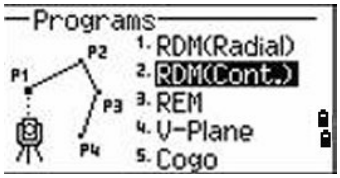


5. Press ESC to exit.

RDM (Cont)

Choose this option to measure between the current point and the immediately preceding point.

1. Press 2 or select RDM(Cont.) from the Programs menu.

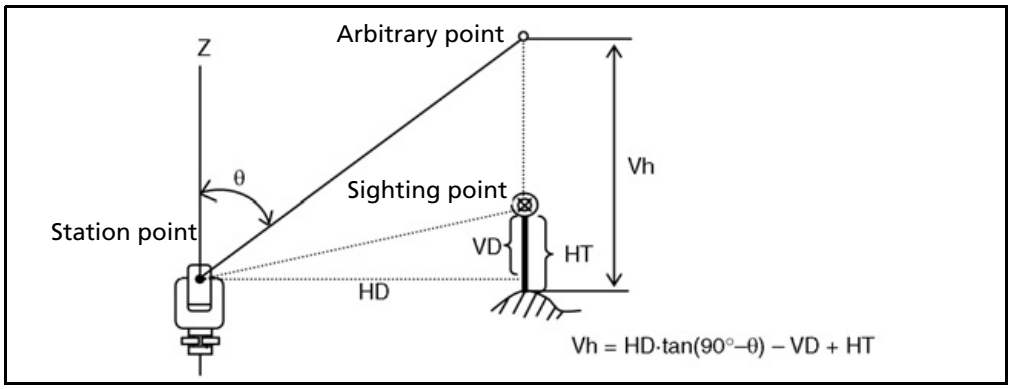


2. Follow the procedure as for a radial RDM measurement. See also RDM (Radial), page 69.

REM

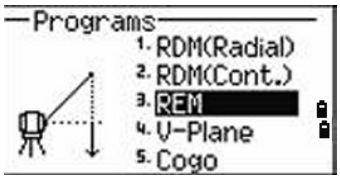
Choose this option to measure a remote elevation.

Note – *A prism is required only at the sighting (target) point.*



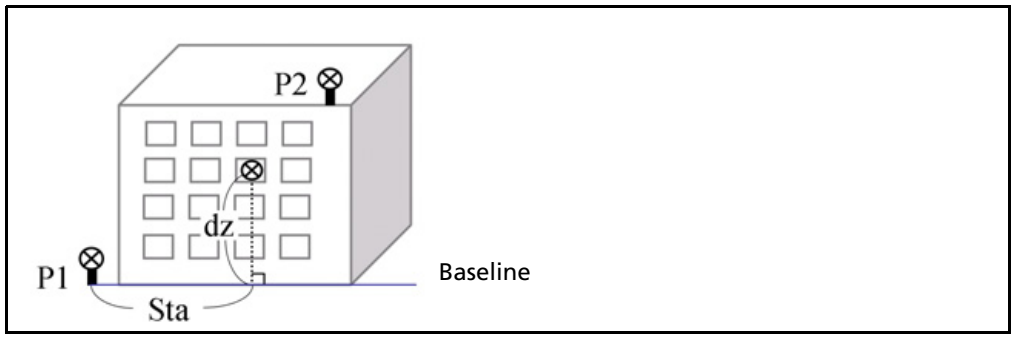
1. Press 3 or select REM in the Programs menu.
2. Enter the height of the target.
3. Sight the target point and press MSR1 or MSR2.
4. Loosen the vertical clamp and then turn the telescope to aim at an arbitrary point.

   The difference in elevation (Vh) appears.
5. Press ESC to exit.

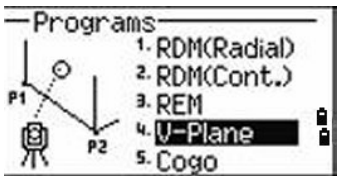


V-Plane

Choose this option to measure distance and offset values in the vertical plane, using the 2-Pt Reference Plane function.



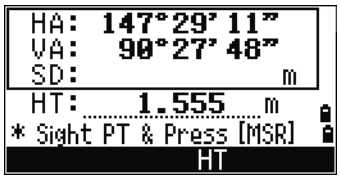
1. Press 4 or select V-Plane in the Programs menu.
2. Enter the first point in the vertical plane:



a. To enter the first point by direct measurement, select the MSR softkey. A temporary observation screen appears.

b. Press MSR1 or MSR2. The Record PT screen appears.

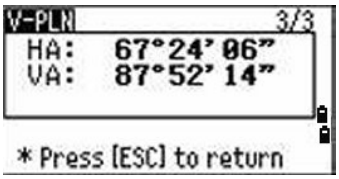
c. Enter a value in the PT and CD fields, and then press ENT.



3. Enter the second point in the vertical plane. To do this, repeat Step 2.

Once the plane is defined, the calculated Dwn and dZ values are updated as you move the telescope. No distance measurement is required.

Dwn	Horizontal distance from P1 to the target point along the baseline
dZ	Vertical distance from P1 to the target point



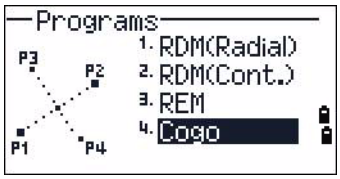
Note – *Press* DSP *to switch between display screens. See also page 83.*

4. Press ESC to exit this function.

Cogo

Choose the Cogo option to perform coordinate geometry (Cogo) calculations.

To open the Cogo menu, press 5 on the Programs menu.



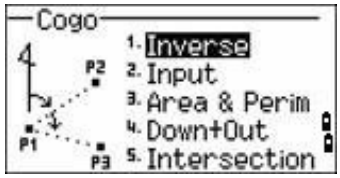
There are five items in the Cogo menu:

- Inverse, page 72
- Input, page 74
- Area & Perm, page 76
- Down+Out, page 77
- Intersection, page 78

Inverse

Choose this option from the Cogo menu to calculate angle and distance between two coordinates.

Press 1 or select Inverse in the Cogo menu. The Inverse menu appears.

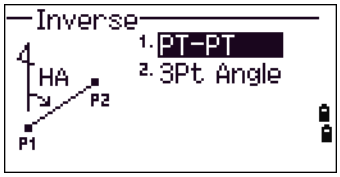


PT-PT inverse

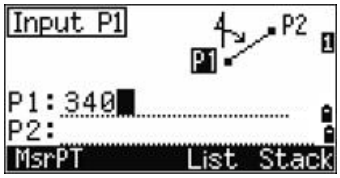
PT-PT calculates the distance and the angle between two input points.

To calculate a PT–PT inverse:

1. Press 1 or select PT-PT in the Inverse menu.

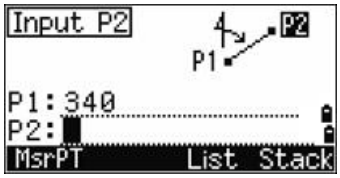


2. Enter the first point number or name, and then press ENT.

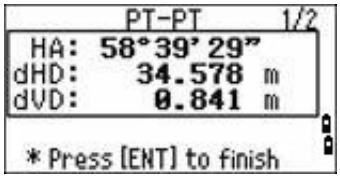


If you press ENT without entering a point name, a coordinate input screen appears, and you can enter coordinates. These coordinates are ***not*** stored to the database. If you want to store the point, specify a new point name.

3. Type the second point number/name, and then press ENT. If necessary select the MSR softkey to shoot the point on the spot so that you can use it in the calculation.



The azimuth, horizontal distance, and vertical distance from the first point to the second point are displayed.

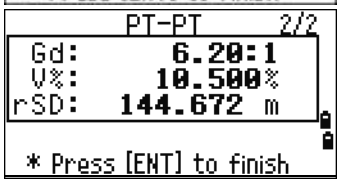


4. Do one of the following:

   – To return to the PT input screen, press ESC.

   – To return to the Cogo menu, press ENT.

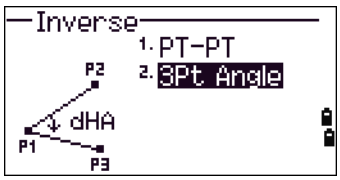
   – To change the contents of the result screen, press DSP.



Gd	Grade (HD/VD)
V%	100/Gd
rSD	Slope distance PT1 to PT2

3Pt Angle

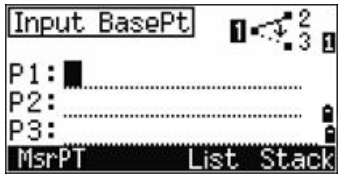
If you choose 3Pt Angle, the TS635 Construction Total Station calculates the angle between two lines defined by three points.



To calculate a 3Pt angle:

1. Press 2 or select `3Pt Angle` from the Inverse menu.

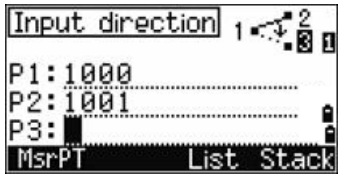
   P1 is the base point. Two lines are to be defined by P2 and P3, both from P1.



2. Enter the P1 point name. Alternatively, use the `MSR` softkey to take a measurement to the point.

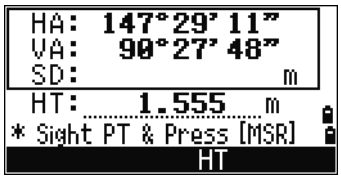
3. Enter the second point (P2) to define the baseline, P1–P2. The angle (dHA) is measured from the baseline.

4. Enter the third point (P3) to define the second line, P1–P3.

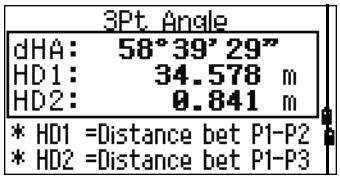


   When you press the MSR softkey, a temporary measuring screen appears. Sight the target and press MSR1 or MSR2 to take a measurement.

   After the measurement, a recording point screen appears. To store the measured point, enter the PT, HT, and CD values and press ENT. To use the point without recording it, press ESC.



   When you have entered three points, the instrument calculates the angle and distances.



5. Do one of the following:

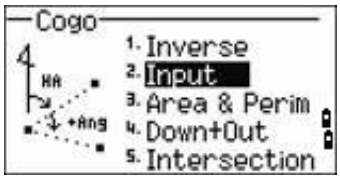
   – To return to the Inverse menu, press ENT.

   – To return to the Input BasePt screen, press ESC.

Input

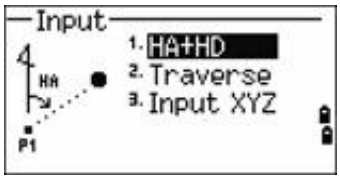
Choose this option from the Cogo menu to calculate and manually input coordinates.

To enter the Input menu, press 2 or select Input from the Cogo menu. There are three functions in this menu for recording new coordinate points.

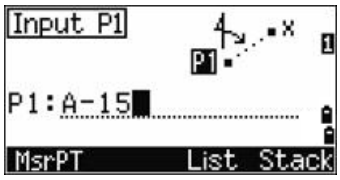


Azimuth+HD input

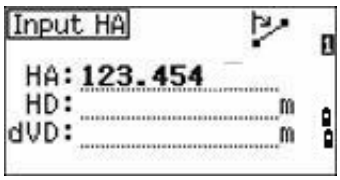
To calculate a coordinate by an angle and distance input from the base point (P1), press 1 or select HA+HD from the Input menu.



Enter the base point, P1. Type the point name and press ENT.

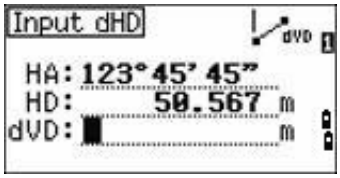


Enter the azimuth, horizontal distance, and vertical distance. Then press ENT.



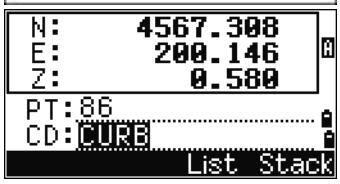
For example, to enter 123°45'45", type 123.4545 and then press ENT.

If you do not enter a value in the dVD field, the value 0.0000 is used.



A recording point screen with the calculated coordinates appears. The PT field defaults to the last recorded point + 1.

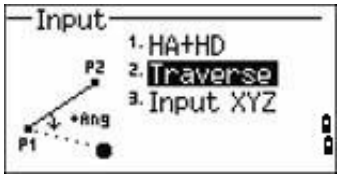
Press ENT to store the point.



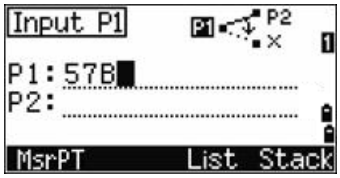
Traverse

To calculate a new point based on two defined points and the angle, horizontal and vertical distances from the line defined by those two points, use the Traverse (2Pt Angle) function.

Press 2 or select Traverse in the Input menu.

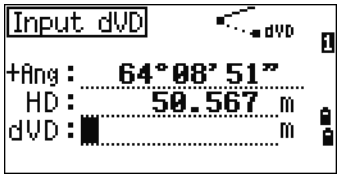


To enter P1 and P2, enter point names or take measurements to targets.



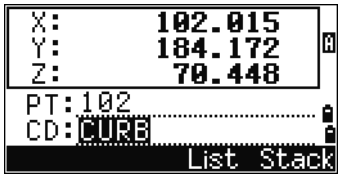
Enter the plus-minus angle, horizontal distance, and vertical distance from the baseline defined by P1–P2.

If you do not enter a value in the dVD field, the value 0.0000 is used.

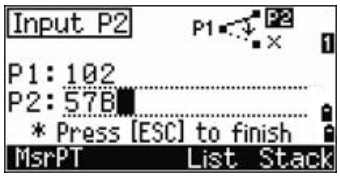


When you press ENT in the dVD field, a new point is calculated. The name in the PT field defaults to the last recorded point, + 1.

To record the new point and return to the point input screen, press ENT.



P1 (the base point) defaults to the previously recorded point value. P2 defaults to the previous P1 value.

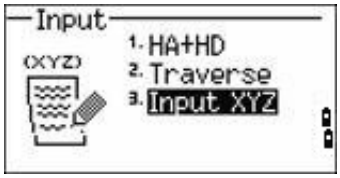


Tip – To continuously calculate a new point, enter +Ang, HD, and dVD from the previous bearing line. This is a convenient way to enter Traverse points.

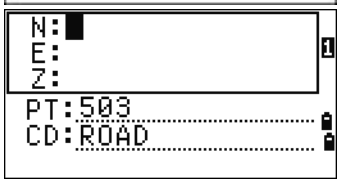
Entering coordinates

To manually enter the XYZ coordinates, press 3 or select `Input XYZ` from the Input menu.

The PT name defaults to the last recorded PT + 1.

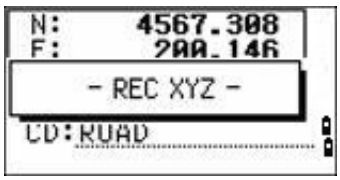


Enter the coordinates using the numeric keys. To move to the next field, press ENT or v in a field.



To store the point as an MP record and return to the point input screen, press ENT in the Z field. The default PT is incremented to the next value.

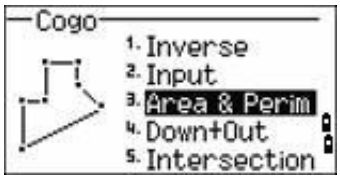
You can record NE, NEZ, or Z-only data.



Area & Perm

Choose this option from the Cogo menu to calculate area and perimeter.

Press 3 or select Area & Perim in the Cogo menu.

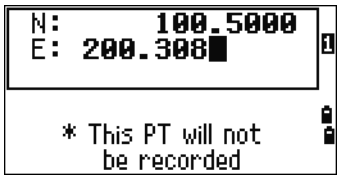


To take a measurement, enter the first point and press ENT, or select the MSR softkey.

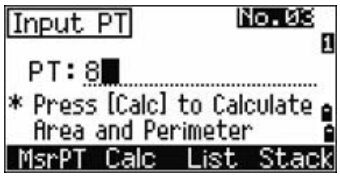
In the upper right corner of the screen, a counter indicates how many points you have entered.

To input point numbers consecutively, use the Fr/To softkey. See also Advanced feature: Entering a range of points, page 76.

If you enter a new point name, you can enter new coordinates and record the point. If you do not want to record the point, press ENT without entering a value in the PT field. An XY coordinate input screen appears.

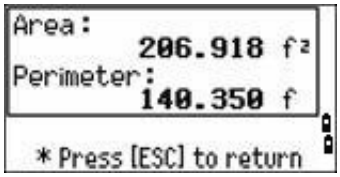


Continue to enter points until you have defined all the points in the lot. Then, press v to calculate the area and perimeter.



The first and last points that you enter are joined to close the area. You must enter the points in the order in which they define the lot. You can enter up to 99 points.

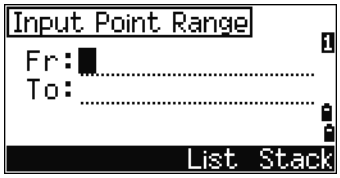
Press ENT to exit from the function, or press ESC to return to the previous screens one by one.



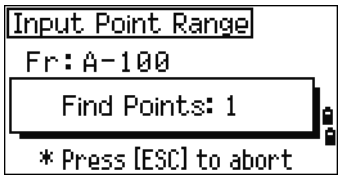
Advanced feature: Entering a range of points

To quickly enter a sequential range of points, use the range input function. To access this function, select the Fr/To softkey in the No. 01 or No. 02 input screens.

Enter the start point name in the Fr field and the end point name in the To field. You can include letters and hyphens in the point names, but the last character must be numeric.



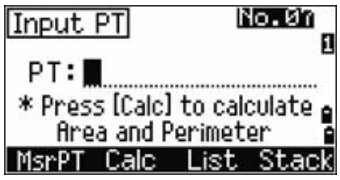
To start searching for matching points, press ENT in the To field. The counter shows the number of matching points found.



When the search is complete, you are returned to the Input PT screen.

Select the Calc softkey to calculate the area and perimeter, or enter point names in the PT field.

Press ESC to return to the Input PT screen where the preceding point name appears.

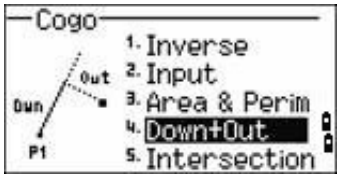


Note – *If you search for a point when a control job is specified, and the system cannot find the point in the current job, the control job is also searched. If the point is found in the control job, it is copied to the current job as a UP record. See also* *Setting the control job, page 89*.

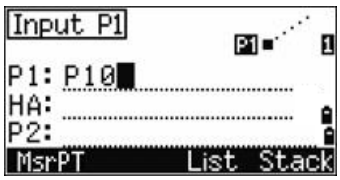
Down+Out

Choose this option from the Cogo menu to calculate coordinates from Down and Out.

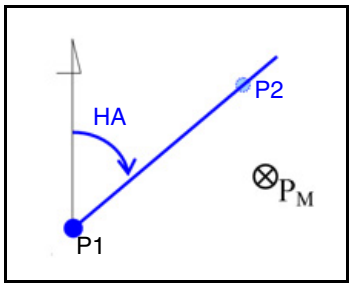
Press 4 or select Down & Out in the Cogo menu.

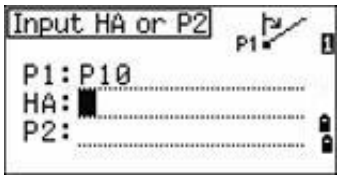


Enter the base point (P1).

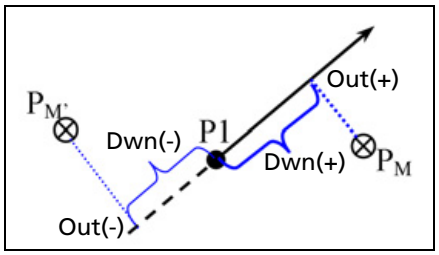


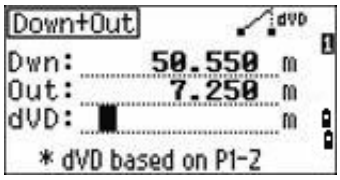
Specify the azimuth bearing. To do this, enter a value in the HA or P2 field. P2 is a second point on the line.





Enter the horizontal distance along the baseline (Dwn), the horizontal distance perpendicular to the line (Out), and the vertical distance (dVD).

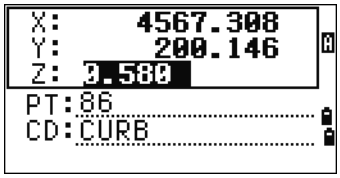




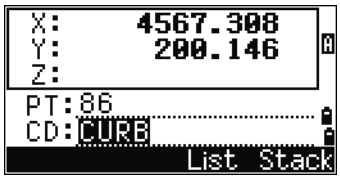
A negative value in the Dwn field means the opposite direction along the defined bearing line.

A negative value in the Out field is for the left-hand side of the bearing line.

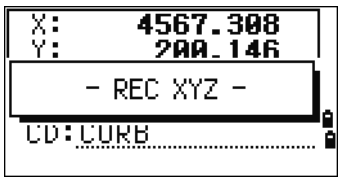
To calculate the coordinates of the point (PM), press ENT in the dVD field. You can change the Z coordinate here.



To record the point, press ENT in the CD field.



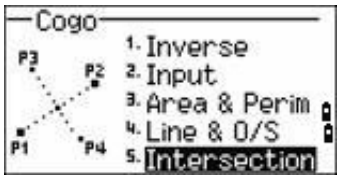
The coordinates are stored as a CC record.



Intersection

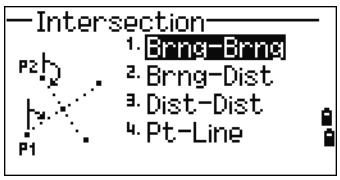
Choose this option from the Cogo menu to calculate coordinates using intersection functions.

Press 5 or select `Intersection` in the Cogo menu. The Intersection menu appears. It has four functions for calculating coordinates.

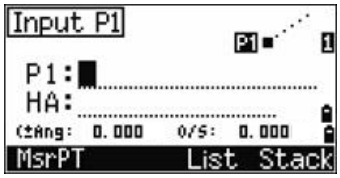


Calculating a bearing-bearing intersection

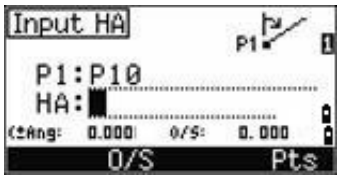
A bearing-bearing intersection is the intersection point of two lines. To calculate a bearing-bearing intersection:



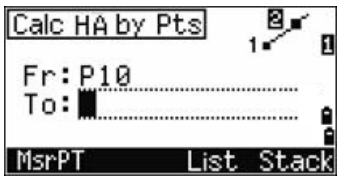
1. Press 1 or select Brng-Brng in the Intersection menu.



2. Enter the first point name and press ENT. Alternatively, to measure directly to the point, select the MSR softkey.



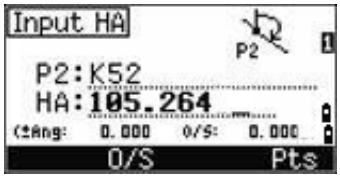
3. Define the first line by azimuth.



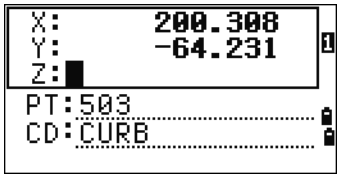
4. To define the line by two points, select the Pts softkey. The Fr field defaults to the P1 point, but you can change the selected point. In the To field, enter or measure to the second point.

   See also Advanced feature: Entering angle and distance offsets, page 82.

5. Do one of the following:
   - To return to the previous screen, press ENT. The calculated value appears in the HA field.
   - To go to the next screen, press ENT.



6. Define the second line by two points or by P2 and HA.



7. To calculate the coordinates of the intersection point, press ENT in the HA field.

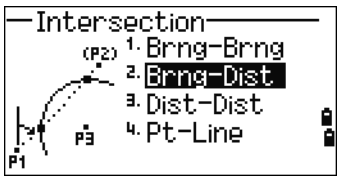
   The calculated coordinates are displayed. You can input a Z coordinate if necessary.

8. Enter a value in the PT field and in the CD field.
9. To record the point, press ENT.

Calculating a bearing-distance intersection

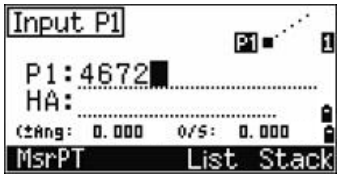
1. Press 2 or select Brng-Dist in the Intersection menu.

   Brng-Dist calculates the intersection point formed by one line and one distance (radius).



2. Enter a point on the line.

   The line can be defined by two points or by a point and an azimuth.

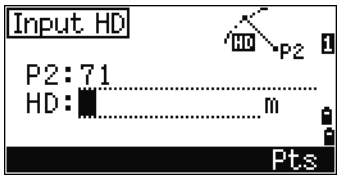


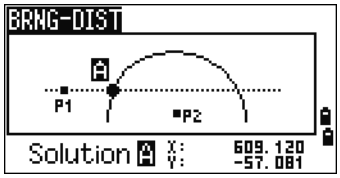
3. Enter the second point (P2) as the center of the circle.

4. Enter the distance from P2:

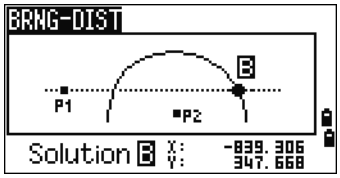
   – To define the distance (HD) by two points, select the Pts softkey.

   – To calculate the coordinates of the intersection point, press ENT in the HD field.

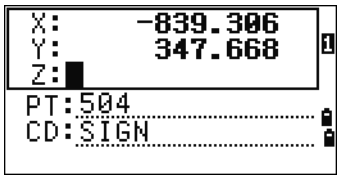




5. If there are two results, the first solution appears graphically relative to the P1–P2 line. To display the second solution, press < or >.
6. To record the point, press ENT when the required solution appears.

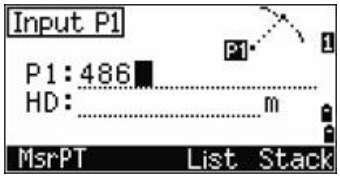


7. Enter a Z coordinate if necessary.
8. To move to the PT and CD fields, press ENT.

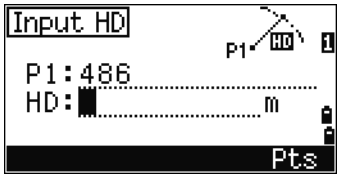


Calculating a distance-distance intersection

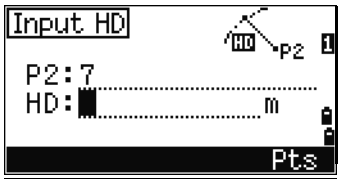
1. Press 3 or select Dist-Dist in the Intersection menu.
2. Enter the first point name and press ENT, or select the MSR softkey to measure directly to the point.



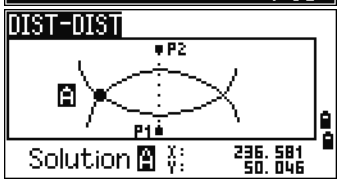
3. Enter the distance from P1 and press ENT.
4. To define the distance (HD) by two points, select the Pts softkey.



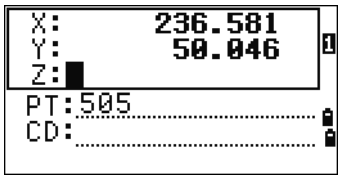
5. Enter P2 and the distance from P2 (HD).
6. To calculate the coordinates of the intersection point, press ENT in the HD field.



7. Press < or > to display the second solution.
8. To record the point, press ENT when the required solution appears.

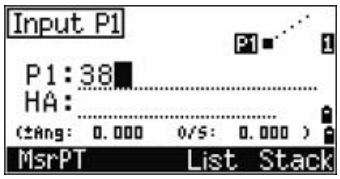


9. Enter a Z coordinate if necessary.
10. Press ENT to move to the PT and CD fields.

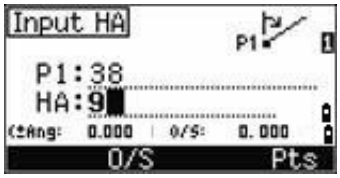


Calculating a point-line intersection

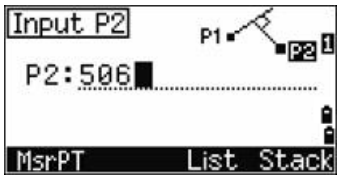
1. Press 4 or select Pt-Line in the Intersection menu.
2. Enter the first point name and press ENT, or select the MSR softkey to measure directly to the point.



3. Enter the azimuth, or select the Pts softkey to enter another point name on the line.

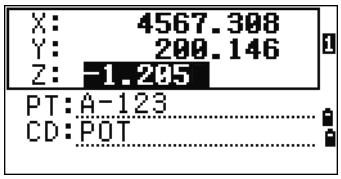


4. Enter the perpendicular point to the line, or select the MSR softkey to take a measurement to the point.



5. To calculate the coordinates of the intersection point, press ENT.

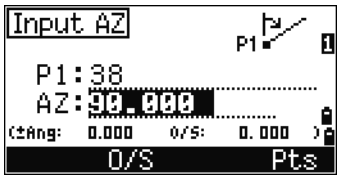
   If P1 and P2 are 3D points, the Z coordinate of the perpendicular point is calculated relative to the P1–P2 slope.



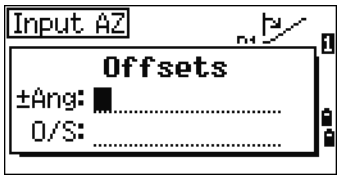
6. Enter PT and CD then press ENT to record the point.

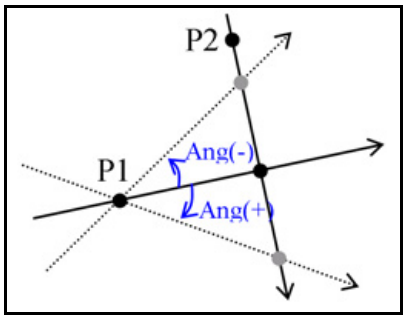
Advanced feature: Entering angle and distance offsets

To display the offset input screen, select the O/S softkey.

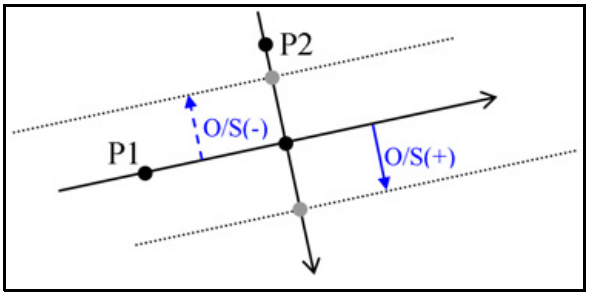


In the Ang field, enter a positive value to rotate the line clockwise. Enter a negative value to rotate the line counter clockwise.



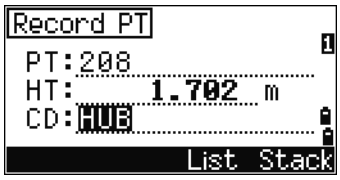


In the O/S field, enter a positive value to specify an offset to the right. Enter a negative value to specify an offset to the left.



Recording measurement data

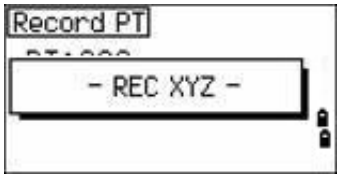
To record points from any observation screen, press ENT.



PT defaults to the last recorded PT, + 1.

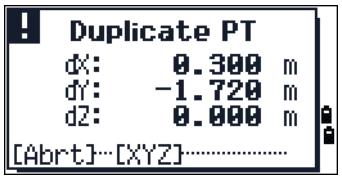
You can enter the PT name from the point list or the point stack. See Entering a point from the point list, page 49, and Entering a point from the point stack, page 49.

To record the point, press ENT on the last field.

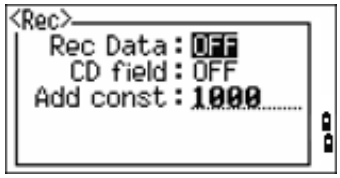


If HA or VA is moved after you take a measurement, but before you press ENT, the recalculated coordinates will be stored.

If the point name that you want to record already exists in the job, an error message appears. Depending on the type of existing record, you can overwrite the old record with the new data. See Recording data, page 125.



If you do not need to record data, press MENU and set Settings / Rec to OFF.



The default setting is OFF.

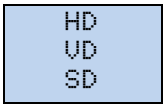
Switching between display screens

Press DSP to switch between display screens. See the DSP button, page 40. Each time you press DSP, the next screen appears. When you press DSP in the final screen, the first screen appears.

The following line display screens are available.

LINE1	LINE2	LINE3	LINE4
dOWN	X	HA	HA
OUT	Y	VA	VD
dZ	Z	SD	HD

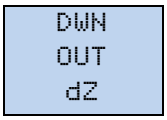
LINE5



The LINE5 screen is available only if the secondary distance unit is set. See also Other settings, page 94.

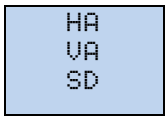
The following arc display screens are available.

ARC1

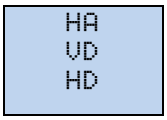


ARC2

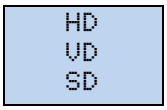
ARC3



ARC4



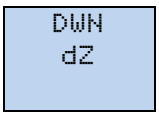
ARC5



The ARC5 screen is available only if the secondary distance unit is set. See also Other settings, page 94.

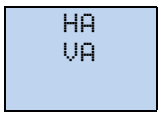
The following plane display screens are available.

PLN1



PLN2

PLN3



CHAPTER

5

Menu Screen

In this chapter:

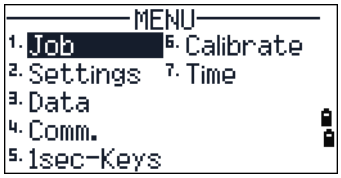
- Job
- Settings (basic job settings)
- Data
- Communication
- 1sec-Key
- Calibration
- Time

Use the MENU screen to access functions and settings.

To display the MENU screen, press the MENU key.

Job

Use the Job option to open, create, delete, and manage jobs.



To open the Job Manager, press 1 or select `Job` from the MENU screen.

If jobs are stored on the TS635 construction total station, the job list appears. It shows all the stored jobs with the newest job at the top of the list. See Opening an existing job, page 86.

If no jobs are stored, the Create Job screen appears. See Creating a new job, page 86.

Opening an existing job

The job list shows all the jobs stored on the instrument, in descending date order.

The following symbols provide extra information about jobs:

Symbol	Meaning
*	Current job
@	Control job
!	Some of the job settings are different from the current job

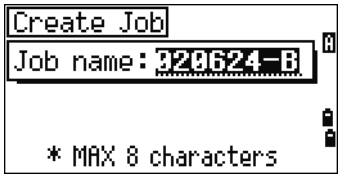
Press ^ to move up or v to move down the job list. Press ENT to open the highlighted job.

When you open a job, all job settings are automatically changed to match those used in the open job.

Creating a new job

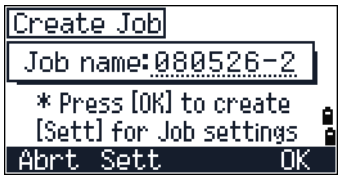
1. Select the `Creat` softkey in the job list.

2. Enter a job name of up to eight characters. Select ENT.



3. Do one of the following:

- To check the job settings, select the Sett softkey.
- To create a new job using the current job settings, press ENT or select the OK softkey.



Job settings

Job settings are separate from other temporary settings.

Job settings are established when a job is created, and cannot be changed. This ensures that the data in a job is correctly stored in the database, and that all necessary corrections are applied when you store each record.

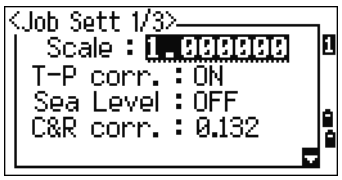
To move between fields, press ^ or v. Alternatively, to move to the next field, press ENT.

To change the setting in the selected field, press < or >.

To confirm the job settings and create the job, press ENT in the last field.

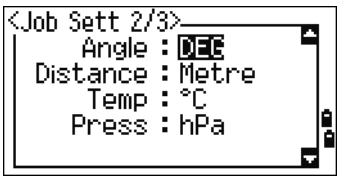
Screen 1

Scale Factor	0.999600 to 1.000400
T-P correction	ON / OFF
Sea Level	ON / OFF
C&R correction	OFF / 0.132 / 0.200



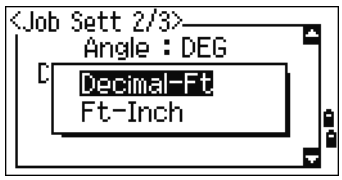
Screen 2

Angle unit	DEG / GON /MIL
Distance unit	Metre / US-Ft / I-Ft
Temp unit	°C / °F
Press unit	hPa / mmHg / inHg



Screen 3

If you select US–Ft or I–Ft, an additional settings screen appears. Use this screen to specify whether to display values in Decimal–Ft or Ft–Inch.



VA zero	Zenith / Horizon
Order	NEZ / ENZ

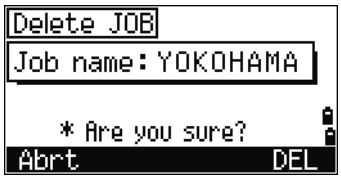
Deleting a job

Note – *There is no undelete function in Job Manager. Before you press* ENT *or select* DEL*, make sure that the selected job is the one that you want to delete.*

1. In the job list, highlight the job to delete.

2. Select the DEL softkey. A confirmation screen appears.
3. Do one of the following:
   - To delete the selected job, press ENT or select the DEL softkey.
   - To cancel the deletion and return to the previous screen, press ESC or select the Abrt softkey.

   After you delete a job, the job list appears.



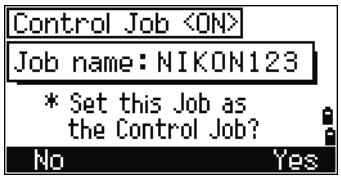
Setting the control job

A control job has the same format as a standard job. You can open and modify it like any other job, and you can use it to record any measured data.

To set the control job:

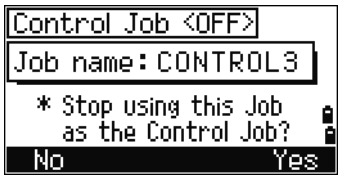
1. Highlight the job that you want to use as the control job.
2. Select the `Ctrl` softkey.

   A confirmation screen appears.



3. Do one of the following:
   - To set the selected job as the control job, press ENT or select the `Yes` softkey.
   - To cancel the process, press ESC or select the `No` softkey.

   If a control job is already assigned, the newly assigned control job replaces it as the control job.



   To clear the selected control job, highlight the current control job in the job list and select the `Ctrl` softkey. Then press ENT or select the `Yes` softkey.

Displaying job information

To display job information, highlight the job name and then select the `Info` softkey.

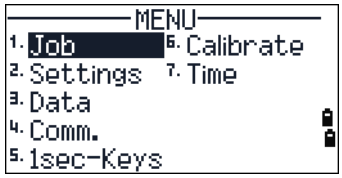
The Information screen shows the number of records in the job, the free space, and the date when the job was created. Free space indicates how many points can be stored in the job.

To return to the job list, press any button.

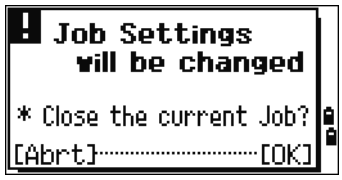
Settings (basic job settings)

Use the Settings menu to configure the basic job settings.

Press 2 or select Settings on the MENU screen.

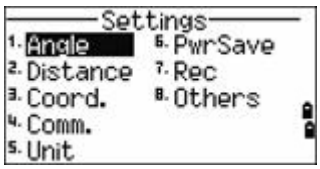


Some job settings, as identified in the following sections, cannot be changed once a job is created. If you attempt to change any of these settings while a job is open, a confirmation screen appears, asking you to create a new job with the new settings, or to work with the new settings without recording any data. See Settings, page 126.

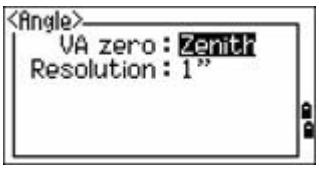


Angle

To change the angles, press 1 or select Angle in the Settings menu.



VA zero	Zenith / Horizon
Resolution	1" / 5" / 10" 0.2 / 1 / 2 mgon 0.005 / 0.02 / 0.05 mil



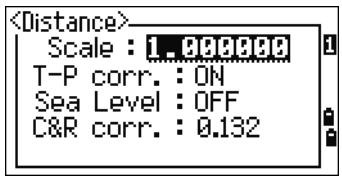
The VA zero job setting cannot be changed once a job is created.

Distance

These settings cannot be changed once a job is created.

To change the distance, press 2 or select Distance in the Settings menu.

Scale	Numeric value between 0.999600 and 1.000400
T-P corr	ON / OFF
Sea Level	ON / OFF
C&R corr	OFF / 0.132 / 0.200



Temperature and pressure corrections

$$K = 275 - \frac{106 \times P \times \left(\frac{10000.0}{13.5951 \times 980.665}\right)}{273 + T}$$

$$SD' = \left(1 + \frac{K}{1000000}\right) \times SD$$

SD	Slope dist. (before adj.)
SD'	Slope dist. (after adj.)
K	Compensation coefficient
P	Pressure (hPa)
T	Temperature (°C)

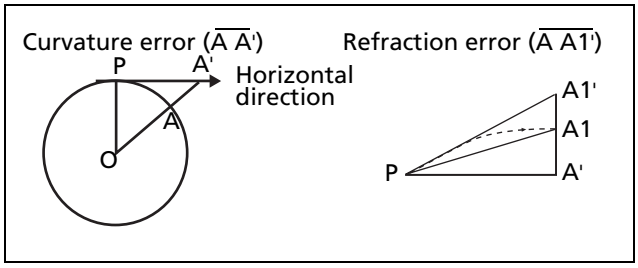
Sea-level corrections

$$HD' = \frac{HD \times R_e}{R_e + Z_{STN}}$$

HD	Horizontal dist. (before adj.)
HD'	Horizontal dist. (after adj.)
Z_{STN}	Instrument-Z
R_e	6370 km

Curvature and refraction corrections

Because the surface of the earth is curved, the vertical difference (VD and Z) at the measurement point, as referenced to the horizontal plane, inevitably includes some error. This error is called ***curvature error***. Also, because the density of the air surrounding the earth decreases with altitude, light is refracted at different rates at different altitudes. The error caused by this change in refraction is called ***refraction error***.



$$HD' = HD - \frac{SD^2 \sin(2VA)}{2R_e}\left(1 - \frac{k}{2}\right)$$

$$VD' = VD + \frac{HD^2}{2R_e}(1 - k)$$

HD	Horizontal dist. (before adj.)
HD'	Horizontal dist. (after adj.)
VD	Vertical dist. (before adj.)
VD'	Vertical dist. (after adj.)
SD	Slope dist
VA	Vertical angle
R_e	6370 km
k	C&R constant (0.132 or 0.200)

Coordinate

Press 3 or select Coord. in the Settings menu. The Coordinate menu appears.

Order	NEZ / ENZ
Label	XYZ / YXZ / NEZ(ENZ)

The Order and AZ job settings cannot be changed once a job is created.

Communications

Press 4 or select Comm. in the Settings menu. The Communication menu appears.

Ext.Comm	NIKON / SET
Port	Serial/Bluetooth
Baud (bps)	1200 / 2400 / 4800 / 9600 / 19200 / 38400
Length	7 / 8
Parity	EVEN / ODD / NONE
Stop bit	1 / 2

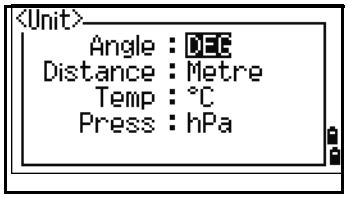
See also Appendix B, Transferring Coordinate Data.

Unit

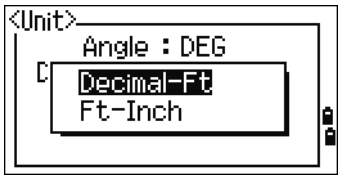
Note – *The Angle, Distance, Temp, and Press job settings cannot be changed once a job is created.*

Press 5 or select Unit in the Settings menu. The Unit menu appears.

Angle	DEG (Degree) GON (GON) MIL (Mil6400)
Distance	Meter US-Ft I-F
Temp	°C (Celsius) °F (Fahrenheit)
Pressure	hPa mmHg inHg



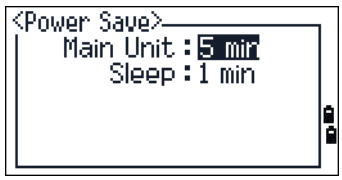
If you select US-Ft or I-Ft, an additional settings screen appears. Use this screen to specify whether to display values in Decimal-Ft or Ft-Inch.



Power saving

To open the Power Save menu, press 4 or select `Pwr Save` in the Settings menu.

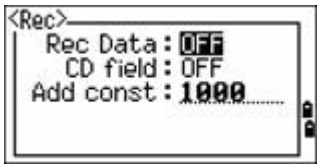
Main unit	OFF / 5 min / 10 min / 30 min
Sleep	OFF / 1 min / 3 min / 5 min



Recording

Press 7 or select `Rec` in the Settings menu. The Rec Menu appears.

Rec Data	ON / OFF
CD field	ON / OFF
Add const	Integer between 1 and 999,999

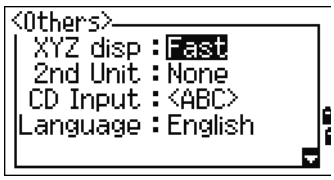


- If you need to record coordinate data from your observations, set the Rec Data field to ON.
- If you would like to record a feature code when you record coordinate data, set the CD field to ON. The CD field appears in the Recording PT screen.
- This field sets the default point number for the observed coordinate data when you select Layout / XYZ.

Other settings

Press 8 or select `Other` in the Settings menu. The Others menu appears.

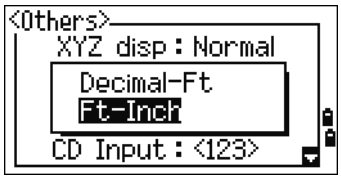
XYZ disp	Fast / Normal / Slow / +ENT
2nd Unit	None / Meter / US-Ft / I-Ft
CD Input	123 / ABC
Language	English / French / German / Italian / Dutch
Owner's Detail	Up to 20 characters



XYZ disp defines the speed to move to the next screen after showing XYZ of the input point.

When the secondary unit is set to a unit, an extra display screen is available in the BMS, layout observation screens, and L–O from line screens. The extra screen shows the HD, VD, and SD in the secondary unit.

If you select US-Ft or I-Ft, an additional settings screen appears. Use this screen to specify whether to display values in Decimal-Ft or Ft-Inch.



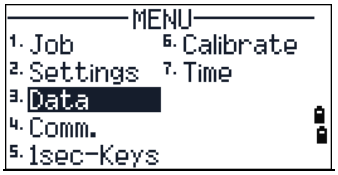
The CD Input field sets the default input mode when a CD field appears.

In the Language field, use [<] / [>] to open the language screen and [v] / [^] to select the required language. Press [ENT] to confirm. In the Reboot confirmation screen, press [ENT] to restart the instrument. The instrument reboots and shows the start-up screen in the selected language. Then a regional setting screen appears, in which you can quickly configure the instrument to a pre-set combination of the default regional settings. See Regional configuration, page 45.

The Owner's Detail field allows you to enter your name or the name of your company. If you enter a value in this field, it appears when you start the TS635 construction total station.

Data

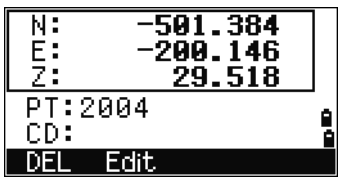
Use the Data menu to view or edit records. To access it, press [3] on the MENU screen.



Viewing coordinate data

Coordinate data appears in a list, with the newest record at the bottom of the screen. Use [^] or [v] to scroll through the records. Use [<] or [>] to move up or down one page.

Press [ENT] to see more detailed information about the selected record.



The header (XYZ, YXZ, NEZ, or ENZ) depends on the Coord. Label setting, which is accessed by pressing MENU and then selecting Settings / Coord. See also Coordinate, page 93.

UP, MP, CC, SS, and SO records

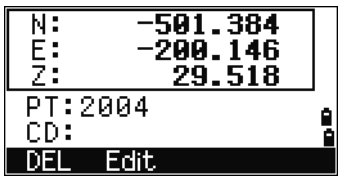
All coordinate records contain PT, CD, X, Y, and Z fields.

- UP records are uploaded point coordinates.
- MP records are manually input point coordinates.
- CC records are points calculated in Cogo.
- SS records are sideshot records stored in the BMS.
- SO records are stored in layout functions.

Deleting coordinate records

1. In the XYZ screen, use ^ or v to highlight the record that you want to delete. Then select the DEL softkey.
2. A confirmation screen appears.
   a. To delete the selected record, press ENT or select the Yes softkey.
   b. To cancel the deletion of data, press ESC or select the No softkey.

Alternatively, delete coordinate data by selecting the DEL softkey in the detailed display screen for the record.



If the record that you want to delete is referred by any station record, a confirmation message appears.

Editing coordinate records

You can edit point, CD, and coordinate values in coordinate records. However, you cannot edit the coordinate record for the current station.

1. Do one of the following:

   - In the XYZ screen, use ^ or v to highlight the record to edit. Then select the Edit softkey.
   - In the detailed data screen, select the Edit softkey.

2. Use ^ or v to highlight a field. Then modify the value in the selected field.
3. When you have finished editing, press ENT in the CD field.

   A confirmation screen appears.
4. Do one of the following:

   - To accept the changes and return to the data view screen, press ENT or select the Yes softkey.
   - To go back to the edit screen, press ESC or select the No softkey.

Searching coordinate records

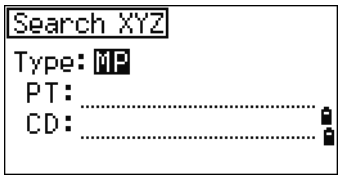
You can search for records by their type, point name, code, or by any combination of these values.

In the XYZ screen, select the Srch softkey to access the XYZ data search function.

To search for a record by point name, enter the point name in the PT field and press ENT twice.

You can use the asterisk (*) as a wildcard. For example, when you enter **500*** in the PT field, the search matches the points named 500, 500-1, 500-A, and 5000.

To search for a record by point type, move to the Type field and use < or > to change the selected point type. The options are ALL, MP, UP, CC, and RE.



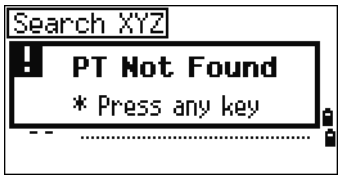
- If more than one point matches the search criteria, the matching points are displayed in a list.

Use ^ or v to highlight the required point. Press ENT to select it.

Detailed data for the selected record appears. Select the DSP softkey to change the fields shown.

Press ESC to return to the list.

- If no point matches the specified criteria, an error screen appears. Press any button to return to the data screen.



Entering coordinates

In the XYZ screen, select the Input softkey. A new input point screen appears.

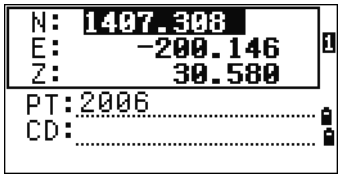
The PT field defaults to the last recorded PT + 1, but you can change the value shown.

Enter the PT and CD and then press ENT to enter coordinates.

Use the numeric keys to enter the coordinates. Press ENT or v in each field to move to the next field.

When you press ENT in the CD field, the point is stored as an MP record.

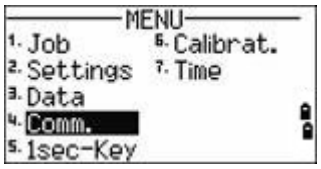
After you have recording a point, the next point input screen is shown with the updated default PT.



You can record NE, NEZ, or Z-only data.

Communication

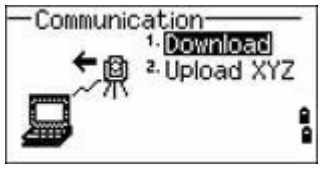
Use the Communication menu to download or upload data. To access it, press 4 or select Comm. on the MENU screen.



Downloading coordinate data

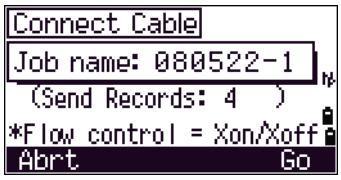
To change the download settings, press 1 or select Download in the Communication menu.

Format	NIKON (Fixed)
Data	Coordinate (all) Coordinate (layout records only)



To display the total number of records that will be downloaded, press ENT in the Data field.

As each record in the current job is output from the TS635 construction total station, the current line number is updated.

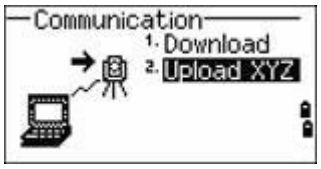


Once transferring is completed, you can choose whether to delete the current job:

- To delete the current job, press 4.
- To return to the Basic Measurement Screen (BMS) without deleting the current job, press ESC or select the Abrt softkey.

Uploading coordinate data

To upload coordinate data from a computer, press 2 or select Upload XYZ in the Communication menu.



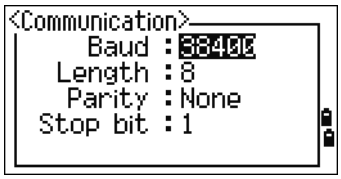
The default data format appears.

To change the order of data fields, select the Edit softkey. See also Advanced feature: Editing the data order for upload, page 100.

Otherwise, press ENT.

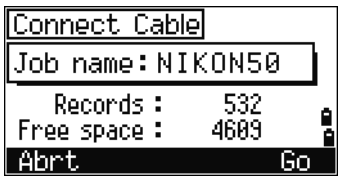
Select the Job softkey to go to the Job Manager screen. See also Job, page 86.

To change the communication settings, select the Comm softkey. The serial port settings must match the settings used by the terminal software on the computer.



Use an RS-232C cable to connect the TS635 construction total station to the computer. In the terminal program, set flow control to Xon/Xoff.

The Free space field shows the number of points that can still be stored on the TS635 construction total station.



Press ENT to put the TS635 construction total station in receive mode. On the computer, choose the Send Text File command in the terminal program to start sending data.

As each point is received by the instrument, the value in the Records field is incremented.

If you press ESC during data upload, the upload is canceled and the display returns to the Communication menu. Records that were received before you pressed ESC are stored in the job.

During upload, the system will truncate any code that is longer than 16 characters.

If the existing point is a UP, CC, or MP record, and it is not referred to by any station or backsight, it is automatically overwritten by the uploaded point. No error message appears.

Advanced feature: Editing the data order for upload

1. Select the Edit softkey. The Data Fields screen appears.
2. To move between the fields, press < or >.
3. To change the selected item in a field, use the G and H softkeys. The options are PT, N, E, Z, CD, or blank.
4. To save your changes and return to the previous screen, select the Save softkey.

For example, if your original data is as follows:

1, 30.000, 20.000, L1

and you set the data fields to PT N E CD, then the uploaded data is:

PT=1, N=30.000, E=20.000, CD=L1

For more information about coordinate data, see Transferring coordinate data to the total station, page 118.

Uploading coordinates without points

You can upload data without points. If you do not include a point in the format definition, each line of data is automatically assigned the next available point number. To help you to select points in the field, make sure that you store an identifier in the CD field.

The data format cannot include duplicate items. Use PT, N, E, Z, and CD once each in the data format.

To skip an item in your original file, set the corresponding field to blank.

1sec-Key

Use the 1sec-Key menu to configure the settings for the one-second buttons, MSR1, MSR2, and DSP.

To access it, press 5 or select `1sec-Keys` in the MENU screen.

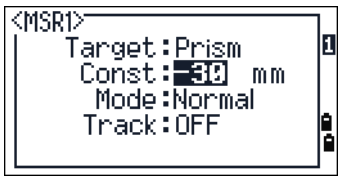
MSR button settings

There are two MSR buttons:

- To change the settings for the MSR1 button, press 1 or select `MSR1`.
- To change the settings for the MSR2 button, press 2 or select `MSR2`.

Each MSR button has four settings.

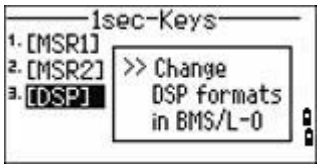
In the Const and Track field, use the numeric keys to enter values. In the other fields, use < or > to change the settings.



Tip – To quickly access the settings screen, hold down MSR1 or MSR2 for one second.

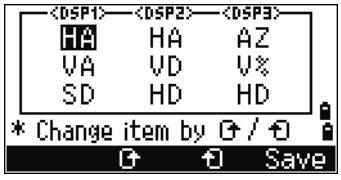
DSP button settings

To change the display items in the BMS and in Layout observation screens, press 2 or select `[DSP]` in the 1sec-Keys menu.



To move the cursor, use <, >, ^ or v. To change the display item, press either the softkey or the softkey.

To save the changes, press ENT from the last line of <DSP3> or select the `Save` softkey.



Tip – To quickly access the DSP settings screen, hold down DSP for one second.

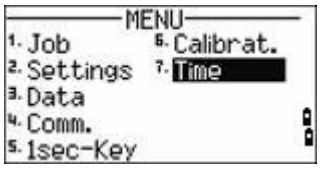
Calibration

Use the Calibration screen to calibrate the instrument if required. To access the Calibration screen, press 6 or select `Calibrat` from the MENU screen.

See also Adjusting the calibration, page 106.

Time

Use the Date & Time screen to set the current date and time.



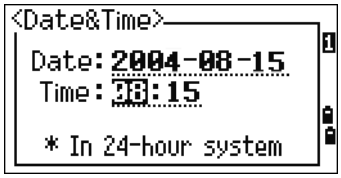
1. Press 7 or select `Time` on the MENU screen. The Date & Time screen appears.

   The current date and time settings are displayed.

2. Enter the date in Year-Month-Day format. For example, to change the date to August 15, 2006 press 2 0 0 6 ENT 8 ENT 1 5 ENT.

   If the highlighted part of the field (for example, the year) is already correct, press ENT to use the current value. For example, if the date is already set to August 20, 2006, and you want to change the date to August 25, 2006, press ENT ENT 2 5 ENT.

3. To move to the Time field, press ENT from the *Date* field:



4. Enter the time in 24-hour format. For example, to set the time to 4:35 PM, press 1 6 ENT 3 5 ENT.

5. Do one of the following:

   – To finish setting the date and time, press ENT in the Minutes field.

   – To cancel the changes, press ESC.

CHAPTER

6

Checking and Adjusting

In this chapter:

- Adjusting the electronic level
- Checking and adjusting the circular level
- Zero point errors of vertical scale and horizontal angle corrections
- The instrument constant
- Checking and adjusting the laser pointer

This chapter describes how to check the accuracy of the TS635 construction total station, and if necessary, adjust the required settings.

Adjusting the electronic level

To adjust the electronic level, Zero point errors of vertical scale and horizontal angle corrections are used. See page 105.

Checking and adjusting the circular level

Once you have checked and adjusted the electronic level, check the circular level.

If the bubble is not in the center of the level, use the adjusting pin to rotate the three adjustment screws of either circular level on the instrument main body or tribrach until the bubble is centered.

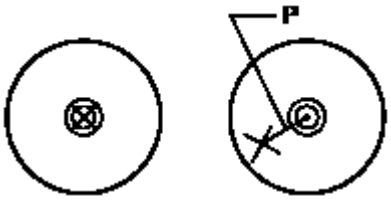
Checking and adjusting the optical/laser plummet

The optical axis of the plummet must be aligned with the vertical axis of the instrument.

To check and adjust the optical/laser plummet:

1. Place the instrument on the tripod. You do not have to level the instrument.
2. Place a thick sheet of paper marked with an X on the ground below the instrument.

3. Do the following:
   - Look through the optical plummet and then adjust the leveling screws until the image of the X is in the center of the reticle mark .
   - For the laser plummet, adjust the laser pointer to the X.
4. Rotate the alidade by 180°.
   - If the marked image is in the same position in the center of the reticle mark, no adjustment is required.



For the laser plummet, if the laser pointer is on the X, no adjustment is required.

5. If the image or laser pointer is not in the same position, adjust the optical or laser plummet:
   a. Use the supplied hexagonal wrench to turn the adjustment screws until the image of the X is in Position P. Position P is the center point of the line connecting the X and the center of the reticle mark .
   b. Repeat from Step 2. For laser plummet adjustment, you must remove a cap.

Zero point errors of vertical scale and horizontal angle corrections

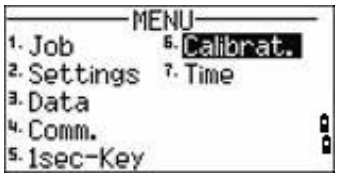
Checking the calibration

1. Set up the instrument on the tripod.
2. Follow the leveling procedures described in Leveling the instrument, page 28.
3. Flip the telescope to the Face-1 position. The display and tangent screws are facing towards you.
4. Sight a target that is within 45° of the horizontal plane.
5. Read the vertical angle from the VA1 field in the Basic Measurement Screen (BMS).
6. Rotate the instrument 180° and flip the telescope to the Face-2 position. The display and tangent screws are turned away from you.
7. Read the vertical angle from the VA2 field.
8. Add the two vertical angles together, VA1 + VA2.
   - No adjustment is required if the zero reference for vertical angles (VA zero setting) is set to Zenith, and VA1 + VA2 equals 360°.
   - No adjustment is required if the zero reference for vertical angles (VA zero setting) is set to Horizon, and VA1 + VA2 is either 180° or 540°.
   - An adjustment is required if VA1 + VA2 is not one of the values listed above.

Note – *The difference between the vertical angle reading the relevant angle (either 360° for Zenith, or 180° or 540° for Horizon) is called the* ***altitude constant****.*

Adjusting the calibration

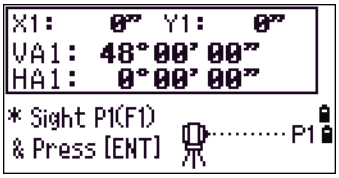
1. Press MENU and 6. The calibration screen appears.



2. Take an F1 measurement to a target on the horizon. Press ENT.

   The calibration fields for F1 are:

X1	Face-1 X-axis tilt value
Y1	Face-1 Y-axis tilt value
VA1	Face-1 vertical angle (tilt-off value)
HA1	Face-1 horizontal angle (tilt-off value)



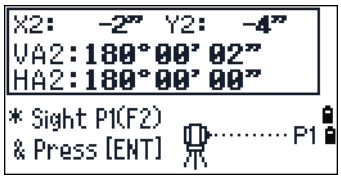
   The vertical angle is shown in the V0 dir= Horiz setting.

   When you have taken the measurement, the message on the bottom line changes from DO NOT TOUCH! to Turn to F2.

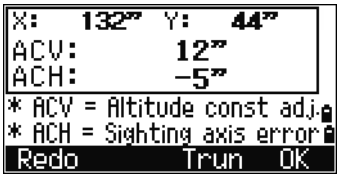
3. Take an F2 measurement to the same target. Press ENT.

   The TS635 construction total station has horizontal and vertical axis adjustment:

X2	Face-2 X-axis tilt value
Y2	Face-2 Y-axis tilt value
VA2	Face-2 vertical angle (tilt-off value)
HA2	Face-2 horizontal angle (tilt-off value)

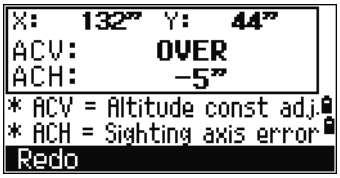


   When the observation on F2 is completed, four parameters are displayed.



4. Do one of the following:
   - To return to the first observation screen, press ESC or select the Redo softkey.
   - To set parameters on the instrument, press ENT or select the OK softkey.

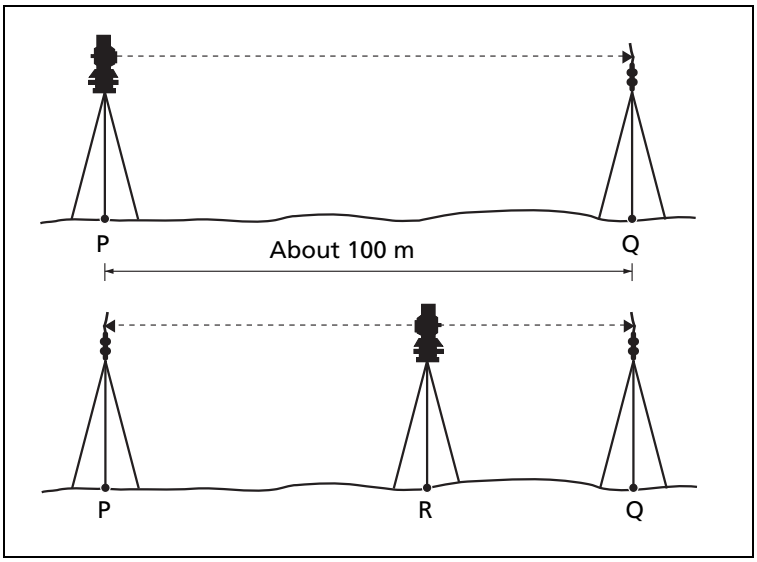
5. If ACV, ACH, or Tilt is out of range, OVER appears. Press any key to return to the first observation screen.



The instrument constant

The ***instrument constant*** is a numerical value used to automatically correct for the displacement between the mechanical and electrical centers when measuring distances. The instrument constant is set at the factory. However, to ensure the highest operational accuracy, we recommend that you check the instrument constant several times a year.

The following figure shows the setup to check the instrument constant.



To check the instrument constant, either compare a correctly measured base line with the distance measured by the EDM, or carry out the following procedure.

1. Set up the instrument at Point P, in as flat an area as possible.
2. Set up a reflector prism at Point Q, 100 m away from Point P. Make sure that you take the prism constant into account.
3. Measure the distance between Point P and Point Q (PQ).
4. Install a reflector prism on the tripod at Point P.
5. Set up another tripod at Point R, on the line between Point P and Point Q.
6. Transfer the TS635 construction total station to the tripod at Point R.
7. Measure the distance from Point R to Point P (RP), and the distance from Point R to Point Q (RQ).
8. Calculate the difference between the value of PQ and the value of RP + RQ.
9. Move the TS635 construction total station to other points on the line between Point P and Point Q.
10. Repeat Step 5 through Step 9 several times.
11. Calculate the average of all the differences.
    The error range is within 3 mm. ***If the error is out of range, contact your dealer.***

Checking and adjusting the laser pointer

The TS635 construction total station uses a red laser beam to measure and as a laser pointer. The laser pointer is coaxial with the line of sight of the telescope. If the instrument is well adjusted, the red laser pointer coincides with the line of sight. External influences such as shock or large temperature fluctuations can displace the red laser pointer relative to the line of sight.

APPENDIX

A

Specifications

In this chapter:

- Measurement range
- Distance precision
- Measurement intervals
- Angle measurement
- Tilt sensor
- Tangent screws
- Tribrach
- Level
- Display and keypad
- Connections in the base of instrument
- Battery pack
- Environmental performance
- Dimensions
- Weight
- Standard components
- External device connector

This appendix details the specifications and standard components of the TS635 construction total station. It also describes the connector that is used to connect the instrument to an external power source or to communicate with an external device.

Main body

Telescope

Tube length	125 mm (4.91 inch)
Magnification	30×
Effective diameter of objective	45 mm (1.77 inch) EDM 50 mm (1.97 inch)
Image	Erect
Field of view	1°20' 2.3 m at 100 m (2.3 ft at 100 ft)
Resolving power	3.0"
Focussing distance	1.5 m to infinity (59 inch to infinity)

Measurement range

Distances shorter than 1.5 m (4.92 ft) cannot be measured with this EDM.

Measurement range with no haze, visibility over 40 km (25 miles)	
Prism mode	
Reflector sheet (5 cm x 5 cm)	300 m (984 ft)
Standard prism (1P)	5,000 m (16,400 ft)
Reflectorless mode	
Reference target	300 m (984 ft)

Notes –
The target should not receive direct sunlight.
"Reference target" refers to a white, highly reflective material (KGC 90%).
In reflectorless mode, the maximum measurement range is 500 m (1,640 feet).

Distance precision

Precise mode	
Prism mode	± (3 + 2 ppm × D) mm –10 °C through +40 °C (+14 °F through +104 °F) ± (3 + 3 ppm × D) mm (–20 °C through –10 °C), (+40 °C through +50 °C) (–4 °F through +14 °F), (+104 °F through +122 °F)
Reflectorless mode	± (3 + 2 ppm × D) mm –10 °C through +40 °C (+14 °F through +104 °F) ± (3 + 3 ppm × D) mm (–20 °C to –10 °C), (+40 °C through +50 °C) (–4 °F through +14 °F), (+104 °F through +122 °F)
Normal mode	
Prism mode	± (10 + 5 ppm × D) mm
Reflectorless mode	± (10 + 5 ppm × D) mm

Measurement intervals

Measurement intervals may vary with the measuring distance or weather conditions; At the initial measurement, it may take longer.

Precise mode	
Prism mode	1.5 sec.
Reflectorless mode	1.8 sec.
Normal mode	
Prism mode	0.8 sec.
Reflectorless mode	1.0 sec.
Prism offset correction	–999 mm to +999 mm (1 mm step)

Angle measurement

Reading system	Absolute encoder
	Diameterial reading on HA Single reading on VA
360°	1"/5"/10"
400G	0.2 mgon / 1 mgon / 2 mgon
MIL6400	0.005 mil / 0.02 mil / 0.05 mil
DIN18723 accuracy	5"/ 1.5 mgon

Tilt sensor

Method	Liquid-electric detection
Compensation range	±3°

Tangent screws

Type	Friction clutch endless fine motion

Tribrach

Type	Detachable

Level

Electronic level	Displayed on the LCD
Circular level vial	Sensitivity 10' / 2 mm

Optical plummet (Optional)

Image	Erect
Magnification	3x
Field of view	5°
Focussing range	0.5 m (1.6 ft) to infinity

Laser plummet

Wave length	635 nm
Laser class	Class 2
Focussing range	∞
Laser diameter	Approximately 2 mm

Display and keypad

Display type	Graphical LCD
Resolution	128 × 64
Display illumination	Backlight
Keys	25

Connections in the base of instrument

Communications	
Type	RS-232C
Maximum baud rate	38400 bps asynchronous
External power supply input voltage	4.5 V through 5.2 V DC

Battery pack

Output voltage	3.8 V DC rechargeable
Continuous operation time	
Continuous distance/angle measurement	10 hours
Distance/angle measurement every 30 seconds	16 hours
Continuous angle measurement	30 hours

Note – *Tested at 25 °C (77 °F) (normal temperature). Operation times may vary depending on the condition and deterioration of the battery.*

Environmental performance

Operating temperature range	–20 °C through +50 °C (–4 °F through +122 °F)
Storage temperature range	–25 °C through +60 °C (–13 °F through +140 °F)

Dimensions

Main unit	149 mm W x 145 mm D x 306 mm H (6.6 inch W x 6.8 inch D x 13.7 inch H)
Carry case	435 mm W x 206 mm D x 297 mm H (18.5 inch W x 13.8 inch D x 9.1 inch H)

Weight

Main unit (without battery)	Approximately 3.5 kg (7.7 lbs)
Battery	Approximately 0.1 kg (0.22 lbs)
Carry case	Approximately 2.4 kg (5.29 lbs)
Charger and AC adapter	Approximately 0.4 kg (0.9 lbs)

Environmental protection

Watertight/dust-proof protection	IP66

Standard components

- Instrument main body
- Battery pack (x 2)
- Universal charger, power cord, and adaptors
- Adjustment pin, Allen wrench
- The *TS635 Construction Total Station User Guide* (this document)
- Carry case

External device connector

This connector can be used to connect to an external power source or to communicate with an external device.

Before using the external device connector, make sure that the external device meets the specifications below.

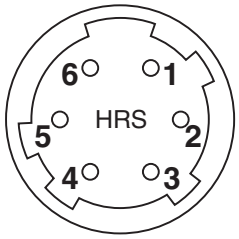
Input voltage	4.5 V DC to 5.2 V DC
System	RS-232C
Signal level	±9 V standard
Maximum baud rate	38400 bps asynchronous
Compatible male connector	Hirose HR10A-7P-6P or HR10-7P-6P

CAUTION – Except when connected as shown in the System diagram, page 14, use of the Hirose HR10A-7P-6P or HR10-7P-6P is at your own risk.

CAUTION – Use only the male connectors specified above. Using other connectors will damage the instrument.

The external device connector is a Hirose HR 10A-7R-6S female connector. The pinouts for connecting the instrument to an external device connector are shown below:

Pin	Signal	Description
1	RxD	Receive data (Input)
2	TxD	Send data (Output)
3	NC	No connection
4	V	Power
5	GND	Ground
6	NC	No connection



CAUTION – Only use the pin connections shown above. Using other connections will damage the instrument.

CAUTION – The TS635 total station has different pin assignments from other Construction total stations.

To connect to an external power source, supply power to Pin 4 (power terminal) and Pin 5 (ground terminal) on the instrument. The instrument will use the external power source even if the internal battery packs is attached.

CAUTION – Make sure that the power supplied is within the rated input range (4.5 V to 5.2 V, 1 A maximum). Power supplied outside this range will damage the instrument.

To communicate with an external device, connect the RS-232C signal from the external device to Pin 1 (input terminal) and to Pin 2 (output terminal) on the instrument.

Cap the data output/external power input connector securely when the instrument is not in use. The instrument is not watertight if the cap is detached or not attached securely, or when the data output/external power input connector is in use.

The instrument can be damaged by static electricity from the human body discharged through the data output/external power input connector. Before handling the instrument, touch any other conductive material once to remove static electricity.

APPENDIX

B

Transferring Coordinate Data

In this chapter:

- Transferring coordinate data to the total station
- Transferring coordinate data from the total station

The TS635 construction total station uses lists of coordinate data. This chapter describes how to transfer data between the total station and the office computer.

Transferring coordinate data to the total station

Settings

To configure the transmission speed and other settings, press MENU and then select `Settings / Comm`. See also Communications, page 93.

Record format

You can transfer coordinate records to the TS635 construction total station in the following formats:

PT	,	X	,	Y	,	Z	,	CD

PT		X		Y		Z		CD

PT	,	X	,	Y	,	Z

PT		X		Y		Z

PT	,	X	,	Y	,	,	CD

PT		X		Y		CD

PT	,	X	,	Y	,	,

PT	,	X	,	Y	,

PT	,	,	,	Z	,	CD

PT	,	,	,	Z

The formats use the following codes:

Code	Description	Length
PT	Point number	Up to 20 digits
X	Actual X coordinate	Variable length
Y	Actual Y coordinate	Variable length
Z	Actual Z coordinate	Variable length
CD	Feature code	Up to 16 characters

Data example

20100,6606.165,1639.383,30.762,RKBSS
20104,1165611.6800,116401.4200,00032.8080
20105 5967.677 1102.343 34.353 MANHOLE
20106 4567.889 2340.665 33.444 PT1
20107 5967.677 1102.343 34.353
20109,4657.778,2335.667,,PT2
20111,4657.778,2335.667
20113 4657.778 2335.667
20115,,,34.353,MANHOLE
20117,,,33.444

Transferring coordinate data from the total station

Settings

To configure the transmission speed and other settings, press MENU and then select `Settings / Comm`. See also Communications, page 93.

Data examples

Nikon coordinate data format

1,100.0000,200.0000,10.0000,
2,200.0000,300.0000,20.0000,
3,116.9239,216.9140,11.8425,TRAIN PLATFORM
4,126.6967,206.2596,11.2539,RAMP
11,100.0045,199.9958,10,0000,
13,116.9203,216.9113,11.7157,
14,126.6955,206.2579,10.9908,
21,100.0103,199.9958,10.0000,
31,100.0013,200.0005,10.0000,
41,100.0224,200.0331,9.9000,
43,116.9263,216,9165,11.8016,CURB
44,126.7042,206.2871,10.8193,DITCH
45,116.9266,216.9160,11.8028,
46,126.7046,206.2845,10.8213,CP POINT

APPENDIX

C

Error Messages

In this chapter:

- Cogo
- Communications
- Data
- Job manager
- Layout
- Programs
- Recording data
- Searching
- Settings
- Station setup
- System error

The appendix describes the error messages that may appear when you use the TS635 construction total station.

Cogo

NO Result

The system was unable to calculate an area because points were not entered in the correct order.

Press any key to return to the Cogo menu. Then enter the points in the correct order.

Same Coordinate

The point or coordinate that you entered is identical to the previous input point.

Press any key to return to the point input screen. Then use a different point.

XY-coordinate is required

The input point does not have XY (NE) coordinates.

Press any key to return to the point input screen. Then enter a point that has X and Y coordinates.

Communications

If an error is detected while data is being transferred to the TS635 construction total station, the total station stops the transfer and displays one of the following messages:

Check Data

There are errors in the data that is being transferred to the total station, such as an alphabetic character in a coordinate field.

Press any key. Then check the specified line in the data.

DUPLICATE PT

CAUTION – If the existing point is a UP, CC, or MP record, and the point is not referred to by ST or BS, the existing point will be overwritten by the uploaded record. No error message appears.

The uploaded data contains a duplicate PT.

Press any button. Then check the specified point in the data.

PT MAX20 chars

The uploaded data contains a PT with a name or number that is longer than 20 digits.

Press any button. Then check the specified line in the data.

XYZ OVERRANGE

The uploaded data contains a coordinate that is longer than 13 digits.

Press any button. Then check the specified line in the data.

Data

Can't Edit XYZ from measurement

You have tried to change the coordinates of an SO, SS, or CP record. You cannot change the coordinates of these records.

Press any button to return to the previous screen.

DELETE Stn-XYZ

You have tried to delete a coordinate record that the current ST or BS refers to. You must confirm that you want to delete this record.

To...	Press...
delete XYZ	the DEL softkey
return to the previous screen without deleting XYZ	ESC or the Abrt softkey

Job manager

Cannot Assign

You have tried to set the current job as the control file.

Press any button to return to the previous screen. Then select a different job.

Can't Create

There is no space available to create a job or record a point.

Press any button to return to the Job Manager. Then select the DEL softkey to delete old jobs.

Existing Job

You have entered an existing job name for a new job.

Press any button and then change the name for the new job.

MAX 32Jobs

You are trying to create a new job when the maximum number of jobs (32) is already stored.

Press any button to return to the Job Manager. Then select the DEL softkey to delete old jobs.

Layout

Input Error

The point name style used in the Fr field is not the same as the style used in the To field. For example, the Fr field style is 1, and the To field style is A200.

Press any button to return to the Fr/To input screen. Then re-enter the point name, using the same naming style in both fields.

NO Stn Setup

You did not perform a station setup or BS check before entering the Layout function.

To...	Press...
go to the Stn Setup menu	2 or select Stn Setup
return to the Basic Measurement Screen (BMS)	ESC
go to the Stakeout menu	1 or select Continue

CAUTION – Selecting Continue does ***not*** resume the last ST record. You should only use the Continue option if you are sure that the previous ST coordinates and the current HA orientation are correct. Otherwise, records in the Stakeout function may not be correct.

Programs

NO Stn Setup

CAUTION – Selecting Continue does ***not*** resume the last ST record. You should only use the Continue option if you are sure that the previous ST coordinates and the current HA orientation are correct. Otherwise, records in the Programs function may not be correct.

You did not perform a station setup or BS check before entering the Programs function.

To...	Press...
go to the Stn Setup menu	2 or select Stn Setup
return to the BMS	ESC
go to the Programs menu	1 or select Continue

Recording data

DATA FULL

The data storage is full.

Press any button to return to the Basic Measurement Screen (BMS). Then:

To...	Press...
delete unnecessary data	MENU and select Data
delete jobs	MENU and select Job

DUPLICATE PT

The input PT you are trying to record already exists in the current job. An existing coordinate record cannot be overwritten by measured data.

Press any button to return to the point input screen. Change the setting in the PT field.

Duplicate PT

The input PT you are trying to record already exists in the current job as an SS, SO, or CP record. An existing SS, SO, or CP record can be overwritten by measured data.

To...	Press...
return to the PT input screen	ESC or the Abrt softkey
record RAW data and update XYZ data	the XYZ softkey
record RAW data only	the RAW softkey

No Open Job

No job is open.

To...	Press...
open the job list, if there are existing jobs	1 or select Select Job
create a new job	2 or select Create Job
return to the previous screen	ESC

NO Stn Setup

There is no station record in the current job, or a station setup or BS check has not been done since the program was rebooted.

To...	Press...
continue recording	1 or select Continue. If there is already an ST record in the job, the message CO, Use current orientation appears.
go to the Stn Setup menu	2 or select STN Setup
return to the previous screen	ESC

OVER RANGE

You are trying to record a coordinate with more than 13 digits.

Press any button to return to the previous screen. Then check the setting for the current ST coordinate.

Searching

PT Not Found

There is no point that matches the criteria entered.

Press any button to return to the point input screen.

This message may appear in any function where the PT/CD is input, such as Station Setup or Stakeout.

Settings

Job Settings will be changed

You have changed one or more of the following job settings:

- VA zero or HA in the Angle screen (see Angle, page 90)
- Scale, T-P, Sea Lvl, or C&R in the Distance screen (see Distance, page 90)
- Coord or Az Zero in the Coordinates screen (see Coordinate, page 93)
- Angle, Dist, Temp, or Press in the Unit screen (see Unit, page 93)

To...	Press...
discard the changes to the job settings	ESC or the Abrt softkey. The current job remains open.
close the current job and save the changes to the job settings	ENT or the OK softkey.

Note – *To record a point using the new settings, create a new job using the new settings.*

Station setup

Same Coordinate

The input PT or coordinate is identical to the current station in STN/2:Known, or the same coordinate or point name/number is found in Resection.

Press any button to return to the PT input screen. Then use a different PT.

Space LOW

There is not enough space to record a station when you start any of the Station Setup functions.

To...	Press...
return to the BMS	press ESC or select the Abrt softkey. Select the DEL softkey in Job Manager to delete old jobs.
continue	press ENT or select the OK softkey. You may not be able to record the whole process.

XY-coordinate is required

The input point for ST/BS does not have N/E coordinates.

Press any button to return to the PT input screen. Then use a PT that has N/E coordinates.

Z-coordinate is required

The input point for Benchmark does not have a Z coordinate.

Press any button to return to the PT input screen. Then use a PT that has a Z coordinate. See page 68.

System error

=SYSTEM ERROR=

The system has detected an internal error that is related to the lower-level system. Press any key to turn the instrument off. The system will reboot when this error is reported. If you still have more points to shoot in the site, turn the instrument on and repeat the open a job and station setup procedures.

Data stored before this error will be kept safely in the Job file. If the error appears frequently, please contact your dealer or Trimble Support and report the message that appears below the =SYSTEM ERROR= line.

Inside cover page

NORTH AMERICA
Trimble Construction Division
5475 Kellenburger Road
Dayton, Ohio 45424
USA
800-538-7800 (Toll Free)
+1-937-245-5154 Phone
+1-937-233-9441 Fax

EUROPE
Trimble GmbH
Am Prime Parc 11
65479 Raunheim
GERMANY
+49-6142-2100-0 Phone
+49-6142-2100-550 Fax

ASIA-PACIFIC
Trimble Navigation
Singapore Pty Limited
80 Marine Parade Road
#22-06, Parkway Parade
Singapore 449269
SINGAPORE
+65-6348-2212 Phone
+65-6348-2232 Fax

Trimble®

www.trimble.com