This document will introduce and give an overview on the TCRA1101plus - a new total station purchased for a specific mission.

Mission:

The TCRA1101plus is dedicated for use in situations where reflectorless technology is required. It is available to borrow for this purpose.
It is not intended to replace any other instrumentation, at present, except the prior reflectorless EDM, the DIOR.

Advantages of TCRA1101plus

Collecting data faster (without having to wait for a person with a reflector and because of accelerated instrument measuring procedures) is not only more cost effective, but is also safer because it should involve less time exposed to potentially unsafe conditions.

Safety

- The ability to collect accurate data, without a reflector, will make it unnecessary for personnel, collecting topography, to work in potentially unsafe conditions, such as in traffic/travel lanes, at heights, or in close proximity to slide areas.

Cost savings

- Ability to collect data in areas that may normally require mapping by aerial photography.
- Time saved collecting data. Collecting data faster without having to wait for a person with a reflector is more cost effective.
- Could potentially require less personnel or persons could be freed up to do other tasks e.g. safety spotting, other survey work/studies, or moving sights/signs.

Features

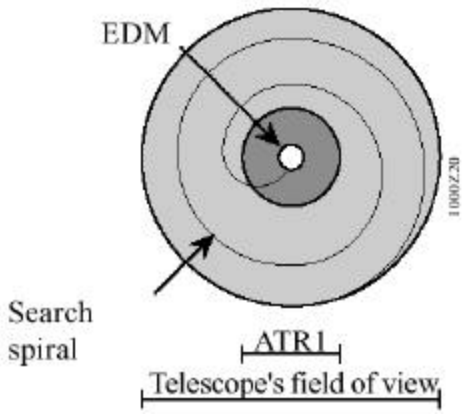
- As a result of new technologies the TCRA is smaller and lighter and the measuring procedures have been accelerated.
- Easily toggled between reflectorless (red laser) and reflector (infrared) mode which are both are coaxial.
- The red laser beam used for measuring without reflector is arranged coaxially with the line of sight of the telescope and emerges from the objective port (making columniation unnecessary for distance changes).
- Up to 60 files can be managed and named freely (with extension .gsi) on the TCRA.
- Codes can be inserted in data files and data blocks automatically re-numbered.
- Has a permanent laser plummet used for Set-up, but this feature requires the use of a tribrach without an optical plummet which makes forced-centering impossible.

- Uses either SRAM card or ATA-Flash card for data collection/storage.
- Uses camcorder batteries.
- Improved ATR tracking system allows higher-speed tracking than previously possible with the TPS1000 instruments.
- The dimension of the search window, in RCS mode, can be defined in the "RCS Searching Window" function.

ATR with the TCA1800

From Leica TPS - System 1000 manual - page 145

The sensitive area of the ATR1 is the central third of the telescope's field of view. The ATR1 recognizes the prism instantly if the latter is within this sensitive area. Otherwise the telescope's field of view is scanned spirally until the prism is located.
The spiral search of the field of view of the telescope, and the recognition of the prism, together take about 2-4 seconds.



ATR with the TCRA1101plus

From Leica TPS1100 Professional Series manual - page 89

Automatic Reflector Search

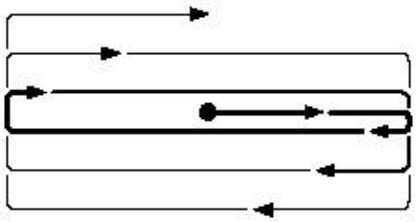
If the reflector is in the telescope's field of view, the crosshair is automatically positioned to the reflector when a measurement is triggered. If the target is not within the telescope's field of view, an automatic reflector search is started.

The shape of the search window is rectangular and the defined area is scanned line by line starting in the center of the searching window.

Depending on the working mode of the instrument different sized search windows and different search strategies are used.
The dimension of the search window in RCS mode can be defined in the "RCS Searching Window" function. In RCS mode, a working area can be additionnally defined. This area is automatically scanned if the loacal search was not successful.

- **ATR and LOCK modes:**

The operator stands at the instrument and can manually position the telescope to the reflector at any time. When a measurement is triggered, a small search window (Hz: 2.5gon / V: 2.5gon) is used to find the reflector as quickly as possible.
If the target is lost in LOCK mode the path of the reflector is predicted for a few seconds.



It is very important that TCRA1101plus be in precise adjustment when used without a reflector !

The TCRA1101plus should be electronically checked and adjusted in the order shown below:

- when the adjustment is in question
- before the first use
- before each precision survey
- after long periods of transport
- after long periods of work
- if the temperature alters by more than 20 ° C

TCRA Face Scanning Program

- INTENDED FOR VERTICAL FACES ONLY! (Scanning horizontal faces requires Parameter Settings to be set to unreasonably small distances for Program to work.)
- Generally do not record 1st & 2nd Corner shots ('continue' instead) as they will be measured and recorded again in the Face Scanning program.
- After 1st & 2nd Corner shots are taken, an estimation of the number of pts. and time to acquire those pts. @ chosen Parameter settings is given.
- Face Scanning always starts @ the bottom of area below 1st Corner and works either left or right towards 2nd Corner.
- Horiz. Grid – the distance the scan will move horizontally across face.
- Vert. Grid – the distance the scan will move vertically up & down the face.
- Continues @ Grid settings and measures remainder of Parameter (Grid) Setting vertically @ top and horizontally @ last side.
- If you change Parameter (Grid) Settings, automatic collection will restart.

From Leica TPS1100 Professional Series Applications Prog. Field Manual 2 - page 63

Face Scanning

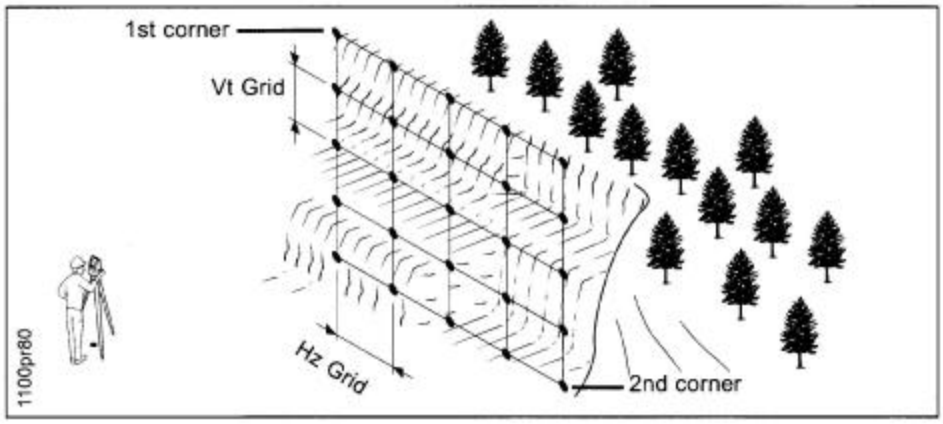
Introduction

Face Scan automates the process of measuring a sequence of points along a vertical face. The boundaries of the window of interest and the interval values for vertical and horizontal grid are defined by the user.

Face Scan can be run on motorized instruments with the option "reflectorless EDM" only.

Basic Procedure

Before starting Face Scanning:
The station must be set up and oriented.



Known:
Window to be scaned
Grid parameters:
- *Hz Grid*
- *Vt Grid*

Unknown:
- *Grid Point Coordinates*

Face Scanning

Long Range Measurements

The following procedures for long range measurements are not normally used or needed for most ODOT surveys.

PPM'S

- Measure temperature & pressure @ both ends and then average each ppm to get average ppm (don't average each temp. and/or pressure to get average ppm).

Reciprocal Zenith Angle Observations

- The vertical angle to be used for each setup in a long range measurement is basically the average of the two reciprocal vertical angles from the two setups, if forced centering is used (HI = HT).
- Minimum refraction occurs from noon to 3 PM and the maximum from 9 PM to midnight.
- The poorest times for observing are between 8 AM and 9 AM, and between 6 PM and 7 PM.
- When simultaneous reciprocal observations are used, the paired observations at each end should be completed within a total elapsed time of 15 min or less to avoid changing refraction conditions. This technique practically eliminates the effects of curvature and refraction.
- Slope distances in the TCRA (and the TCA1800) and in the Liscad .raw (and .gsi) files are not corrected for Curvature and Refraction. When the files are processed in Liscad the corrections will be made then. That way the correction is only made once.

	TCRA1101plus	**TCRA1102plus**	**TCRA1103plus**	**TCRA1105plus**
Angle measurement	1.5"	2"	3"	5"
Distance measurement	3mm + 2ppm (without reflector) 2mm + 2ppm (with reflector)			
Measuring time	3 sec. (without reflector up to 30m) 1 sec. (with reflector)			
Range in average atmospheric conditions	Range-Reflector		3 km (circular prism)	
			1.5 km (360 degree prism)	
	Reflectorless - standard range		80m (without reflector)	
			5 km (circular prism)	
	Reflectorless - eXtended Range		200m (without reflector)	
			7.5 km (circular prism)	
Built-in programs	Orientation and height transfer, Resection, Tie-distance, Stakeout			
Recording	PCMCIA SRAM/FLASH, RS232 interface for external connection			
Magnification	30 x			
Plummet	Optical: 2x Laser: located in alidade, turning with the instrument, accuracy + 0.8mm at 1.5 m			

Geometronics Testing For Accuracy

- Geometronics has tested the TCRA1101plus in reflectorless mode to be accurate for horizontal surfaces in a DTM to:

- ~ 60 m when dry &/or sunny
- ~ 40 m when wet &/or raining

- **Note:** It is, at times, possible to increase these distances, but this should be avoided as the accuracy of the TCRA1101plus, in reflectorless mode, has only been tested to a maximum distance of ~ 60 m.

From Leica TPS1100 Professional Series Document - May 1999

Summary

This report describes the main components of the new generation of total stations, a further development of the successful TPS System 1000 series. The angle-measuring system, the measurement of distance without the use of a reflector, the automatic target recognition and the flexible coding are all dealt with in detail.

The application of new technologies and the implementation of the wishes of customers across the globe have led to appreciable improvements in the operating concept and in the functionality. The resulting expansion of the range of applications, and the simplification of procedures, have made it possible to improve productivity substantially.

1. Overview

The new generation of total stations has been developed from the successful TPS System 1000 series, from which it has adopted the most successful features. Much has been improved, and the functionality expanded, on the basis of input from customers all over the world. As a result of new technologies, the instruments have become smaller and lighter and the measuring procedures have been accelerated.

The existing operating concept, involving the large eight-line display and the clear, systematically-arranged keyboard, has been retained. Years of experience with the TPS1000 instruments have enabled the user guidance and the operation to be clarified and simplified yet further.

Fig 1: Motorized total station with automatic target recognition and EGL electronic guide light

The improved automatic target recognition system allows higher-speed tracking than was possible with the TPS1000 instruments.

For the first time, an electronic total station includes not only the established infrared distancer which measures to prisms and reflector tapes, but also a distancer for reflectorless measurement and in which the emitter projects a visible laser beam.

Other new features are the use of camcorder batteries as the power supply, the endless fine drives even with the instrument models which are not motorized, and the laser plummet permanently in the vertical axis as a standard feature. The spot brightness of this laser plummet is adjustable, so that the instrument can be set up over the ground point quickly and conveniently, irrespective of the ambient conditions.

Many versions of the instrument are available. The user can choose the most appropriate of them:

TC.....	Classical total station
TCM.....	Motorized total station
TCR.....	Total station with reflectorless distancer
TCRM.....	Motorized total station with reflectorless distancer
TCA.....	Motorized total station with automatic target recognition

Each of these versions is produced at four different levels of accuracy (angle-measuring accuracy in accordance with DIN 18723 and ISO 12857).

Type 1101	1.5",	0.5 mgon
Type 1102	2",	0.6 mgon
Type 1103	3",	1.0 mgon
Type 1105	5",	1.5 mgon

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