Interfacing with the

SOKKIA

SDR
Electronic Field Book

Software Version 04-04.xx

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Chapter 1 Overview

1.1 Introduction

A primary function of the SDR Electronic Field Book is to collect and transmit data to computers (upload) and also receive data from computers (download). The characteristics and format of SDR transmissions have been designed so interfacing of the SDR to different computers and surveying software is a straightforward task. All communication is done in an ASCII format to make interfacing as easy as possible.

1.2 Hardware

The SDR33 is supplied with two RS232 ports, referred to as the "**Top**" and "**Bottom**" ports. The bottom port of the SDR33 is located under the bottom cover, and is a 25 pin, female port. The top port of the SDR31 is an RJ45-type connector. While this is actually a TTL port, the Sokkia cable converts it to an RS232. The top ports of the SDR33 and SDR31 have a fixed cable that is used to communicate with the field instrument. This cable has a round 6 pin Hirose connector. The SDR is are supplied with an interface adapter, on some models this is a DB25 with a switch to reverse the SEND/RECEIVE lines, (supplied as a female, a male is also available, Sokkia product number 5300-08) on other models it is a cable with a DB9 on the computer end. These adapters connect from the Hirose plug to a PC or printer. The DB25 interface's switch is generally used in the DTE position and with printers or other peripherals, in the DCE position. This means that the SDR33 and SDR31 can be interfaced, at a hardware level, to any PC serial port.

The top ports can use software XON/XOFF flow control. On output, hardware flow control is used if available, otherwise XON/XOFF is attempted. On input, XON/XOFF flow control is used.

1.3 Communications

1.3.1 Interfacing with printers

The SDR33 has the ability to print a formatted copy of the stored data directly on a **serial printer**. Note that the printer must have a serial interface. The SDR33 cannot print directly to a parallel device without additional hardware. Most serial printers have one or more dip switch banks that enable different settings for baud rate, parity, etc. The SDR33 parameters for baud rate, parity and word length must be set to match the printer settings. These settings can be checked on the SDR33 by selecting the **<COM>** softkey, then selecting the "***Setup comms***" menu options. If the SDR33 displays **"Attach cable"**, change the position of the switch on the DB25 and re-send the print job. If this does not correct the problem, it is possible that the printer does not support data terminal ready (DTR) on pin 20. A, DE9-pin, is provided with all SDR Electronic Field Books as standard equipment for data transfer in place of the older style DB25 adapters.

1.3.2 Receiving data

The term **DOWNLOADING** describes the loading of data from a computer to the SDR33. The SDR33 accepts data in exactly the same format as it transmits. Any variation in the format will cause the SDR33 to reject the input. Typically, downloading is used to load the SDR33 with control points or points to be set out in the field. If a job record is sent the SDR33 will create another job file. If not, the data will be added to the current job in the SDR33. See also "**Receiving data from a computer**" in the "**Communications**" Chapter within the **SDR33 Reference Manual.**

1.3.3 Modem communication

The SDR33 has the ability to communicate over a Hayes compatible modem. The only difference between communicating over a modem and directly to the computer is that the receiving program must auto answer the modem. After all communication is finished the receiving program should also issue a hang up command to its modem. See also "**Using a modem**" in the "**Communications**" Chapter within the **SDR Reference Manual.**

Chapter 2 Data structure

The SDR can store and transmit two distinctly different data formats. Their point identifier type differentiates them. The standard SDR2x format has 4-digit numeric point Ids. The new SDR33 format has 14-character alphanumeric point names. When starting a new job, the "***Point Id***" field can be set to either "***Numeric (4)***" or "***Alpha (14)***". This determines the format of that job. It is important to set this to the format supported by your receiving program, because it cannot be changed later.

Much flexibility is available in determining how the data is stored. The simplest method is to store all observations as POS records, sending these to a receiving program, which uses them directly. This can be useful for jobs such as large-scale topographic detail data collection for subsequent contour plotting.

More comprehensive processing by the receiving program is possible, such as reducing raw observations, producing traverse information for input into a network adjustment program, or processing feature codes to produce linework.

Topographical observations can be stored and output as raw OBS records, corrected OBS MC records, reduced RED records, or POS coordinate records. These records can also contain averaged data from multiple measurements or combined face one/face two readings.

The format (or View) in which topographical observations are stored is determined by the setting of the "**Topo view stored**" parameter, (found in the ***"Configuration"*** menu (**<CNFG>** softkey).)

More precise measurements can be made with the ***"Set Collection"*** program, which stores the raw observations in OBS records, and the averaged results in MC records. Sets marked BAD in set review are not used for further averaging.

After data has been collected via the ***"Topography"*** or ***"Set Collection"*** programs, the ***"Traverse"*** program may be used to calculate the closure, and adjust the traverse (in versions V04-02 and above). The adjusted data is in the form of notes describing the start and close points, and a new POS AJ record for each traverse station.

Note that the position of the SET record in the job varies. The standard SDR33 format a SET record before the raw observations. However in version V04-02 and stores above SDR2x format only (four digit numeric point Ids) MC records. This is to ensure 100% compatibility with SDR2x format. Examples of these types of data collection follow.

2.1 Views

Topographical observations are always stored in the SDR as raw observations. This ensures that the cause of any errors can be traced. However, these OBS records contain a VIEW attribute, which determines how the record appears for data review or output. An observation in POS view looks and acts like a POS record.

In the SDR ***"Communications"*** menu, the **"Output record views"** option allows you to change the views of the observations to be sent. For instance, if you had stored all observations in POS view but knew there was an error somewhere causing a large misclose, you could send all records in OBS view in order to trace the observation that was in error.

2.2 Coordinate calculations

Because of the view system described above, coordinates of POS view observations are calculated at the time they are sent. This has some important and useful side effects, due to the way the searching and calculating is done. (The algorithms used by the SDR are described in the chapter of the **SDR Reference Manual** entitled "**The SDR Database**"). Take the example of a station from which sideshot observations are taken and stored in POS view, and later the station coordinates are altered by a certain amount (perhaps by a traverse adjustment). During output the coordinates of each sideshot are calculated by searching for the coordinates of the station and reducing the observation. The SDR will use the latest coordinates of the station point, so the sideshot coordinates output will be altered by the same amount the station coordinates were.

2.3 Duplicate points

Any receiving program must be aware that the SDR may contain several different observations or coordinates to any one-point name. The question of which coordinates are correct" must be addressed. The algorithm used by the SDR is described in the chapter of the SDR Reference Manual entitled The SDR Database". The rule is essentially that the latest coordinates are the best(or an observation in POS view) will over-ride an observation in OBS view even if the OBS view is stored later. This is used to implement the Check-only" and Overwrite" options when sighting a known point.

2.4 Examples

The following example SDR files are displayed in Printed output form. A simple topo job with observations stored in POS view follows:

```
SDR33 V04-02.00   Software © Sokkia Technology, inc.        06-Jan-80
                  Angle Degrees       Dist Feet            Press Inch Hg
                  Temp Farenht        Coord N-E-Elev
JOB               SIMPLE POS TOPO
                  Atmos crn No        Point Id Numeric (4)
                  Record elev Yes     Sea level crn No
                  SCALE               S.F. 1.00000000
                  NOTE TS             05-Jan-80 23:48
INSTRUMENT        Manual              EDM <No text>        EDM S/N 000000
                  Theo desc <No text> Theo S/N 000000      Mount Not applic
                  V.obs Zenith        EDM o/s <Null>       Refl o/s <Null>
                  P.C. mm 0.000
STN TP 0100       North 745256.356    East 415265.958      Elev 23.256
                  Theo ht 5.230       Code OIT II
RED KI 0100-0101  Azimuth 23-56'15"   H.dist <Null>        V.Dist <Null>
                  Code BS AZ
BKB TP 0100-0101  Azimuth 23-56'15"   H.obs 0-00'00"
TARGET            Target ht 5.840
OBS F1 0100-0101  S.Dist <Null>       V.obs <Null>         H.obs 0-00'00"
                  Code BS
POS TP 1000       North 745427.696    East 415468.380      Elev 27.702
                  Code TREE
POS TP 1001       North 745215.782    East 415357.357      Elev 22.646
                  Code BLDG CNR F1
POS TP 1001       North 745215.771    East 415357.357      Elev 22.665
                  Code BLDG CNR F2
POS TP 1001       North 745215.777    East 415357.357      Elev 22.656
                  Code BLDG CNR AVERAGE
** End of report **
```

The same job with observations stored in OBS view follows. This may give greater flexibility in post-processing software. For example, in the office a target height or station coordinate may need to be changed and the sideshot coordinates recalculated.

```
SDR33 V04-02.00   Software © Sokkia Technology, inc.        06-Jan-80
                  Angle Degrees       Dist Feet            Press Inch Hg
                  Temp Farenht        Coord N-E-Elev
JOB               SIMPLE OBS TOPO
                  Atmos crn No        Point Id Numeric (4)
                  Record elev Yes     Sea level crn No
SCALE             S.F. 1.00000000
NOTE TS           05-Jan-80 23:48
INSTRUMENT        Manual              EDM <No text>        EDM S/N 000000
                  Theo desc <No text> Theo S/N 000000      Mount Not applic
                  V.obs Zenith        EDM o/s <Null>       Refl o/s <Null>
                  P.C. mm 0.000
STN TP 0100       North 745256.356    East 415265.958      Elev 23.256
                  Theo ht 5.230       Code OIT II
RED KI 0100-0101  Azimuth 23-56'15"   H.dist <Null>        V.Dist <Null>
                  Code BS AZ
TARGET            Target ht 5.840
OBS F1 0100-0101  S.Dist <Null>       V.obs <Null>         H.obs 0-00'00"
                  Code BS
OBS F1 0100-1000  S.Dist 265.250      V.obs 88-54'28"      H.obs 25-48'59"
                  Code TREE
OBS F1 0100-1001  S.Dist 100.000      V.obs 90-00'00"      H.obs 90-00'00"
                  Code BLDG CNR F1
OBS F2 0100-1001  S.Dist 100.005      V.obs 270-00'40"     H.obs 270-00'20"
                  Code BLDG CNR F2
OBS MC 0100-1001  S.Dist 100.004      V.ang 90-20'38"      Azimuth 113-56'25"
                  Code BLDG CNR AVERAGE
** End of report **
```

A simple traverse example follows. Note that only SDR V04-02 and above has traverse adjustment capability, but the results stored are the same as V04-01. For V04-01, if no adjustment is done, the POS TV records are still output for each station on the traverse route. Note also that the coordinates of the sideshots (such as 1000) are automatically adjusted, as explained in the Section 2.2 “Coordinate calculations”, page 6

```
SDR33 V04-02.00   Software © Sokkia Technology, inc.        06-Jan-80
                  Angle Degrees       Dist Feet            Press Inch Hg
                  Temp Farenht        Coord N-E-Elev
JOB               TRAVERSE
                  Atmos crn No        Point Id Numeric (4)
                  Record elev Yes     Sea level crn No
SCALE             S.F. 1.00000000
NOTE TS           06-Jan-80 00:23
```

```
POS KI 0001        North 0.000          East 0.000          Elev 0.000
POS KI 0004        North 0.000          East 300.000        Elev 0.000
POS KI 0005        North 100.000        East 0.000          Elev <Null>
INSTRUMENT         Manual               EDM <No text>       EDM S/N 000000
                   Theo desc <No text>  Theo S/N 000000     Mount Not applic
                   V.obs Zenith         EDM o/s <Null>      Refl o/s <Null>
                   P.C. mm 0.000
STN TP 0001        North 0.000          East 0.000          Elev 0.000
                   Theo ht 0.000
BKB TP 0001-0005   Azimuth 0-00'00"     H.obs 0-00'00"
TARGET             Target ht 0.000
OBS F1 0001-0005   S.Dist <Null>        V.obs <Null>        H.obs 0-00'00"
POS TP 0002        North 0.000          East 100.000        Elev 0.000
STN TP 0002        North 0.000          East 100.000        Elev 0.000
                   Theo ht 0.000
BKB TP 0002-0001   Azimuth 270-00'00"   H.obs 270-00'00"
OBS F1 0002-0001   S.Dist <Null>        V.obs <Null>        H.obs 270-00'00"
POS TP 1000        North 99.998         East 99.996         Elev -0.002
                   Code SIDESHOT 1
POS TP 0003        North 0.003          East 200.001        Elev 0.008
STN TP 0003        North 0.005          East 200.005        Elev 0.010
                   Theo ht 0.000
BKB TP 0003-0002   Azimuth 269-59'50"   H.obs 270-00'00"
OBS F1 0003-0002   S.Dist <Null>        V.obs <Null>        H.obs 270-00'00"
POS TP 1001        North 100.004        East 199.991        Elev 0.006
                   Code SIDESHOT 2
NOTE TP            Action Check only    Pt-Pt SDist 0.013
OBS F1 0003-0004   S.Dist 100.008       V.obs 90-00'10"     H.obs 90-00'20"
NOTE TV            Start 0001           To pt 0003
NOTE TV            BS pt 0005           Azimuth 0-00'00"
NOTE TV            FS pt 0004           Azimuth 90-00'00"
NOTE TV            No fixed close coord 0003
NOTE TV            Closed On FS Coord 0004
NOTE TV            D.ang 0-00'10"       D.Dist 0.013        Precision 23079.
NOTE TV            D.North 0.000        D.East 0.013        D.Elev 0.005
POS AJ 0002        North -0.002         East 99.996         Elev -0.002
POS AJ 0003        North 0.004          East 199.996        Elev 0.006
 ** End of report **
```

Below is a set collection example done with the SDR V04-03. As previously described, the SET record precedes the MC records for SDR2x format compatibility. This example has been edited, because the Comms output differs from the actual printed output.

SDR33 V04-03.00	Software © Sokkia Technology, inc.		06-Jan-80
	Angle Degrees	Dist Feet	Press Inch Hg
	Temp Farenht	Coord N-E-Elev	
JOB	TRAVERSE		
	Atmos crn No	Point Id Numeric (4)	
	Record elev Yes	Sea level crn No	
SCALE	S.F. 1.00000000		
NOTE TS	06-Jan-80 00:23		
POS KI 0001	North 0.000	East 0.000	Elev 0.000
POS KI 0004	North 0.000	East 300.000	Elev 0.000
POS KI 0005	North 100.000	East 0.000	Elev <Null>
INSTRUMENT	Manual	EDM <No text>	EDM S/N 000000
	Theo desc <No text>	Theo S/N 000000	Mount Not applic
	V.obs Zenith	EDM o/s <Null>	Refl o/s <Null>
	P.C. mm 0.000		
STN TP 0001	North 0.000	East 0.000	Elev 0.000
	Theo ht 0.000		
BKB TP 0001-0005	Azimuth 0-00'00"	H.obs 0-00'00"	
TARGET	Target ht 0.000		
OBS F1 0001-0005	S.Dist <Null>	V.obs <Null>	H.obs 0-00'00"
POS TP 0002	North 0.000	East 100.000	Elev 0.000
STN TP 0002	North 0.000	East 100.000	Elev 0.000
	Theo ht 0.000		
BKB TP 0002-0001	Azimuth 270-00'00"	H.obs 270-00'00"	
OBS F1 0002-0001	S.Dist <Null>	V.obs <Null>	H.obs 270-00'00"
POS TP 1000	North 99.998	East 99.996	Elev -0.002
	Code SIDESHOT 1		
POS TP 0003	North 0.003	East 200.001	Elev 0.008
STN TP 0003	North 0.005	East 200.005	Elev 0.010
	Theo ht 0.000		
BKB TP 0003-0002	Azimuth 269-59'50"	H.obs 270-00'00"	
OBS F1 0003-0002	S.Dist <Null>	V.obs <Null>	H.obs 270-00'00"
POS TP 1001	North 100.004	East 199.991	Elev 0.006
	Code SIDESHOT 2		
NOTE TP	Action Check only	Pt-Pt SDist 0.013	
OBS F1 0003-0004	S.Dist 100.008	V.obs 90-00'10"	H.obs 90-00'20"
NOTE TV	Start 0001	To pt 0003	
NOTE TV	BS pt 0005	Azimuth 0-00'00"	
NOTE TV	FS pt 0004	Azimuth 90-00'00"	

```
NOTE TV            No fixed close coord 0003
NOTE TV            Closed On FS Coord 0004
NOTE TV            D.ang 0-00'10"      D.Dist 0.013        Precision 23079.
NOTE TV            D.North 0.000       D.East 0.013        D.Elev 0.005
POS AJ 0002        North -0.002        East 99.996         Elev -0.002
POS AJ 0003        North 0.004         East 199.996        Elev 0.006
 ** End of report **
```

A set collection example done with the SDR V04-01 follows:

```
SDR33 V04-01.00   Software © Sokkia Technology, inc.        06-Jan-80
                  Angle Degrees       Dist Feet             Press Inch Hg
                  Temp Farenht        Coord N-E-Elev
JOB               TRAVERSE
                  Atmos crn No        Point Id Numeric (4)
                  Record elev Yes     Sea level crn No
SCALE             Scale 1.00000000
NOTE TS           05-Mar-91 17:30
NOTE              SDR33 V04-01 Set Collection example
INSTRUMENT        Manual              EDM <No text>       EDM serial 000000
                  Theo desc <No text> Theo serial 000000  Mount Not applic
                  V.obs Zenith        EDM o/s <Null>      Refl o/s <Null>
                  P.C. mm 0.000
STN SC 0100       North 256356.250    East 548125.250     Elev 62.350
                  Theo ht 5.200       Code OIT III
RED KI 0100-0101  Azimuth 25-36'45"   H.dist <Null>       V.Dist <Null>
                  Code BS AZ
SET SC 0100       Set # 1             Point count 4
TARGET            Target ht 5.450
OBS F1 0100-0101  S.Dist 100.000      V.obs 90-00'00"     H.obs 0-00'00"
TARGET            Target ht 4.850
OBS F1 0100-0102  S.Dist 200.000      V.obs 90-00'00"     H.obs 90-00'00"
OBS F2 0100-0102  S.Dist 200.005      V.obs 270-00'20"    H.obs 270-00'10"
TARGET            Target ht 5.450
OBS F2 0100-0101  S.Dist <Null>       V.obs 270-00'02"    H.obs 180-00'30"
NOTE SC           The following MCs are derived from set(s)  1.
OBS MC 0100-0101  S.Dist 100.000      V.ang 90-08'35"     Azimuth 25-36'45"
OBS MC 0100-0102  S.Dist 200.003      V.ang 89-53'49"     Azimuth 115-36'35"
BKB SC 0100-0101  Azimuth 25-36'45"   H.obs 0-00'15"
** End of report **
```

The following file is an example of a GPS RTK collected data with V04-04.30. This file also contains various views that the data can be stored, such as GOBS, GPOS and POS views. Also included is a calibration and stake out records collected with GPS RTK software.

```
SDR33  V04-04.30    (C) Copyright 1996  Sokkia             May-12-97 15:00
                    Angle Degrees       Dist Feet          Press Inch Hg
                    Temp Farenht        Coord E-N-Elev
JOB                 FINI                Point Id Numeric (4)
                    Atmos crn No        C and R crn No     Refract const 0.14
                    Record elev Yes     Sea level crn No
SCALE               S.F. 1.00000000
NOTE OO             Current view, GPOS
NOTE TS             May-12-97 10:53
NOTE JS             10000
GPSINSTR RK         Model GSR2200       Description <No text>
                    Serial no 000000    Rcvr mode Rover    BPS period 30
                    DBEN period 1       Base elev mask 10
                    Antenna type User   Ant meas method Vertical
                    Vertical offset(mm) 0                  Radius(mm) 0
                    Store raw obs No
GSTN RK 0001        East 0.000          North 0.000        Elev 0.000
                    Quality 1           Method 4           Ant ht 2.000
PROJ RK             Lat  38-58'42.1866"N                   Lon  94-42'29.7795"W
                    Height 888.965
                    East 0.000          North 0.000        Elev 0.000
                    Method Plane        Scale 1.00000000   S/P1 <Null>
                    P2 <Null>
ANT HT RK           Ant ht 2.000
GOBS TP 0001-1000   S.Dist 27.405       V.obs 90-00'29"    H.obs 115-26'28"
                    Quality 5           Method 4
                    Code THIS IS THE CODE
GOBS TP 0001-1001   S.Dist 27.143       V.obs 89-52'04"    H.obs 118-07'18"
                    Quality 5           Method 4           Code CONT
GPOS TP 1002        East 23.939         North -12.795      Elev 0.055
                    Quality 2           Method 4           Code CONT

GPOS TP 1003        East 23.935         North -12.803      Elev 0.052
                    Quality 2           Method 4           Code CONT
POS TP 1004         East 5023.912       North 4987.453     Elev 250.086
                    Code CONT
POS TP 1005         East 5023.913       North 4987.453     Elev 250.086
                    Code EVENT
GOBS TP 0001-1006   S.Dist 27.141       V.obs 89-53'37"    H.obs 118-07'44"
                    Quality 1           Method 4           Code EVENT
GOBS TP 0001-1007   S.Dist 27.142       V.obs 89-53'27"    H.obs 118-07'51"
                    Quality 1           Method 4           Code CONT
GOBS TP 0001-1008   S.Dist 27.144       V.obs 89-52'25"    H.obs 118-06'40"
                    Quality 2           Method 4           Code CONT
GOBS TP 0001-1009   S.Dist 27.159       V.obs 89-49'27"    H.obs 118-08'03"
                    Quality 1           Method 4
```

```
NOTE OS            27.159    89-53'53"          118-08'08"          OS 25.000
NOTE OS            Ofs az 118-04'59"
GOBS TP 0001-1010  S.Dist 52.160      V.obs 89-53'53"     H.obs 118-06'38"
                   Quality 1          Method 4            Code OFFSET
NOTE OS            27.161    89-52'36"          118-08'00"          OS 25.000
NOTE OS            Ofs az 208-04'59"
GOBS TP 0001-1011  S.Dist 36.931      V.obs 89-52'36"     H.obs 160-44'19"
                   Quality 1          Method 4            Code OFFSET
NOTE OS            27.155    89-48'47"          118-07'11"          OS 25.000
NOTE OS            Ofs az 298-04'59"
GOBS TP 0001-1012  S.Dist 2.154       V.obs 89-48'47"     H.obs 118-32'43"
                   Quality 1          Method 4            Code OFFSET
NOTE OS            27.153    89-48'29"          118-07'07"          OS 25.000
NOTE OS            Ofs az 28-04'59"
GOBS TP 0001-1013  S.Dist 36.898      V.obs 89-48'29"     H.obs 75-27'59"
                   Quality 1          Method 4            Code OFFSET
POS KI 1010        East 5046.000      North 4976.500      Elev 250.100
                   Code OFFSET
POS KI 1011        East 5012.000      North 4965.000      Elev 250.080
                   Code OFFSET
POS KI 1012        East 5002.000      North 4999.000      Elev 250.000
                   Code OFFSET
POS KI 1013        East 5035.700      North 5009.300      Elev 250.200
                   Code OFFSET
GOBS TP 0001-1014  S.Dist 27.145      V.obs 89-53'18"     H.obs 118-07'05"
                   Quality 5          Method 4
GOBS TP 0001-1015  S.Dist 27.146      V.obs 89-50'41"     H.obs 118-07'31"
                   Quality 1          Method 4
GOBS TP 0001-1016  S.Dist 27.150      V.obs 89-50'20"     H.obs 118-07'11"
                   Quality 1          Method 4
VERTADJ RK         Origin N <Null>    Origin E <Null>
                   Slope N 0.001      Slope E 0.001
                   Const Adj 250.012  Method Inclined Plane
HORZADJ RK         Origin N <Null>    Origin E <Null>
                   Trans.N 4999.958   Trans.E 5000.013
                   Rotation 0-27'50"  Scale 0.99643189
GOBS TP 0001-1017  S.Dist 27.132      V.obs 89-55'45"     H.obs 118-07'26"
                   Quality 5          Method 4
INSTRUMENT         SET                EDM <No text>       EDM S/N 000000
                   Theo desc <No text> Theo S/N 000000    Mount Not applic
                   V.obs Zenith       EDM o/s <Null>      Refl o/s <Null>
                   P.C. mm 0.000
NOTE PC            P.C. mm Applied
STN TP 0001        East 4999.958      North 5000.013      Elev 250.012
                   Theo ht 2.000
TARGET             Target ht 2.000
OBS F1 0001-1018   S.Dist 250.000     V.obs 90-00'00"     H.obs 0-00'00"
NOTE AC            Direction Left     From 1000           To pt 1012
NOTE AC            Radius 50.000
```

NOTE LN	From 1002	To pt 1003	
POS RK 1019	East 5023.928	North 4987.451	Elev 250.116
NOTE LN	Dist 1000.001	Cut 0.042	Offline -0.015
GSTN RK 1005	East 23.938	North -12.800	Elev 0.067
	Quality 1	Method 4	Ant ht 0.000
	Code EVENT		
ANT HT RK	Ant ht 2.000		
GOBS TP 1005-1020	S.Dist 27.155	V.obs 89-49'03"	H.obs 118-08'31"
	Quality 1	Method 4	Code A B
NOTE SO	Cut 249.993	ëNorth <Null>	ëEast <Null>
POS SO 1021	East 5047.880	North 4974.902	Elev 246.151
	Code 1009		
NOTE SO	Cut 250.014	ëNorth <Null>	ëEast <Null>
GPOS SO 1022	East 47.891	North -25.600	Elev -1.844
	Quality 1	Method 4	Code 1009

Chapter 3 Record types and definitions

This section provides a definition of the format of the database records as they are transmitted from the SDR. There are two formats: one for jobs with 4-digit numeric point Ids which is compatible with the SDR2, 20, 22 and 24 and one for jobs with 14-character alphanumeric point names.

A transmission consists of a sequence of data records, preceded by a start-of-transmission record and followed by an end-of-text record.

The format for "***Comms output***" and "***Comms input***" is:

- Start-of-transmission record: STX CR LF (Hex 02, Hex 0D, Hex 0A).
- An unspecified number of variable length data records of the form: (DATA) CR LF. The (data) portion does not contain any special ASCII characters i.e., less than hex 20.
- An end-of-text record: ETX checksum CR LF (Hex 03, checksum, Hex 0D, Hex 0A). The checksum portion is 5 ASCII digits whose value equals the modulo 65536 sum of the numeric value of all data bytes. Data bytes are defined as all the characters transmitted (or received) inclusive of trailing spaces but exclusive of CR (ASCII 0D), LF (ASCII 0A), STX (ASCII 02) and ETX (ASCII 03) characters. The checksum is calculated by adding up the numeric value of all the data bytes, dividing by 65536 and taking the remainder as the modulus. The checksum value is generated on output and checked on input. If an incoming checksum is zero (00000), it is not checked.

Each data record consists of a fixed number of bytes of data that are ASCII characters in the range 20 hex to 7F hex. The first 4 bytes of each record always have the following format:

Bytes	**Contents**
1 and 2	A two digit integer identifying the record type
3 and 4	A two character derivation code indicating the origin of the data.

Section 3.6 **"Record formats"**, page 29, lists the different record types and the composition of the data fields in the record.

Note that most records will have two different fixed record lengths depending on the format of the job (i.e. SDR33 or SDR20 compatible).

Each record is terminated by the characters 0D and 0A hex

The first data record of each transmission is always of type 00. This is the header record, which contains the information on how the rest of the fields in the file are to be interpreted.

The version number field in the header record identifies the SDR version the file relates to. A number of option fields in the header record determine the measurement units in which different data fields have been recorded. A header record is always followed by a job, road definition or template definition record.

Each record is divided into a number of fields of data. Each field can be one of three types:

Integer	An integer value.
Alpha	A set of alphanumeric and punctuation characters.
Real	A real number value.

The fields of data are categorized further by their field width in characters (eg., Real 10 is a 10 character real number). The fields are also categorized by the units in which the field value is measured (e.g. a Real 10 angle is a real number which holds the value of an angle).

3.1 Integer fields

The integer data format holds a non-negative integer value. The field can have one of two formats:

i. The field consists of a sequence of the digits from 0 to 9. No space characters are allowed. Leading zeros must be used if the integer is smaller than the field size. The numerical value of the field is the value of the integer.

ii. If the entire field consists of space characters then the field is null (not measured). This is denoted on display outputs as "**<Null>**". When receiving data the SDR33 does not accept null values for certain fields e.g. target heights.

iii. If the SDR file is from an SDR, the leading characters can be "**<Null>**" or space. If the SDR file is from any other source rule, (i) must be applied.

The integer field can be of one of the following categories:

- Integer
- Point Id
- Type code

3.1.1 Integer category

The integer category applies to those integers, which do not require special handling.

3.1.2 Point Id category

The point Id category applies to those integer fields, which are point numbers identifying observation points. This is only the case when the SDR33 job is in SDR20 compatibility mode (Numeric (4) point identifiers). These are used as labels to identify points within the SDR file.

3.1.3 Type code category

The type code category applies to the first field of each record. The type value must be one of the values listed in Section 3.6 "**Record formats**", page 29.

3.2 Alpha fields

The Alpha data format holds a sequence of alphanumeric and punctuation characters. Any character from hex 20 to hex 7F is valid. If the field consists entirely of space characters then the field is null (not measured) and is normally displayed as "**<No text>**". Alpha data fields which are not of the full field width are padded to the right with space characters.

An Alpha field can be of one of the following units and categories:

- Derv code
- Option
- Point Id
- Text
- Version

3.2.1 Derivation codes

Derivation codes always occupy bytes 3 and 4 of a record. They are used to qualify the record type and provide information about the source of the data.

Derivation codes are displayed as their two character code except for the code **NM** (not measured) which is not displayed.

The set of valid derivation codes is listed in Section 3.4 "**Derivation codes**", page 21. Those derivation codes which apply to a particular record type are listed in brackets in the derivation code field for that record type in Section 3.6 "**Record formats**", page 29.

3.2.2 Option fields

An option is a special type of one byte wide Alpha field, which is used to hold the value of a selection from a list of options. The meanings of the different option fields are listed in Section 3.5 "**Options**", page 18. The field must contain one of the valid options for that type. The locations of these option fields are shown in Section 3.6 "**Record formats**", page 29.

3.2.3 Point Id category

Alpha fields in the point Id category hold the alphanumeric names for points. These are used as labels to identify different points in the job. When the point Id is an alpha field the job is said to be in SDR33 mode.

3.2.4 Text category

Alpha fields in the text category contain ordinary text with no special format.

3.2.5 Version category

The version number is an alpha 16 field in the header record, which determines the format of the SDR file. For jobs with 4-digit point numbers (which are fully compatible with SDR2x output) the version is `SDR20 V03-05'; for jobs with 14-character point names the version number is `SDR33 V04-02.00' or `SDR33 V04-03.00'.

3.3 Real fields

The real data format holds a real number. The field is of one of the following 4 formats:

i.. The field starts with an optional minus character, followed by a sequence of at least one digit from 0 to 9, optionally followed by a decimal point (period character), optionally followed by one or more digits from 0 to 9, followed by space characters if required to pad out the field.

ii. If the entire field consists of space characters then the field is null (not measured). This is displayed as "**<Null>**".

iii. If the entire field consists of the `9' character (without a decimal point, minus sign or spaces) then the field is infinite. This is valid only for grade fields in version V04-02.00.

iv. If the field is a grade field for version V04-03.00 then its first character must be a `modifier' followed by a real number being either in format i) or in format ii) above.

A real value is measured in a system of units, which must be one of the following:

- angle
- azimuth
- latitude
- longitude
- distance
- +distance
- grade
- mm
- scale factor
- pressure
- temperature

3.3.1 Angles and azimuths

Angles are transmitted in degrees, gons or mils depending on the setting of the Angle units field in the header record. An angle can range from 0° up to (but not including) 360° (or 0 to 400 gons, 0 to 6400 mils).

Angles are transmitted with 4 decimal places in SDR20-compatible mode (i.e. point ids are 4 digits long), and 8 decimal places in SDR33-mode (i.e. point ids are 14 characters long).

3.3.2 Distances and +Distances

Distances are transmitted in the units defined by the Distance units field of the header record (meters or feet).

+Distances mat not be negative.

Note that, due to the fixed field length of real fields, a value may not be exactly represented within such a field. A real value, which does not fit into its field, will be rounded and truncated so that it does fit. For example -

1234567.455 1234567.46
1234567.454 1234567.45

In order to keep the COMS output header compatible with previous versions, a new derivation code was created. The code "DU" stands for Distance Unit. This code is used to indicate distance unit display type that, in addition to meters and international feet, now includes US Survey Feet.

This derivation code can hold three different distance unit display types. It is sent immediately after the SDR33 Comms Output Header has been sent to flag the type of units. It is being used only if the distance unit display type is other than Meters or International Feet, i.e. US Feet. All distances specified after this Note record are displayed in the specified distance units.

The three possible forms of this note record are:

1) 13DU1:Meters:
2) 13DU2:Feet:
3) 13DU3:US Feet:

Although there are three possibilities, as stated above, only the third form is needed in practice. If for any reason it becomes necessary, the first two forms could be activated.

The numeric code directly after DU specifies which distance unit display type is requested. The text is informational only.

NOTE US: This note is used to tell the SDR33 that the following feature codes (during a comms-in session) are to be sorted in User Sorted rather than alpha order. If this note is not present the feature codes will be sorted in alpha order.

3.3.3 Grades

For version V04-02.00, a grade is a vertical distance divided by a horizontal distance. It is transmitted as a percentage, which is 0.0 for a horizontal slope. Cut grades and fill grades are always positive. Cut grades measure upward slopes and fill grades measure downward slopes. A vertical slope (upwards or downwards) is stored as infinity.

For version V04-03, the grade field is split into the first byte, containing the modifier and the remaining 16 bytes, containing a number. Note these new grade fields are only used in records view to V04-03, such as the Temp1-element, Temp1-sideslope and Apply-Super records. If the modifiers value is `0' then the grade is horizontal, if the modifiers' value is `1' or `2' the grade is vertically up or vertically down respectively. If the modifiers' value is `3' then the grade is transmitted as a percentage and should be displayed in percentage format. If the modifiers value is `4' then the grade is transmitted as a percentage but should be displayed in ratio format. A modifier with a value of `5' specifies a null (not measured) grade.

3.3.4 mm

A real value in mm units is measured in millimeters regardless of the value of the distance option in the header record (eg. the prism constant field). It is transmitted with 0 decimal places.

3.3.5 Scale factor

A scale factor is a real value, which is displayed to its full precision.

3.3.6 Pressure

A real value measured in pressure units with the units given by the pressure units field in the header record (mm Hg, inch Hg or mbar).

3.3.7 Temperature

A real value measured in temperature units with the units given by the temperature units field in the header record (Celsius or Fahrenheit).

3.4 Derivation codes

The following are derivation codes indicating the type or source of records generated by the SDR:

" "	Blank derivation code - used in reports
AC	Arcs program
AR	Areas program
AT	Feature code attribute note
AJ	Adjusted by traverse
BF	Building face pickup program
CA	HP Calculator
CC	Plane Curvature Correction
CG	Cogo record
CJ	Control Job
CL	Collimation program
CO	Coordinates program
CP	Setting of correction parameter
DO	Distance and offset program
DU	Distance units
D2	Distance 2 points
FC	Feature code note
F1	Uncorrected observation measured with face 1
F2	Uncorrected observation measured with face 2
IN	Inverse program
IR	Now redundant
IX	Intersections program
JS	Job settings
KI	Keyboard input
KM	Kinematic GPS data (low accuracy)
KP	Kinematic GPS processed data (high accuracy)
LN	Lines program
LV	Leveling records
MC	Measurement corrected for instrumental and environmental factors
MD	Multiple distance readings
NM	Not measured

OO	Output options
OS	Offset reading note
PC	Prism constant
PJ	Point projection program
PT	Pressure and Temperature (Atmos)
RE	Remote elevation program
RK	Real Time Kinematic GPS
RO	Roading program
RS	Resection program
RT	Road topography program
SC	Set collection
SK	Static/Kenematic
SO	Setting out program
SR	Slope reduction program
SS	Road setting out surface program
ST	System Time
TA	Taping from baseline
TP	Topography program
TS	Automatic time stamp note
TV	Traverse program
US	User sorted -- feature code list
XD	Externally derived
XF	Transformation

3.5 Option field details

The sections below list all the possible option values for the different fields in SDR33 records.

Angle Unit

The angle unit is defined in the header record. It has the following values:

1	Degrees
2	Gons
3	Mils

Distance Unit

The distance unit is defined in the header record. It has the following values:

1	Meters
2	Feet

Pressure Unit

The pressure unit is defined in the header field. It has the following values:

1	MmHg	Millimeters of mercury
2	Inch Hg	Inches of mercury
3	mbar	Millibars

Temperature Unit

The temperature unit is defined in the header record. It has the following values:

1	Celsius
2	Fahrenheit

Initial Coordinate Setup

The initial coordinate setup can be defined by the following values:

0	Arbitrary (Unknown)
1	Known

Coordinate Prompt Option

The coordinate prompt option is defined in the header record. It has the following values:

1	N-E-Elev	North, East, Elevation
2	E-N-Elev	East, North, Elevation

Corrections

The corrections (and all other "***Yes/No***" fields) have the following values:

1	No
2	Yes (correction applied)

Refractive Constant

The refractive constant used by reduction calculations is defined in the **JOB** record in SDR33 format.

1	0.14
2	0.20

EDM Type

The EDM type is defined in the instrument details record (**INSTR**). It has the following values:

Sokkia Instruments

1	Manual
3	SET5A
4	DT4/5/5A/20

5	DT5 RedMini Combo
6	SDM3E
7	SDM3ER
8	SDM3F
9	SDM3FR
:	SET (older styles)
;	DT2/4
<	REDmini
>	NET2
=	SET with 2-way comms (newer style) and SET C series.

Wild Instruments

N	T1000DI
O	T2000DI
P	T1600DI
Q	T1000
R	T2000
S	T1600
T	T1010
U	T1010DI
V	TC500/TC600

TOPCON

D	GTS3
E	GTS3/ET1/ET2
I	GTS300

Pentax

c	II or III
b	PTS10

Nikon

v	D50
w	A series

Geodimeter

g	400/500

Elta

]	3
x	46

y	Zeiss RL

Laser Range Finder

h	ProSurvey 1000
i	Criterion 400

Level Type

A	Manual
B	NA2000/3000

Mounting Type

The mounting type is defined in the instrument details record (**INSTR**). It has the following values:

1	Telescope	Telescope
2	Standards	Standards
3	Not Applic	Not applicable

Vertical Angle Option

The vertical angle option is defined in the instrument details record (INSTR). It has the following values:

1	Zenith	measured downwards from upwards vertical.
2	Horiz	measured upwards from horizontal.

This option applies to the vertical observation in **OBS** records which have not had any corrections applied (derivation code of **F1**, **F2** or **MD**).

Point Id Length

The point id length option is defined in the **JOB**, **ROAD NAME** and **TEMPLATE** records (SDR33 format only). It has the following value:

1	14

Note that it does not appear in the SDR20 (Numeric 4) format

Bad Mark

Stored in the SET record, the bad mark option defines whether the SET has been marked as bad. It has the following values:

1	Not a bad set
2	Bad set

Return Sight Made

Stored in the SET record, this option defines whether the set contains a return sighting.

1 No
2 Yes

Obs Order

Stored in the SET record, this option defines the order in which the set was observed. It is used only for re-calculating sets containing return sights.

1 Order was 123...321
2 Order was 123...123...

Pivot

Stored in the APPLY SUPER record, this option defines the point on the road cross-section which does not have its elevation changed due to the application of superelevation.

1 Left
2 Center
3 Right

Apply Superelevation

Stored in the TEMP ELEMENT record, this option specifies if the element should be superelevated.

1 No
2 Yes

Apply Widening

Stored in the TEMP ELEMENT record, this option specifies if the element should be widened.

1 No
2 Yes

Model

Model corresponds to the GPS Instrument model that used to collect the GPS information. The possible models are listed below:

1 GSR Series Receiver
2 Manual
3 Radian Series Receiver

Receiver Mode

Receiver Mode corresponds to the option to configure the GPS receiver to a Base or Rover. The possible receiver modes are listed below:

1 Base
2 Rover
3 Receiver
4 SDR

BPS Period

BPS Period is the interval, in seconds, that the **B**ase **P**ositional **S**ignal is broadcast from the base receiver. The possible BPS periods are listed below:

1 0
2 10
3 30
4 60
5 120
6 300

Antenna Type

Antenna Type is the type of GPS Antenna that was used while collecting GPS information. The possible Antenna types are listed below:

1 User
2 Geod2
3 Geod3
4 Marine3L1
5 Marine3L1/L2
6 Marine4

Antenna Meas Method

Antenna Measurement Method is the measurement method that was used while collecting GPS information. The possible measurement methods are listed below:

1 Slant
2 Vertical

Quality

Quality is based upon the Total RMS value where a quality of one (1) is the best and five (5) the worst. The Total RMS values that will determine the quality shall be as follows:

1 0.000 to 0.025
2 0.026 to 0.050
3 0.051 to 0.100

4	0.101 to 0.250
5	0.251 or more

Method

Method contains information about how the GPS information was collected. The following methods shall be defined:

1 Old Position
2 User Input
3 Point Positioning (100m 95% of the time)
4 DGPS (code differential)
5 Ambiguity Float
6 Ambiguity Fixed
7 Static
8 Kinematic

Projection Method

Projection Method is the method in which the horizontal components of the GPS-RTK collected data. The possible Projection methods are listed below:

1 Plane

Adjustment Type

Adjustment Type is the method in which the vertical component of the GPS-RTK collected data. The possible Adjustment types are listed below:

1 Inclined Plane

3.6 Record formats

The tables below give a description of the format for the different types of record. The tables are divided into 5 columns:

- The **Record details** column lists the abbreviated and full names for the record type and the total byte count for the record.
- The **Pos** column lists the start and end byte positions for the field within the record.
- The **Format** column details whether the field is integer, alpha or real and gives the field size in bytes.
- The **Field Description** column gives a description of the purpose of the field.
- The **Units / Category** field provides information on the nature of the data in the field.

3.6.1 SDR2x format

Record details	*Pos*	*Format*	*Field Description*	*Units/Category*
Header	1-2	Integer 2	Type code 00	Type code
46 bytes	3-4	Alpha 2	Derivation code (NM)	Derv code
Header record	5-20	Alpha 16	Version number	Version
	21-24	Integer 4	Serial number	Integer
	25-40	Alpha 16	Date and time	Text
	41	Alpha 1	Angle unit	Option
	42	Alpha 1	Distance unit	Option
	43	Alpha 1	Pressure unit	Option
	44	Alpha 1	Temperature unit	Option
	45	Alpha 1	Coordinate prompt option	Option
	46	Alpha 1	Always `1'	Option
INSTR	1-2	Integer 2	Type code 01	Type code
81 bytes	3-4	Alpha 2	Derivation code	Derv code
Instrument details	5	Alpha 1	EDM type	Option
	6-21	Alpha 16	EDM description	Text
	22-27	Integer 6	EDM serial number	Integer
	28-43	Alpha 16	Theodolite description	Text
	44-49	Integer 6	Theodolite serial number	Integer
	50	Alpha 1	Mounting type	Option
	51	Alpha 1	Vertical angle option	Option
	52-61	Real 10	EDM offset	Distance
	62-71	Real 10	Reflector offset	Distance
	72-81	Real 10	Prism constant	mm
STN	1-2	Integer 2	Type code 02	Type code
64 bytes	3-4	Alpha 2	Derivation code	Derv code
Station details	5-8	Integer 4	Point number	Point
	9-18	Real 10	Northing	Distance
	19-28	Real 10	Easting	Distance
	29-38	Real 10	Elevation	Distance
	39-48	Real 10	Theodolite height	Distance
	49-64	Alpha 16	Station description	Text
TRGET	1-2	Integer 2	Type code 03	Type code
14 bytes	3-4	Alpha 2	Derivation code (NM)	Derv code
Target details	5-14	Real 10	Target height	Distance
COL	1-2	Integer 2	Type code 04	Type code
24 bytes	3-4	Alpha 2	Derivation code (CL)	Derv code
Collimation	5-14	Real 10	Vertical collimation	Angle
values	15-24	Real 10	Horizontal collimation	Angle
ATMOS	1-2	Integer 2	Type code 05	Type code
24 bytes	3-4	Alpha 2	Derivation code	Derv code
Environment	5-14	Real 10	Pressure	Pressure
details	15-24	Real 10	Temperature	Temperature
SCALE	1-2	Integer 2	Type code 06	Type code
14 bytes	3-4	Alpha 2	Derivation code (NM)	Derv code
Scale factor	5-14	Real 10	Scale factor	Scale factor
BKB	1-2	Integer 2	Type code 07	Type code
32 bytes	3-4	Alpha 2	Derivation code	Derv code
Back bearing	5-8	Integer 4	Source point number	Point
details	9-12	Integer 4	Target point number	Point
	13-22	Real 10	Azimuth	Azimuth
	23-32	Real 10	Horizontal observation	Angle
POS	1-2	Integer 2	Type code 08	Type code
54 bytes	3-4	Alpha 2	Derivation code	Derv code
Coordinates	5-8	Integer 4	Point number	Point
	9-18	Real 10	Northing	Distance

	19-28	Real 10	Easting	Distance
	29-38	Real 10	Elevation	Distance
	39-54	Alpha 16	Description	Text
OBS (Note 3)	1-2	Integer 2	Type code 09	Type code
58 bytes	3-4	Alpha 2	Derivation code (F1,F2,MD)	Derv code
Observation	5-8	Integer 4	Source point number	Point
	9-12	Integer 4	Target point number	Point
	13-22	Real 10	Slope distance	+Distance
	23-32	Real 10	Vertical observation	Angle
	33-42	Real 10	Horizontal observation	Angle
	43-58	Alpha 16	Description	Text
OBS (Note 3)	1-2	Integer 2	Type code 09	Type code
58 bytes	3-4	Alpha 2	Derivation code (MC)	Derv code
Observation	5-8	Integer 4	Source point number	Point
	9-12	Integer 4	Target point number	Point
	13-22	Real 10	Slope distance	+Distance
	23-32	Real 10	Vertical angle	Angle
	33-42	Real 10	Horizontal azimuth	Azimuth
	43-58	Alpha 16	Description	Text
JOB	1-2	Integer 2	Type code 10	Type code
20 bytes	3-4	Alpha 2	Derivation code (NM)	Derv code
Job identifier	5-20	Alpha 16	Job identifier	Text
RED	1-2	Integer 2	Type code 11	Type code
58 bytes	3-4	Alpha 2	Derivation code (IN,SR,TP)	Derv code
Reduced	5-8	Integer 4	Source point number	Point
measurements	9-12	Integer 4	Target point number	Point
	13-22	Real 10	Azimuth	Azimuth
	23-32	Real 10	Horizontal distance	+Distance
	33-42	Real 10	Vertical distance	Distance
	43-58	Alpha 16	Description	Text
SET	1-2	Integer 2	Type code 12	Type code
11 bytes	3-4	Alpha 2	Derivation code (RS,TV)	Derv code
Set of	5-8	Integer 4	Source point number	Point
observations	9-11	Integer 3	Count of observations	Integer
NOTE	1-2	Integer 2	Type code 13	Type code
64 bytes	3-4	Alpha 2	Derivation code (TP, TS, JS, …)	Derv code
Note	5-64	Alpha 60	Alphanumeric note	Text
GPSINST	1-2	Integer 2	Type code 14	Type code
43 bytes	3-4	Alpha 2	Derivation code (RK)	Derv code
RTK instrument	5	Alpha 1	Model	Option
details	6-21	Alpha 16	Description Text	Text
	22-27	Integer 6	Serial Number	Integer
	28	Alpha 1	Receiver Mode	Option
	29	Alpha 1	BPS Period	Option
	30-32	Integer 3	DBEN Period	Integer
	33-34	Integer 2	Reference Elev Mask (degree)	Integer
	35	Alpha 1	Antenna Type	Option
	36	Alpha 1	Antenna Meas Method	Option
	37-39	Integer 3	Vertical Offset(mm)	Integer
	40-42	Integer 3	Radius (mm)	Integer
	43	Alpha 1	Store OBS	Option
GSTN	1-2	Integer 2	Type code 15	Type code
96 bytes	3-4	Alpha 2	Derivation code (RK)	Derv code
RTK station details	5-8	Integer 4	Point number	Point
	9-18	Real 10	Northing	Distance
	19-28	Real 10	Easting	Distance
	29-38	Real 10	Elevation	Distance
	39-48	Real 10	Horiz Dist (offset)	+Distance
	49-58	Real 10	Horiz Angle (offset)	Angle
	59-68	Real 10	Height (offset)	+Distance

	69-78	Real 10	Antenna height	Distance
	79-94	Alpha 16	Description Text	Text
	95	Alpha 1	Quality	Option
	96	Alpha 1	Method	Option
GOBS	1-2	Integer 2	Type code 16	Type code
60 bytes	3-4	Alpha 2	Derivation code (RK)	Derv code
RTK observation	5-8	Integer 4	Source point number	Point
	9-12	Integer 4	Target point number	Point
	13-22	Real 10	Slope distance	+Distance
	23-32	Real 10	Vertical Angle	Angle
	33-42	Real 10	Horizontal Angle	Angle
	43-52	Real 10	Antenna Height	Distance
	53-68	Alpha 16	Description Text	Text
	69	Alpha 1	Quality	Option
	70	Alpha 1	Method	Option
GRED	1-2	Integer 2	Type code 17	Type code
60 bytes	3-4	Alpha 2	Derivation code (RK)	Derv code
RTK reduced	5-8	Integer 4	Source point number	Point
measurements	9-12	Integer 4	Target point number	Point
	13-22	Real 10	Horizontal azimuth	Azimuth
	23-32	Real 10	Horizontal distance	+Distance
	33-42	Real 10	Vertical distance	+Distance
	43-58	Alpha 16	Description Text	Text
	59	Alpha 1	Quality	Option
	60	Alpha 1	Method	Option
GPOS	1-2	Integer 2	Type code 18	Type code
56 bytes	3-4	Alpha 2	Derivation code (RK)	Derv code
RTK position	5-8	Integer 4	Target point number	Point
	9-18	Real 10	Northing	Distance
	19-28	Real 10	Easting	Distance
	29-38	Real 10	Elevation	Distance
	39-54	Alpha 16	Description Text	Text
	55	Alpha 1	Quality	Option
	56	Alpha 1	Method	Option
PROJ	1-2	Integer 2	Type code 19	Type code
95 bytes	3-4	Alpha 2	Derivation code (RK)	Derv code
RTK projection	5	Alpha 1	Projection Method	Option
	6-21	Real 16	Origin Latitude	Latitude
	22-37	Real 16	Origin Longitude	Longitude
	38-47	Real 10	Origin Height	Distance
	48-57	Real 10	Origin North	Distance
	58-67	Real 10	Origin East	Distance
	68-77	Real 10	Origin Elevation	Distance
	78-87	Real 10	Scale Factor	Scale Factor
	88-97	Real 10	Orientation 1	N/A
	98-107	Real 10	Orientation 2	N/A
VERTADJ	1-2	Integer 2	Type code 21	Type code
55 bytes	3-4	Alpha 2	Derivation code (RK)	Derv code
RTK vertical	5	Alpha 1	Adjustment type	Option
adjustment	6-15	Real 10	Origin North	Distance
	16-25	Real 10	Origin East	Distance
	26-35	Real 10	Height Constant	Distance
	36-51	Real 16	Slope North	Slope
	51-66	Real 16	Slope East	Slope
GPS	1-2	Integer 2	Type code 24	Type code
66 bytes	3-4	Alpha 2	Derivation code (KM,KP,NM)	Derv code
Global	5-8	Integer 4	Point number	Point
positioning	9-24	Real 16	Latitude	Latitude
system	25-40	Real 16	Longitude	Longitude

	41-50	Real 10	Elevation	Distance
	51-66	Alpha 16	Code	Text
RSTN	1-2	Integer 2	Type code 25	Type code
100 bytes	3-4	Alpha 2	Derivation code (RO)	Derv code
Road station	5-8	Integer 4	Point number	Point
	9-18	Real 10	Northing	Distance
	19-28	Real 10	Easting	Distance
	29-38	Real 10	Elevation	Distance
	39-48	Real 10	Theodolite height	Distance
	49-64	Alpha 16	Code	Text
	65-74	Real 10	Station	Distance
	75-84	Real 10	Offset	Distance
	85-100	Alpha 16	Road name	Text
RPOS	1-2	Integer 2	Type code 26	Type code
74 bytes	3-4	Alpha 2	Derivation code (RO)	Derv code
Road position	5-8	Integer 4	Point number	Point
	9-18	Real 10	Northing	Distance
	19-28	Real 10	Easting	Distance
	29-38	Real 10	Elevation	Distance
	39-54	Alpha 16	Code	Text
	55-64	Real 10	Station	Distance
	65-74	Real 10	Offset	Distance
RCHK	1-2	Integer 2	Type code 27	Type code
84 bytes	3-4	Alpha 2	Derivation code (RO)	Derv code
Road check	5-8	Integer 4	Point number	Point
	9-18	Real 10	Station	Distance
	19-28	Real 10	Offset	Distance
	29-38	Real 10	Elevation	Distance
	39-48	Real 10	Delta Station	Distance
	49-58	Real 10	Delta offset	Distance
	59-68	Real 10	Delta elevation	Distance
	69-84	Alpha 16	Code	Text
ROAD NAME	1-2	Integer 2	Type code 28	Type code
20 bytes	3-4	Alpha 2	Derivation code (KI,NM,)	Derv code
Road	5-20	Alpha 16	Road name	Text
HORZ ALIGN	1-2	Integer 2	Type code 29	Type code
44 bytes	3-4	Alpha 2	Derivation code (NM,)	Derv code
Horizontal align	5-14	Real 10	Start station	Distance
	15-24	Real 10	Start azimuth	Azimuth
	25-34	Real 10	Start northing	Distance
	35-44	Real 10	Start easting	Distance
HORZ POINT	1-2	Integer 2	Type code 30	Type code
24 bytes	3-4	Alpha 2	Derivation code (NM,)	Derv code
Horizontal point	5-14	Real 10	Northing	Distance
	15-24	Real 10	Easting	Distance
HORZ STRAIGHT	1-2	Integer 2	Type code 31	Type code
24 bytes	3-4	Alpha 2	Derivation code (NM,)	Derv code
Horizontal	5-14	Real 10	Azimuth	Azimuth
straight	15-24	Real 10	Distance	+Distance
HORZ ARC	1-2	Integer 2	Type code 32	Type code
24 bytes	3-4	Alpha 2	Derivation code (NM,)	Derv code
Horizontal arc	5-14	Real 10	Distance	+Distance
	15-24	Real 10	Radius	Distance
HORZ SPIRAL	1-2	Integer 2	Type code 33	Type code
24 bytes	3-4	Alpha 2	Derivation code (NM,)	Derv code
Horizontal	5-14	Real 10	Distance	+Distance
spiral	15-24	Real 10	Radius	Distance
VERT ALIGN	1-2	Integer 2	Type code 34	Type code
24 bytes	3-4	Alpha 2	Derivation code (NM,)	Derv code
Vertical align	5-14	Real 10	Start station	Distance
	15-24	Real 10	Start elevation	Distance

CIRCULAR VC	1-2	Integer 2	Type code 35	Type code
34 bytes	3-4	Alpha 2	Derivation code (NM,)	Derv code
Vertical	5-14	Real 10	Station of intersection	Distance
circular	15-24	Real 10	Elevation of intersection	Distance
	25-34	Real 10	Radius	+Distance
PARABOLIC VC	1-2	Integer 2	Type code 36	Type code
34 bytes	3-4	Alpha 2	Derivation code (NM,)	Derv code
Vertical	5-14	Real 10	Station of intersection	Distance
parabolic	15-24	Real 10	Elevation of intersection	Distance
	25-34	Real 10	Length	+Distance
VERT POINT	1-2	Integer 2	Type code 37	Type code
24 bytes	3-4	Alpha 2	Derivation code (NM,)	Derv code
Vertical point	5-14	Real 10	Station	Distance
	15-24	Real 10	Elevation	Distance
XSEC	1-2	Integer 2	Type code 38	Type code
46 bytes	3-4	Alpha 2	Derivation code (NM,)	Derv code
Cross section	5-14	Real 10	Station	Distance
	15-30	Alpha 16	Left template	Text
	31-46	Alpha 16	Right template	Text
TEMP	1-2	Integer 2	Type code 39	Type code
20 bytes	3-4	Alpha 2	Derivation code (KI,NM,)	Derv code
Template	5-20	Alpha 16	Template name	Text
TEMP-OFS/ HTDIFF	1-2	Integer 2	Type code 40	Type code
24 bytes	3-4	Alpha 2	Derivation code (NM,)	Derv code
Template offset	5-14	Real 10	Offset	+Distance
	15-24	Real 10	Height difference	Distance
TEMP-GRADE/ DIST	1-2	Integer 2	Type code 41	Type code
24 bytes	3-4	Alpha 2	Derivation code (NM,)	Derv code
Template grade	5-14	Real 10	Grade	Grade
	15-24	Real 10	Horizontal distance	+Distance
TEMP- SIDESLOPE	1-2	Integer 2	Type code 42	Type code
24 bytes	3-4	Alpha 2	Derivation code (NM,)	Derv code
Template sideslope	5-14	Real 10	Cut grade	Grade
	15-24	Real 10	Fill grade	Grade

HORIZADJ	1-2	Integer 2	Type code 50	Type code
64 bytes	3-4	Alpha 2	Derivation code (RK)	Derv code
RTK horizontal	5-14	Real 10	Origin North	Distance
adjustment	15-24	Real 10	Origin East	Distance
	25-34	Real 10	Translation North	Distance
	35-44	Real 10	Translation East	Distance
	45-60	Real 16	Rotation	Azimuth
	61-76	Real 16	Scale Factor	Scale Factor
ANTHT	1-2	Integer 2	Type code 57	Type code
14 bytes	3-4	Alpha 2	Derivation code (RK)	Derv code
RTK antenna ht	5-14	Real 10	Antenna height	Distance
LEVEL INST	1-2	Integer 2	Type code 60	Type code
37 bytes	3-4	Alpha 2	Derivation code (LV)	Derv code
Instrument details	5	Alpha 1	Level type	Option
	6-21	Alpha 16	Description	Text
	22-27	Integer 6	Serial Number	Integer
	28-37	Real 10	Stadia (Note 4)	Distance
LEVEL ELEVATION	1-2	Integer 2	Type code 61	Type code
34 bytes	3-4	Alpha 2	Derivation code (LV)	Derv code
Elevation	5-8	Integer 4	Point Id	Point
	9-24	Alpha 16	Description	Text

	25-34	Real 10	Elevation	Distance
LEVEL STATION	1-2	Integer 2	Type code 62	Type code
18 bytes	3-4	Alpha 2	Derivation code (LV)	Derv code
Station details	5-9	Integer 5	Station number	Integer
	10-13	Integer 4	BS Point Id	Point
	14-18	Integer 5	Turning Point Count	Integer
LEVEL	1-2	Integer 2	Type code 63	Type code
OBSERVATION	3-4	Alpha 2	Derivation code (LV)	Derv code
1 Wire 59 bytes	5-8	Integer 4	Point Id	Point
Observation	9-18	Real 10	Distance	Distance
single wire	19-28	Real 10	Middle Wire Reading	Distance
	29-44	Alpha 16	Description	Text
	45-49	Integer 5	Station number	Integer
	50-54	Integer 5	IsABs	Integer
	55-59	Integer 5	IsATP	Integer
	60-69	Real 10	Offset	Distance
LEVEL	1-2	Integer 2	Type code 64	Type code
OBSERVATION	3-4	Alpha 2	Derivation code (LV)	Derv code
3 Wire 79 bytes	5-8	Integer 4	Point Id	Point
Observation	9-18	Real 10	Distance	Distance
three wire	19-28	Real 10	Middle Wire Reading	Distance
	29-44	Alpha 16	Description	Text
	45-49	Integer5	Station number	Integer
	50-54	Integer 5	IsABs	Integer
	55-59	Integer 5	IsATP	Integer
	60-69	Real 10	Offset	Distance
	70-79	Real 10	Top Wire Reading	Distance
	80-89	Real 10	Low Wire Reading	Distance
LEVEL OFFSET	1-2	Integer 2	Type code 65	Type code
14 bytes	3-4	Alpha 2	Derivation code (LV)	Derv code
Vertical offset	5-14	Real 10	Offset	Distance
GROBS	1-2	Integer 2	Type code 66	Type code
GPS Raw	3-4	Alpha 2	Derivation code	Derv code
Observation	5-8	Integer 4	Target point ID	Point
	9-24	Alpha 16	Description	Text
	25-32	Alpha 8	Begin Time	Text(HH:MM:SS)
	33-40	Alpha 8	End Time	Text(HH:MM:SS)
	41-48	Integer 8	Epoch Count	Integer
	49-53	Integer 5	Epoch Rate	Integer
	54-69	Real 16	WGS84 Latitude	Latitude
	70-85	Real 16	WGS84 Longitude	Longitude
	86-95	Real 10	WGS84 Height	Distance
	96	Alpha 1	Method	Option
LLHStn	1-2	Integer 2	Type code 96	Type code
78 bytes	3-4	Alpha 2	Derivation code (XF)	Derv code
Lat/Long	5-8	Integer 4	Point number	Point
Station	9-24	Real 16	Latitude	Latitude
	25-40	Real 16	Longitude	Longitude
	41-50	Real 10	Height	Distance
	51-60	Real 10	Collection Height	Distance
	61-76	Alpha 16	Description	Text
	77	Alpha 1	Quality	Option
	78	Alpha 1	Method	Option
XFORM	1-2	Integer 2	Type code 97	Type code
65 bytes	3-4	Alpha 2	Derivation code (XF)	Derv code
Transformation	5-24	Alpha 20	XFM File Name	Text
	25-44	Alpha 20	XFM Description	Text
	45-64	Alpha 20	XFM Datum/Zone	Text

	65	Alpha 1	Init Coord Setup	Option
WGS84LLH	1-2	Integer 2	Type code 98	Type code
68 bytes	3-4	Alpha 2	Derivation code (XF)	Derv code
WGS84 LatLong	5-8	Integer 4	Point number	Point
	9-24	Real 16	Latitude	Latitude
	25-40	Real 16	Longitude	Longitude
	41-50	Real 10	Height	Distance
	51-66	Alpha 16	Description	Text
	67	Alpha 1	Quality	Option
	68	Alpha 1	Method	Option
LocalLLH	1-2	Integer 2	Type code 99	Type code
68 bytes	3-4	Alpha 2	Derivation code (XF)	Derv code
Local Datum	5-8	Integer 4	Point number	Point
LatLong	9-24	Real 16	Latitude	Latitude
	25-40	Real 16	Longitude	Longitude
	41-50	Real 10	Height	Distance
	51-66	Alpha 16	Description	Text
	67	Alpha 1	Quality	Option
	68	Alpha 1	Method	Option

3.6.2 SDR33 format

Record details	*Pos*	*Format*	*Field Description*	*Units/Category*
HEADER	1-2	Integer 2	Type code 00	Type code
46 bytes	3-4	Alpha 2	Derivation code (ED,NM)	Derv code
Header record	5-20	Alpha 16	Version number	Version
	21-24	Integer 4	Serial number	Integer
	25-40	Alpha 16	Date and time	Text
	41	Alpha 1	Angle unit	Option
	42	Alpha 1	Distance unit	Option
	43	Alpha 1	Pressure unit	Option
	44	Alpha 1	Temperature unit	Option
	45	Alpha 1	Coord prompt option	Option
	46	Alpha 1	Angles left/right option	Option
INSTR	1-2	Integer 2	Type code 01	Type code
99 bytes	3-4	Alpha 2	Derivation code	Derv code
Instrument details	5	Alpha 1	EDM type	Option
	6-21	Alpha 16	EDM description	Text
	22-27	Integer 6	EDM serial number	Integer
	28-43	Alpha 16	Theodolite description	Text
	44-49	Integer 6	Theodolite serial number	Integer
	50	Alpha 1	Mounting type	Option
	51	Alpha 1	Vertical angle option	Option
	52-67	Real 16	EDM offset	Distance
	68-83	Real 16	Reflector offset	Distance
	84-99	Real 16	Prism constant	mm
STN	1-2	Integer 2	Type code 02	Type code
100 bytes	3-4	Alpha 2	Derivation code	Derv code
Station details	5-20	Alpha 16	Point id	Point
	21-36	Real 16	Northing	Distance
	37-52	Real 16	Easting	Distance
	53-68	Real 16	Elevation	Distance
	69-84	Real 16	Theodolite height	Distance
	85-100	Alpha 16	Station description	Text
TRGET	1-2	Integer 2	Type code 03	Type code
20 bytes	3-4	Alpha 2	Derivation code (NM)	Derv code
Target details	5-20	Real 16	Target height	Distance
COL	1-2	Integer 2	Type code 04	Type code
36 bytes	3-4	Alpha 2	Derivation code (CL)	Derv code
Collimation values	5-20	Real 16	Vertical collimation	Angle
	21-36	Real 16	Horizontal collimation	Angle
ATMOS	1-2	Integer 2	Type code 05	Type code
36 bytes	3-4	Alpha 2	Derivation code	Derv code
Environment	5-20	Real 16	Pressure	Pressure
details	21-36	Real 16	Temperature	Temperature
SCALE	1-2	Integer 2	Type code 06	Type code
20 bytes	3-4	Alpha 2	Derivation code (NM)	Derv code
Scale factor	5-20	Real 16	Scale factor	Scale factor
BKB	1-2	Integer 2	Type code 07	Type code
68 bytes	3-4	Alpha 2	Derivation code	Derv code
Back bearing	5-20	Alpha 16	Source point id	Point
details	21-36	Alpha 16	Target point id	Point
	37-52	Real 16	Azimuth	Azimuth
	53-68	Real 16	Horizontal observation	Angle
POS	1-2	Integer 2	Type code 08	Type code
84 bytes	3-4	Alpha 2	Derivation code	Derv code
Coordinates	5-20	Alpha 16	Point id	Point
	21-36	Real 16	Northing	Distance

	37-52	Real 16	Easting	Distance
	53-68	Real 16	Elevation	Distance
	69-84	Alpha 16	Description	Text
OBS (Note 1)	1-2	Integer 2	Type code 09	Type code
100 bytes	3-4	Alpha 2	Derivation code (F1,F2,MD)	Derv code
Observation	5-20	Alpha 16	Source point id	Point
	21-36	Alpha 16	Target point id	Point
	37-52	Real 16	Slope distance	+Distance
	53-68	Real 16	Vertical observation	Angle
	69-84	Real 16	Horizontal observation	Angle
	85-100	Alpha 16	Description	Text
OBS (Note 1)	1-2	Integer 2	Type code 09	Type code
100 bytes	3-4	Alpha 2	Derivation code (MC)	Derv code
Observation	5-20	Alpha 16	Source point id	Point
	21-36	Alpha 16	Target point id	Point
	37-52	Real 16	Slope distance	+Distance
	53-68	Real 16	Vertical angle	Angle
	69-84	Real 16	Horizontal azimuth	Azimuth
	85-100	Alpha 16	Description	Text
JOB	1-2	Integer 2	Type code 10	Type code
26 bytes	3-4	Alpha 2	Derivation code (NM)	Derv code
Job identifier	5-20	Alpha 16	Job identifier	Text
	21	Alpha 1	Point id type	Option
	22	Alpha 1	Include elevation	Option
	23	Alpha 1	Atmos correction	Option
	24	Alpha 1	C & R correction	Option
	25	Alpha 1	Refraction constant	Option
	26	Alpha 1	Sea level correction	Option
RED	1-2	Integer 2	Type code 11	Type code
100 bytes	3-4	Alpha 2	Derivation code (IN, TP,)	Derv code
Reduced	5-20	Alpha 16	Source point id	Point
measurements	21-36	Alpha 16	Target point id	Point
	37-52	Real 16	Azimuth	Azimuth
	53-68	Real 16	Horizontal distance	+Distance
	69-84	Real 16	Vertical distance	Distance
	85-100	Alpha 16	Description	Text
SET	1-2	Integer 2	Type code 12	Type code
29 bytes	3-4	Alpha 2	Derivation code (RS,TV)	Derv code
Set of	5-20	Alpha 16	Source point id	Point
observations	21-23	Integer 3	Count of observations	Integer
	24-26	Integer 3	Number of set	Integer
	27	Alpha 1	Bad marker	Option
	28	Alpha 1	Return sight made	Option
	29	Alpha 1	Prompt order	Option
NOTE	1-2	Integer 2	Type code 13	Type code
64 bytes	3-4	Alpha 2	Derivation code (CP, NM,TS)	Derv code
Note	5-64	Alpha 60	Alphanumeric note	Text
GPSINST	1-2	Integer 2	Type code 14	Type code
43 bytes	3-4	Alpha 2	Derivation code (RK)	Derv code
RTK instrument	5	Alpha 1	Model	Option
details	6-21	Alpha 16	Description Text	Text
	22-27	Integer 6	Serial Number	Integer
	28	Alpha 1	Receiver Mode	Option
	29	Alpha 1	BPS Period	Option
	30-32	Integer 3	DBEN Period	Integer
	33-34	Integer 2	Reference Elev Mask (degree)	Integer

	35	Alpha 1	Antenna Type	Option
	36	Alpha 1	Antenna Meas Method	Option
	37-39	Integer 3	Vertical Offset (mm)	Integer
	40-42	Integer 3	Radius (mm)	Integer
	43	Alpha 1	Store OBS	Option
GSTN	1-2	Integer 2	Type code 15	Type code
150 bytes	3-4	Alpha 2	Derivation code (RK)	Derv code
RTK station details	5-20	Alpha 16	Point id	Point
	21-36	Real 16	Northing	Distance
	37-52	Real 16	Easting	Distance
	53-68	Real 16	Elevation	Distance
	69-84	Real 16	Horiz Dist (offset)	+Distance
	85-100	Real 16	Horiz Angle (offset)	Angle
	101-116	Real 16	Height (offset)	+Distance
	117-132	Real 16	Antenna height	Distance
	133-148	Alpha 16	Description Text	Text
	149	Alpha 1	Quality	Option
	150	Alpha 1	Method	Option
GOBS	1-2	Integer 2	Type code 16	Type code
102 bytes	3-4	Alpha 2	Derivation code (RK)	Derv code
RTK observation	5-20	Alpha 16	Source point id	Point
	21-36	Alpha 16	Target point id	Point
	37-52	Real 16	Slope distance	+Distance
	53-68	Real 16	Vertical Angle	Angle
	69-84	Real 16	Horizontal Angle	Angle
	85-100	Real 16	Antenna Height	Distance
	101-116	Alpha 16	Description Text	Text
	117	Alpha 1	Quality	Option
	118	Alpha 1	Method	Option
GRED	1-2	Integer 2	Type code 17	Type code
102 bytes	3-4	Alpha 2	Derivation code (RK)	Derv code
RTK reduced	5-20	Alpha 16	Source point id	Point
measurements	21-36	Alpha 16	Target point id	Point
	37-52	Real 16	Horizontal azimuth	Azimuth
	53-68	Real 16	Horizontal distance	+Distance
	69-84	Real 16	Vertical distance	+Distance
	85-100	Alpha 16	Description Text	Text
	101	Alpha 1	Quality	Option
	102	Alpha 1	Method	Option
GPOS	1-2	Integer 2	Type code 18	Type code
86 bytes	3-4	Alpha 2	Derivation code (RK)	Derv code
RTK position	5-20	Alpha 16	Target point id	Point
	21-36	Real 16	Northing	Distance
	37-52	Real 16	Easting	Distance
	53-68	Real 16	Elevation	Distance
	69-84	Alpha 16	Description Text	Text
	85	Alpha 1	Quality	Option
	86	Alpha 1	Method	Option
PROJ	1-2	Integer 2	Type code 19	Type code
149 bytes	3-4	Alpha 2	Derivation code (RK)	Derv code
RTK projection	5	Alpha 1	Projection Method	Option
	6-21	Real 16	Origin Latitude	Latitude
	22-37	Real 16	Origin Longitude	Longitude
	38-53	Real 16	Origin Height	Distance
	54-69	Real 16	Origin North	Distance
	70-85	Real 16	Origin East	Distance
	86-101	Real 16	Origin Elevation	Distance
	102-117	Real 16	Scale Factor	Scale Factor
	118-133	Real 16	Orientation 1	N/A
	134-149	Real 16	Orientation 2	N/A
VERTADJ	1-2	Integer 2	Type code 21	Type code

85 Bytes	3-4	Alpha 2	Derivation code (RK)	Derv code
RTK vertical	5	Alpha 1	Adjustment type	Option
adjustment	6-21	Real 16	Origin North	Distance
	22-37	Real 16	Origin East	Distance
	38-53	Real 16	Height Constant	Distance
	54-69	Real 16	Slope North	Slope
	70-85	Real 16	Slope East	Slope
GPS	1-2	Integer 2	Type code 24	Type code
84 bytes	3-4	Alpha 2	Derivation code (KM,KP,NM)	Derv code
Global	5-20	Alpha 16	Point id	Point
positioning	21-36	Real 16	Latitude	Latitude
system	37-52	Real 16	Longitude	Longitude
	53-68	Real 16	Elevation	Distance
	69-84	Alpha 16	Code	Text
RSTN	1-2	Integer 2	Type code 25	Type code
148 bytes	3-4	Alpha 2	Derivation code (RO)	Derv code
Road station details	5-20	Alpha 16	Point id	Point
	21-36	Real 16	Northing	Distance
	37-52	Real 16	Easting	Distance
	53-68	Real 16	Elevation	Distance
	69-84	Real 16	Theodolite height	Distance
	85-100	Alpha 16	Code	Text
	101-116	Real 16	Station	Distance
	117-132	Real 16	Offset	Distance
	133-148	Alpha 16	Road name	Text
RPOS	1-2	Integer 2	Type code 26	Type code
116 bytes	3-4	Alpha 2	Derivation code (RO)	Derv code
Road position	5-20	Alpha 16	Point id	Point
	21-36	Real 16	Northing	Distance
	37-52	Real 16	Easting	Distance
	53-68	Real 16	Elevation	Distance
	69-84	Alpha 16	Code	Text
	85-100	Real 16	Station	Distance
	101-116	Real 16	Offset	Distance
RCHK	1-2	Integer 2	Type code 27	Type code
132 bytes	3-4	Alpha 2	Derivation code (RO)	Derv code
Road check	5-20	Alpha 16	Point id	Point
	21-36	Real 16	Station	Distance
	37-52	Real 16	Offset	Distance
	53-68	Real 16	Elevation	Distance
	69-84	Real 16	Delta Station	Distance
	85-100	Real 16	Delta offset	Distance
	101-116	Real 16	Delta elevation	Distance
	117-132	Alpha 16	Code	Text
ROAD NAME	1-2	Integer 2	Type code 28	Type code
21 bytes	3-4	Alpha 2	Derivation code (KI,NM,##)	Derv code
Road	5-20	Alpha 16	Road name	Text
	21	Alpha 1	Point id type	Option
HORZ ALIGN	1-2	Integer 2	Type code 29	Type code
68 bytes	3-4	Alpha 2	Derivation code (NM,##)	Derv code
Horizontal align	5-20	Real 16	Start Station	Distance
	21-36	Real 16	Start azimuth	Azimuth
	37-52	Real 16	Start northing	Distance
	53-68	Real 16	Start easting	Distance
HORZ POINT	1-2	Integer 2	Type code 30	Type code
36 bytes	3-4	Alpha 2	Derivation code (NM,##)	Derv code
Horizontal point	5-20	Real 16	Northing	Distance
	21-36	Real 16	Easting	Distance
HORZ STRAIGHT	1-2	Integer 2	Type code 31	Type code
36 bytes	3-4	Alpha 2	Derivation code (NM,##)	Derv code

Horizontal straight	5-20	Real 16	Azimuth	Azimuth
	21-36	Real 16	Distance	+Distance
HORZ ARC	1-2	Integer 2	Type code 32	Type code
36 bytes	3-4	Alpha 2	Derivation code (NM,##)	Derv code
Horizontal arc	5-20	Real 16	Distance	+Distance
	21-36	Real 16	Radius	Distance
HORZ SPIRAL	1-2	Integer 2	Type code 33	Type code
36 bytes	3-4	Alpha 2	Derivation code (NM,##)	Derv code
Horizontal spiral	5-20	Real 16	Distance	+Distance
	21-36	Real 16	Radius	Distance
VERT ALIGN	1-2	Integer 2	Type code 34	Type code
36 bytes	3-4	Alpha 2	Derivation code (NM,##)	Derv code
Vertical align	5-20	Real 16	Start station	Distance
	21-36	Real 16	Start elevation	Distance
CIRCULAR VC	1-2	Integer 2	Type code 35	Type code
52 bytes	3-4	Alpha 2	Derivation code (NM,##)	Derv code
Vertical circular	5-20	Real 16	Station of intersection	Distance
	21-36	Real 16	Elevation of intersection	Distance
	37-52	Real 16	Radius	+Distance
PARABOLIC VC	1-2	Integer 2	Type code 36	Type code
52 bytes	3-4	Alpha 2	Derivation code (NM,##)	Derv code
Vertical	5-20	Real 16	Station of intersection	Distance
parabolic	21-36	Real 16	Elevation of intersection	Distance
	37-52	Real 16	Length	+Distance
VERT POINT	1-2	Integer 2	Type code 37	Type code
36 bytes	3-4	Alpha 2	Derivation code (NM,##)	Derv code
Vertical point	5-20	Real 16	Station	Distance
	21-36	Real 16	Elevation	Distance
XSEC	1-2	Integer 2	Type code 38	Type code
52 bytes	3-4	Alpha 2	Derivation code (NM,##)	Derv code
Cross section	5-20	Real 16	Station	Distance
	21-36	Alpha 16	Left template	Text
	37-52	Alpha 16	Right template	Text
TEMP	1-2	Integer 2	Type code 39	Type code
21 bytes	3-4	Alpha 2	Derivation code (KI,NM,##)	Derv code
Template	5-20	Alpha 16	Template name	Text
	21	Alpha 1	Point id type	Option
TEMP-	1-2	Integer 2	Type code 40	Type code
OFS/ HTDIFF	3-4	Alpha 2	Derivation code (NM,##)	Derv code
36 bytes	5-20	Real 16	Offset	+Distance
Template offset	21-36	Real 16	Height difference	Distance
TEMP-	1-2	Integer 2	Type code 41	Type code
GRADE/DIST	3-4	Alpha 2	Derivation code (NM,##)	Derv code
36 bytes	5-20	Real 16	Grade	Grade
Template grade	21-36	Real 16	Horizontal distance	+Distance
TEMP-	1-2	Integer 2	Type code 42	Type code
SIDESLOPE	3-4	Alpha 2	Derivation code (NM,##)	Derv code
36 bytes	5-20	Real 16	Cut grade	Grade
Template sideslope	21-36	Real 16	Fill grade	Grade
APPLY SUPER	1-2	Integer 2	Type code 44	Type code
87 bytes	3-4	Alpha 2	Derivation code (NM)	Derv code
Apply super-	5-20	Real 16	Chainage	Distance
elevation	21-37	Grade 17	Left Super	New Grade
	38-54	Grade 17	Right Super	New Grade
	55-70	Real 16	Left Widen	+Distance
	71-86	Real 16	Right Widen	+Distance
	87	Alpha 1	Pivot	Option

DEFINE SUPER	1-2	Integer 2	Type code 45	Type code
36 bytes	3-4	Alpha 2	Derivation code (NM)	Derv code
Define super-	5-20	Real 16	Start chainage	Distance
elevation	21-36	Real 16	End chainage	Distance
TEMP-ELEMENT	1-2	Integer 2	Type code 46	Type code
103 bytes	3-4	Alpha 2	Derivation code	Derv code
Template	5-21	Grade 17	Grade	New Grade
	22-37	Real 16	Horizontal distance	+Distance
	38-53	Real 16	Vertical distance	Distance
	54-69	Real 16	Offset	+Distance
	70-85	Real 16	Height difference	Distance
	86	Alpha 1	Apply super elevation	Option
	87	Alpha 1	Apply Widening	Option
	88-103	Alpha 16	Code	Text
TEMP-	1-2	Integer 2	Type code 47	Type code
SIDESLOPE	3-4	Alpha 2	Derivation code	Derv code
38 bytes	5-21	Grade 17	Cut batter	New Grade
Template side- slope	22-38	Grade 17	Fill batter	New Grade
HORIZADJ	1-2	Integer 2	Type code 50	Type code
100 bytes	3-4	Alpha 2	Derivation code (RK)	Derv code
RTK horizontal	5-20	Real 16	Origin North	Distance
adjustment	21-36	Real 16	Origin East	Distance
	37-52	Real 16	Translation North	Distance
	53-68	Real 16	Translation East	Distance
	69-84	Real 16	Rotation	Azimuth
	85-100	Real 16	Scale Factor	Scale Factor
ANTHT	1-2	Integer 2	Type code 57	Type code
20 bytes	3-4	Alpha 2	Derivation code (RK)	Derv code
RTK antenna ht	5-20	Real 16	Antenna height	Distance
LEVEL	1-2	Integer 2	Type code 60	Type code
INSTRUMENT	3-4	Alpha 2	Derivation code (LV)	Derv code
43 bytes	5	Alpha 1	Level Type	Option
Instrument details	6-21	Alpha 16	Description	Text
	22-27	Integer 6	Serial number	Integer
	28-43	Real 16	Stadia	Distance
LEVEL	1-2	Integer 2	Type code 61	Type code
ELEVATION	3-4	Alpha 2	Derivation code (LV)	Derv code
52 bytes	5-20	Alpha 16	Point Id	Point
Elevation	21-36	Alpha 16	Description	Text
	37-52	Real 16	Elevation	Distance
LEVEL	1-2	Integer 2	Type code 62	Type code
STATION	3-4	Alpha 2	Derivation code (LV)	Derv code
30 bytes	5-9	Integer 5	Station number	Integer
Station details	10-25	Alpha 16	BS Point Id	Point
	26-30	Integer 5	Turning point count	Integer
LEVEL	1-2	Integer 2	Type code 63	Type code
OBSERVATION	3-4	Alpha 2	Derivation code (LV)	Derv code
1 Wire 83 bytes	5-20	Alpha 16	Point Id	Point
Observation	21-36	Real 16	Distance	Distance
single wire	37-52	Real 16	Middle Wire Reading	Distance
	53-68	Alpha 16	Description	Text
	69-73	Integer 5	Station number	Integer
	74-78	Integer 5	IsABs	Integer
	79-83	Integer 5	IsATP	Integer
	84-99	Real 16	Offset	Distance
LEVEL	1-2	Integer 2	Type code 64	Type code
OBSERVATION	3-4	Alpha 2	Derivation code (LV)	Derv code
3 Wire	5-20	Alpha 16	Point Id	Point
115 bytes	21-36	Real 16	Distance	Distance
Observation	37-52	Real 16	Middle Wire Reading	Distance
three wire	53-68	Alpha 16	Description	Text

	69-73	Integer 5	Station number	Integer
	74-78	Integer 5	IsABs	Integer
	79-83	Integer 5	IsATP	Integer
	84-99	Real 16	Offset	Distance
	100-115	Real 16	Top Wire Reading	Distance
	116-131	Real 16	Low Wire Reading	Distance
LEVEL OFFSET	1-2	Integer 2	Type code 65	Type code
20 bytes	3-4	Alpha 2	Derivation code (LV)	Derv code
Vertical offset	5-20	Real 16	Offset	Distance
GROBS	1-2	Interger 2	Type code 66	Type code
114 bytes	3-4	Alpha 2	Derivation code (RK)	Derv code
GPS Raw	5-20	Alpha 16	Target point ID	Point
Observation	21-36	Alpha 16	Description	Text
	37-44	Alpha 8	Begin Time	Text (HH:MM:SS)
	45-52	Alpha 8	End Time	Text (HH:MM:SS)
	53-60	Integer 8	Epoch Count	Integer
	61-65	Integer 5	Epoch Rate	Integer
	66-81	Real 16	WGS84 Latitude	Latitude
	82-97	Real 16	WGS84 Longitude	Longitude
	98-113	Real 16	WGS84 Height	Distance
	114	Alpha 1	Method	Option
LLHStn	1-2	Integer 2	Type code 96	Type code
102 bytes	3-4	Alpha 2	Derivation code (XF)	Derv code
Lat/Long	5-20	Alpha 16	Point id	Point
Station	21-36	Real 16	Latitude	Latitude
	37-52	Real 16	Longitude	Longitude
	53-68	Real 16	Height	Distance
	69-84	Real 16	Collection Height	Distance
	85-100	Alpha 16	Description	Text
	101	Alpha 1	Quality	Option
	102	Alpha 1	Method	Option
XFORM	1-2	Integer 2	Type code 97	Type code
65 bytes	3-4	Alpha 2	Derivation code (XF)	Derv code
Transformation	5-24	Alpha 20	XFM File Name	Text
	25-44	Alpha 20	XFM Description	Text
	45-64	Alpha 20	XFM Datum/Zone	Text
	65	Alpha 1	Init Coord Setup	Option
WGS84LLH	1-2	Integer 2	Type code 98	Type code
86 bytes	3-4	Alpha 2	Derivation code (XF)	Derv code
WGS84 LatLong	5-20	Alpha 16	Point id	Point
	21-36	Real 16	Latitude	Latitude
	37-52	Real 16	Longitude	Longitude
	53-68	Real 16	Height	Distance
	69-84	Alpha 16	Description	Text
	85	Alpha 1	Quality	Option
	86	Alpha 1	Method	Option
LocalLLH	1-2	Integer 2	Type code 99	Type code
86 bytes	3-4	Alpha 2	Derivation code (XF)	Derv code
Local Datum	5-20	Alpha 16	Point id	Point
LatLong	21-36	Real 16	Latitude	Latitude
	37-52	Real 16	Longitude	Longitude
	53-68	Real 16	Height	Distance
	69-84	Alpha 16	Description	Text
	85	Alpha 1	Quality	Option
	86	Alpha 1	Method	Option

- TEMP-GRADE/DIST (type code 41), TEMP-OFS/HTDIFF (type code 40) and TEMP-SIDESLOPE (type code 47) are only valid in V04-02.00 files.
- DEFINE SUPER (type code 45), APPLY SUPER (type code 44), TEMP-ELEMENT (type code 46), and TEMP-SIDESLOPE (type code 47) are only valid in V03-03.00 files.
- GPSINST (Type code 14), GSTN (Type code 15), GOBS (Type code 16), GRED (Type code 17), GPOS (Type code 18), PROJ (Type code 19), VERTADJ (Type code 21), HORIZADJ (Type code 50), and ANTHT (Type code 57) are only valid in V04-04.30 files.
- The OBS record type has two forms depending on the derivation code.
- The Linstr record contains the Stadia number. The Stadia is always 1 to a value.
- The value is the item found in the SDR Linstr record.

Chapter 4 Sample Comms output SDR files

Listed below is a Comms output SDR2x format file. Note the <STX> record at the start of the file and the <ETX> with associated checksum value at the end of the file.

```
<STX>
00NMSDR20     V03-05    18-Jan-80 20:34 122211
10NMSmall Example
13CPSea level crn: N
13CPC and R crn: N
13CPAtmos crn: N
06NM1.00000000
13TS18-Jan-80 20:14
01NM1RED            000000DT2           00000031              0.000
02TP0001100.000   200.000   50.000   1.000     Dead dog gully
11KI0001999914.00000                      Rusted pick-up
07TP0001999914.00000  0.00000
03NM0.000
09F100019999          90.00000  0.00000   Rusted pick-up
03NM0.750
08TP1000204.400   370.945   45.498    Old cow bones
08TP1001-132.937  398.153   55.917    Sleeping mule
02TP1001-132.937  398.153   55.917   1.000     Sleeping mule
07TP10010001319.61312 0.00000
09F110010001                    0.00000   Dead dog gully
08TP1002-125.983  154.785   79.152    Tumble weed farm
08TP1003177.283   298.631   41.572    Bloody sky ranch
<ETX>59766
```

A similar set of data to that shown in the previous SDR2x Comms output format (4-digit point Ids) is listed below in the SDR33 Comms output format (14-character alphanumeric point Ids). Note that some of the records are displayed on 2 lines due to the extra length of the records. Note again the <STX> record at the start of the file and the <ETX> with associated checksum value at the end of the file.

```
<STX>
00NMSDR33 V04-02.00t    07-Mar-91 13:36 111111
10NMSmall Example 2 121111
06NM1.00000000
13TS07-Mar-91 12:49
01NM1RED             000000DT2             00000031
0.00000000
```

```
02TP        TOPO0001100.00000000    200.00000000    50.00000000     1.00000000
Dead dog gully
11KI        TOPO0001            BS114.00000000
Rusted pick-up
07TP        TOPO0001            BS114.00000000     0.00000000
03NM0.00000000
09F1        TOPO0001            BS1                                1.00000000
Rusted pick-up
03NM0.75000000
08TP        AUTO1000204.40204371    370.94523543    45.49813752     Old cow
bones
08TP        AUTO1001-132.93718021   398.15306676    55.91713086     Sleeping
mule
02TP        AUTO1001-132.93718021   398.15306676    55.91713086     1.00000000
Sleeping mule
07TP        AUTO1001        TOPO0001319.61312390    0.00000000
09F1        AUTO1001        TOPO0001                                   0.00000000
Dead dog gully
08TP        AUTO1002-125.9831473    154.78514783    79.15227282     Tumble
weed farm
08TP        AUTO1003177.28340358    298.63117389    41.57230161     Bloody sky
ranch
<ETX>09436
```

Chapter 5 General notes on SDR files

- The SDR requires a precise data format when receiving data. All data must be in the exact format that it requires. Spaces may not be substituted for 0s, trailing blanks may be truncated, and the header and job records are required to be in the same order and format as the SDR sends out. If no job record is sent data is appended to the current job.
- In Comms output of numeric point Id jobs, the version number sent is `SDR20 V03-05'. This is to ensure 100% compatibility with the SDR2x format.
- The traverse program no longer works as in the SDR2x versions. Data is now collected first, and then processed. The traverse station records will not have special TV derivation codes. Notes are stored describing the start and close points, and new POS AJ records are stored for each station on the route.
- If a job has been created in the new 14 character point name alpha numeric mode (not the normal 4 digit mode) the data will be output in SDR33 format, which is quite different from the SDR20 format. The order of fields is generally the same but the positions are different, and new fields may have been added. The version field of the header record should be examined to determine which type of job it is.
- The reading program needs to look at the header record to determine the units for all the following data.
- Roading is a new program released with the SDR. It produces many new types of data records.

Three types of jobs are recognized by the SDR, they are
normal jobs, road jobs and template jobs. Road jobs and template jobs must meet the following conditions:

- A normal job begins with a JOB record.
- A road job begins with a ROAD record, which has a derivation code of KI.
- A template job begins with a TEMPLATE record, which has a derivation code of KI.
- All jobs end either when the end of the input is reached or another job begins.
- Road jobs may only contain the following records: ROAD NAME, SCALE, NOTE, HORZ ALIGN, HORZ POINT, HORZ STRAIGHT, HORZ ARC, HORZ SPIRAL, VERT ALIGN, CIRCULAR VC, PARABOLIC VC, VERT POINT, XSEC,

DEFINE SUPER and APPLY SUPER. DEFINE SUPER and APPLY SUPER are only valid in V04-03.xx files.

- V04-2.xx and SDR2x Template jobs may only contain the following records: TEMP, NOTE, TEMP-OFS/HTDIFF, TEMP-GRADE/DIST and TEMP-SIDESLOPE (type code 42).
- V04-3.xx Template jobs may only contain the following records: TEMP, NOTE, TEMP-ELEMENT and TEMP-SIDESLOPE (type code 47).
- Only one ROAD record may exist per road, and it must be the first record of the road job.
- Only one SCALE record may exist, it must be the first non-NOTE record following the ROAD record.
- Only one HORZ ALIGN record may exist per road.
- No horizontal alignment records (type codes 30, 31, 32 and 33) may only occur after a HORZ ALIGN record.
- No vertical alignment records (type codes 35, 36 and 37) may only occur after a VERT ALIGN record.
- If a VERT ALIGN record exists then there must also exist a VERT POINT record. The VERT POINT record must be the last vertical alignment record.
- Only one TEMPLATE record may exist per template, and it must be the first record of the template job.
- If a TEMP-SIDESLOPE record exists then it may not be followed by any other template record.

Note: Note Records (type code 13) may occur at any place within a road or template job.

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