

Riegl VZ400 CSV File Format

The Riegl VZ400 comma separated value (CSV) file format is a *time-sequential* dump of contents from the proprietary Riegl RXP files.

All information required to reconstruct the complete scan is retained. For each pulse, only the discrete returns are provided as the waveform data volume is too high for ASCII.

There are three types of records in the CSV file:

1. Scan records – these give data on the scan position, extent and angular resolution, scan line and measurement status.
2. Pulse records – these give data on an individual pulse origin, direction, and timestamp.
3. Point records – these give Spherical and Cartesian coordinates for an individual point corresponding to the preceding pulse record. Additional attributes extracted from the waveform are also provided.

Each instance of a record is a single line in the CSV file. The items corresponding to each of these records are listed below in the order they appear within the CSV file.

Scan Records

Table 1. Scan field-of-view record description

Item [unit]	Description
“scan_fov”	Flag to indicate this is a scan field-of-view record
Zenith Min [deg]	Nominal minimum zenith angle
Zenith Max [deg]	Nominal maximum zenith angle
Zenith Increment [deg]	Nominal zenith pulse angular spacing
Azimuth Min [deg]	Nominal minimum azimuth angle
Azimuth Max [deg]	Nominal maximum azimuth angle
Azimuth Increment [deg]	Nominal azimuth pulse angular spacing

Table 2. Scan position record description

Item [unit]	Description
“scan_pos”	Flag to indicate this is a scan position record
Latitude [dd]	Latitude from the scanner GPS
Longitude [dd]	Longitude from the scanner GPS
Ellipsoid Height [m]	Ellipsoid height from scanner GPS
Mean Sea Level Height [m]	Derived height of mean sea level
Roll [deg]	Inclinometer roll angle
Pitch [deg]	Inclinometer pitch angle

Yaw [deg]	Compass yaw angle
Horizontal Accuracy [m]	Inclinometer horizontal accuracy
Vertical Accuracy [m]	Inclinometer vertical accuracy
Roll Accuracy [deg]	Inclinometer roll accuracy
Pitch Accuracy [deg]	Inclinometer pitch accuracy
Yaw Accuracy [deg]	Compass yaw accuracy

1. If the compass fails or is not present, yaw will be "nan".
2. There may be multiple "scan_pos" records. Use the last record to construct the rotation matrix.

Table 3. Scan line record description.

Item	Description
line [up down]: n	Flag to identify the start and number (n) of a new scan line - "up" or "down" indicates the direction of the scan line.

1. The first few scan lines often do not contain any pulse or point records.

Table 4. Scan measurement status record description.

Item	Description
scan_[start stop]	Flag to identify that the scanner has started or stopped measurements.

Pulse Record

Table 5. Pulse record description.

Item [unit]	Description
"0"	Flag to indicate this is a pulse record
dX	Unity direction vector X value
dY	Unity direction vector Y value
dZ	Unity direction vector Z value
X origin [m]	Virtual pulse origin X coordinate
Y origin [m]	Virtual pulse origin Y coordinate
Z origin [m]	Virtual pulse origin Z coordinate
Facet number	Prism mirror facet for the current pulse
Number of prism facets	Number of prism facets (instrument constant)
Time [sec]	The instrument internal timestamp of the pulse origin
Time [sec]	The instrument internal timestamp of the start of the range gate

Point Record

Table 6. Point record description.

Item [unit]	Description
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Return number	The return number for the current pulse. A maximum of 4 returns are recorded.
Return type	Return classification. Valid values are 0 to 4, indicating: 0. single return 1. first return 2. middle return 3. last return 4. none
X [m]	Cartesian X coordinate
Y [m]	Cartesian Y coordinate
Z [m]	Cartesian Z coordinate
Range [m]	Distance from scan origin (X=0, Y=0, Z=0; not the virtual pulse origin) to return location.
Zenith [deg]	Calculated return zenith angle
Azimuth [deg]	Calculated return azimuth angle
Amplitude [dB]	This is the return amplitude, expressed as the ratio of the received power to the power received at the detection threshold.
Reflectance [dB]	Apparent reflectance, defined as the ratio of the received power to the power that would be received from a white Lambertian extended target at the same distance, assuming the surface normal of this target is parallel to the laser beam direction.
Deviation	A larger value for deviation indicates greater difference between the shapes of the system waveform and received waveform.
Time [sec]	The instrument internal timestamp of the return.

1. Cartesian coordinates are in the scanners own coordinate system. You need to use the inclinometer readings from the scan position record to level the scan.

Filename	Plot	Date	Location	Tilt	PRF	Resolution	Scanner Height	Deviation Threshold	Comment
gpv1wf_15282714e02742935s_201308011139_aa0f0_p01.rxp	GOLD0101	2013-08-01	South	0	300	0.06	1.2	20	
gpv1wf_15282714e02742935s_201308011139_aa0f0_p02.rxp	GOLD0101	2013-08-01	South	90	300	0.06	1.2	20	
gpv1wf_15282714e02742935s_201308011139_aa0f0_p03.rxp	GOLD0101	2013-08-01	West	0	300	0.06	1.2	20	
gpv1wf_15282714e02742935s_201308011139_aa0f0_p04.rxp	GOLD0101	2013-08-01	West	90	300	0.06	1.2	20	
gpv1wf_15282714e02742935s_201308011139_aa0f0_p05.rxp	GOLD0101	2013-08-01	North	0	300	0.06	1.2	20	
gpv1wf_15282714e02742935s_201308011139_aa0f0_p06.rxp	GOLD0101	2013-08-01	North	90	300	0.06	1.2	20	
gpv1wf_15282714e02742935s_201308011139_aa0f0_p07.rxp	GOLD0101	2013-08-01	East	0	300	0.06	1.2	20	
gpv1wf_15282714e02742935s_201308011139_aa0f0_p08.rxp	GOLD0101	2013-08-01	East	90	300	0.06	1.2	20	
gpv1wf_15282714e02742935s_201308011139_aa0f0_p09.rxp	GOLD0101	2013-08-01	Centre	0	300	0.06	1.2	20	
gpv1wf_15282714e02742935s_201308011139_aa0f0_p10.rxp	GOLD0101	2013-08-01	Centre	90	300	0.06	1.2	20	
gpv1wf_15282714e02742935s_201308011528_aa0f0_p01.rxp	GOLD0101	2013-08-01	Centre	0	100	0.06	1.2	20	
gpv1wf_15282714e02742935s_201308011528_aa0f0_p02.rxp	GOLD0101	2013-08-01	Centre	90	100	0.06	1.2	20	
gpv1wf_15282714e02742935s_201308011607_aa0f0_p01.rxp	GOLD0101	2013-08-01	Centre	0	300	0.04	1.2	20	
gpv1wf_15282714e02742935s_201308011607_aa0f0_p02.rxp	GOLD0101	2013-08-01	Centre	90	300	0.04	1.2	20	
gpv1wf_15308686e02762492s_201307291630_aa0f0_p01.rxp	KARA002	2013-07-29	Centre	0	300	0.04	1.2	20	
gpv1wf_15308686e02762492s_201307291630_aa0f0_p02.rxp	KARA002	2013-07-29	Centre	90	300	0.04	1.2	20	
gpv1wf_15308822e02762710s_201307311609_aa0f0_p01.rxp	KARA005	2013-07-31	East	0	300	0.06	1.2	20	
gpv1wf_15308822e02762710s_201307311609_aa0f0_p02.rxp	KARA005	2013-07-31	East	90	300	0.06	1.2	20	
gpv1wf_15308822e02762710s_201307311609_aa0f0_p03.rxp	KARA005	2013-07-31	South	0	300	0.06	1.2	20	
gpv1wf_15308822e02762710s_201307311609_aa0f0_p04.rxp	KARA005	2013-07-31	South	90	300	0.06	1.2	20	
gpv1wf_15308822e02762710s_201307311609_aa0f0_p05.rxp	KARA005	2013-07-31	West	0	300	0.06	1.2	20	
gpv1wf_15308822e02762710s_201307311609_aa0f0_p06.rxp	KARA005	2013-07-31	West	90	300	0.06	1.2	20	
gpv1wf_15308822e02762710s_201307311609_aa0f0_p07.rxp	KARA005	2013-07-31	North	0	300	0.06	1.2	20	
gpv1wf_15308822e02762710s_201307311609_aa0f0_p08.rxp	KARA005	2013-07-31	North	90	300	0.06	1.2	20	
gpv1wf_15308822e02762710s_201307311609_aa0f0_p09.rxp	KARA005	2013-07-31	Centre	0	300	0.06	1.2	20	
gpv1wf_15308822e02762710s_201307311609_aa0f0_p10.rxp	KARA005	2013-07-31	Centre	90	300	0.06	1.2	20	
gpv1wf_15308822e02762710s_201307311625_aa0f0_p01.rxp	KARA005	2013-07-31	Centre	0	100	0.06	1.2	20	
gpv1wf_15308822e02762710s_201307311625_aa0f0_p02.rxp	KARA005	2013-07-31	Centre	90	100	0.06	1.2	20	
gpv1wf_15308822e02762710s_201307311627_aa0f0_p01.rxp	KARA005	2013-07-31	Centre	0	300	0.04	1.2	20	
gpv1wf_15308822e02762710s_201307311627_aa0f0_p02.rxp	KARA005	2013-07-31	Centre	90	300	0.04	1.2	20	
gpv1wf_15308822e02762710s_201307311627_aa0f0_p03.rxp	KARA005	2013-07-31	East	0	300	0.04	1.2	20	Reigl error: "Missing data for sequence". Data currently not imported.
gpv1wf_15308822e02762710s_201307311627_aa0f0_p04.rxp	KARA005	2013-07-31	East	90	300	0.04	1.2	20	Reigl error: "Missing data for sequence". Data currently not imported.
gpv1wf_15308910e02762520s_201307301326_aa0f0_p01.rxp	KARA001	2013-07-30	North	0	300	0.06	1.2	20	
gpv1wf_15308910e02762520s_201307301326_aa0f0_p02.rxp	KARA001	2013-07-30	North	90	300	0.06	1.2	20	
gpv1wf_15308910e02762520s_201307301326_aa0f0_p03.rxp	KARA001	2013-07-30	East	0	300	0.06	1.2	20	
gpv1wf_15308910e02762520s_201307301326_aa0f0_p04.rxp	KARA001	2013-07-30	East	90	300	0.06	1.2	20	
gpv1wf_15308910e02762520s_201307301326_aa0f0_p05.rxp	KARA001	2013-07-30	South	0	300	0.06	1.2	20	
gpv1wf_15308910e02762520s_201307301326_aa0f0_p06.rxp	KARA001	2013-07-30	South	90	300	0.06	1.2	20	
gpv1wf_15308910e02762520s_201307301326_aa0f0_p07.rxp	KARA001	2013-07-30	West	0	300	0.06	1.2	20	
gpv1wf_15308910e02762520s_201307301326_aa0f0_p08.rxp	KARA001	2013-07-30	West	90	300	0.06	1.2	20	
gpv1wf_15308910e02762520s_201307301326_aa0f0_p09.rxp	KARA001	2013-07-30	Centre	0	300	0.06	1.2	20	
gpv1wf_15308910e02762520s_201307301326_aa0f0_p10.rxp	KARA001	2013-07-30	Centre	90	300	0.06	1.2	20	

Filename	Plot	Date	Location	Tilt	PRF	Resolution	Scanner Height	Deviation Threshold	Comment
gpv1wf_15308910e02762520s_201307301447_aa0f0_p01.rxp	KARA001	2013-07-30	-	0	300	0.06	1.2	20	Extra scan location for tree reconstruction
gpv1wf_15308910e02762520s_201307301447_aa0f0_p02.rxp	KARA001	2013-07-30	-	90	300	0.06	1.2	20	Extra scan location for tree reconstruction
gpv1wf_15308910e02762520s_201307301508_aa0f0_p01.rxp	KARA001	2013-07-30	Centre	0	100	0.06	1.2	20	
gpv1wf_15308910e02762520s_201307301508_aa0f0_p02.rxp	KARA001	2013-07-30	Centre	90	100	0.06	1.2	20	
gpv1wf_15308910e02762520s_201307301521_aa0f0_p01.rxp	KARA001	2013-07-30	Centre	0	300	0.04	1.2	20	
gpv1wf_15308910e02762520s_201307301521_aa0f0_p02.rxp	KARA001	2013-07-30	Centre	90	300	0.04	1.2	20	
gpv1wf_15282714e02742935s_201308031445_aa0f0_p01.rxp	GOLD0101	2013-08-03	-	0	300	0.06	1.2	20	Extra scan location for destructive harvesting
gpv1wf_15282714e02742935s_201308031445_aa0f0_p02.rxp	GOLD0101	2013-08-03	-	90	300	0.06	1.2	20	Extra scan location for destructive harvesting
gpv1wf_15282714e02742935s_201308031445_aa0f0_p03.rxp	GOLD0101	2013-08-03	-	0	300	0.06	1.2	20	Extra scan location for destructive harvesting
gpv1wf_15282714e02742935s_201308031445_aa0f0_p04.rxp	GOLD0101	2013-08-03	-	90	300	0.06	1.2	20	Extra scan location for destructive harvesting
gpv1wf_15282714e02742935s_201308031445_aa0f0_p05.rxp	GOLD0101	2013-08-03	-	0	300	0.06	1.2	20	Extra scan location for destructive harvesting
gpv1wf_15282714e02742935s_201308031445_aa0f0_p06.rxp	GOLD0101	2013-08-03	-	90	300	0.06	1.2	20	Extra scan location for destructive harvesting
gpv1wf_15282714e02742935s_201308031445_aa0f0_p07.rxp	GOLD0101	2013-08-03	-	0	300	0.06	1.2	20	Extra scan location for destructive harvesting

Filename	Panel	Range	Angle	PRF	Resolution
gpv1wf_cal-02m-00pd-p0_20130728_aa0f0.rxp	Grid-6	2	0	300	0.04
gpv1wf_cal-04m-00pd-p0_20130728_aa0f0.rxp	Grid-6	4	0	300	0.04
gpv1wf_cal-06m-00pd-p0_20130728_aa0f0.rxp	Grid-6	6	0	300	0.04
gpv1wf_cal-08m-00pd-p0_20130728_aa0f0.rxp	Grid-6	8	0	300	0.04
gpv1wf_cal-10m-00pd-p0_20130728_aa0f0.rxp	Grid-6	10	0	300	0.04
gpv1wf_cal-10m-05nd-p0_20130728_aa0f0.rxp	Grid-6	10	-5	300	0.04
gpv1wf_cal-10m-05pd-p0_20130728_aa0f0.rxp	Grid-6	10	5	300	0.04
gpv1wf_cal-10m-10nd-p0_20130728_aa0f0.rxp	Grid-6	10	-10	300	0.04
gpv1wf_cal-10m-10pd-p0_20130728_aa0f0.rxp	Grid-6	10	10	300	0.04
gpv1wf_cal-10m-15pd-p0_20130728_aa0f0.rxp	Grid-6	10	15	300	0.04
gpv1wf_cal-15m-00pd-p0_20130728_aa0f0.rxp	Grid-6	15	0	300	0.04
gpv1wf_cal-20m-00pd-p0_20130728_aa0f0.rxp	Grid-6	20	0	300	0.04
gpv1wf_cal-20m-00pd-p1_20130728_aa0f0.rxp	Panel1	20	0	300	0.04
gpv1wf_cal-20m-00pd-p2_20130728_aa0f0.rxp	Panel2	20	0	300	0.04
gpv1wf_cal-20m-00pd-p3_20130728_aa0f0.rxp	Panel3	20	0	300	0.04
gpv1wf_cal-20m-00pd-p4_20130728_aa0f0.rxp	Panel4	20	0	300	0.04
gpv1wf_cal-40m-00pd-p0_20130728_aa0f0.rxp	Grid-6	40	0	300	0.02
gpv1wf_cal-40m-00pd-p1_20130728_aa0f0.rxp	Panel1	40	0	300	0.02
gpv1wf_cal-40m-00pd-p2_20130728_aa0f0.rxp	Panel2	40	0	300	0.02
gpv1wf_cal-40m-00pd-p3_20130728_aa0f0.rxp	Panel3	40	0	300	0.02
gpv1wf_cal-40m-00pd-p4_20130728_aa0f0.rxp	Panel4	40	0	300	0.02
gpv1wf_cal-60m-00pd-p0_20130728_aa0f0.rxp	Grid-6	60	0	300	0.02
gpv1wf_cal-60m-00pd-p1_20130728_aa0f0.rxp	Panel1	60	0	300	0.02
gpv1wf_cal-60m-00pd-p2_20130728_aa0f0.rxp	Panel2	60	0	300	0.02
gpv1wf_cal-60m-00pd-p3_20130728_aa0f0.rxp	Panel3	60	0	300	0.02
gpv1wf_cal-60m-00pd-p4_20130728_aa0f0.rxp	Panel4	60	0	300	0.02

Filename	Site	Position	Tilt	PRF	Resolution
gpv1wf_espatrium_20130802_aa0f0_p01.rxp	ESP atrium	-	0	300	0.04
gpv1wf_espatrium_20130802_aa0f0_p02.rxp	ESP atrium	-	90	300	0.04