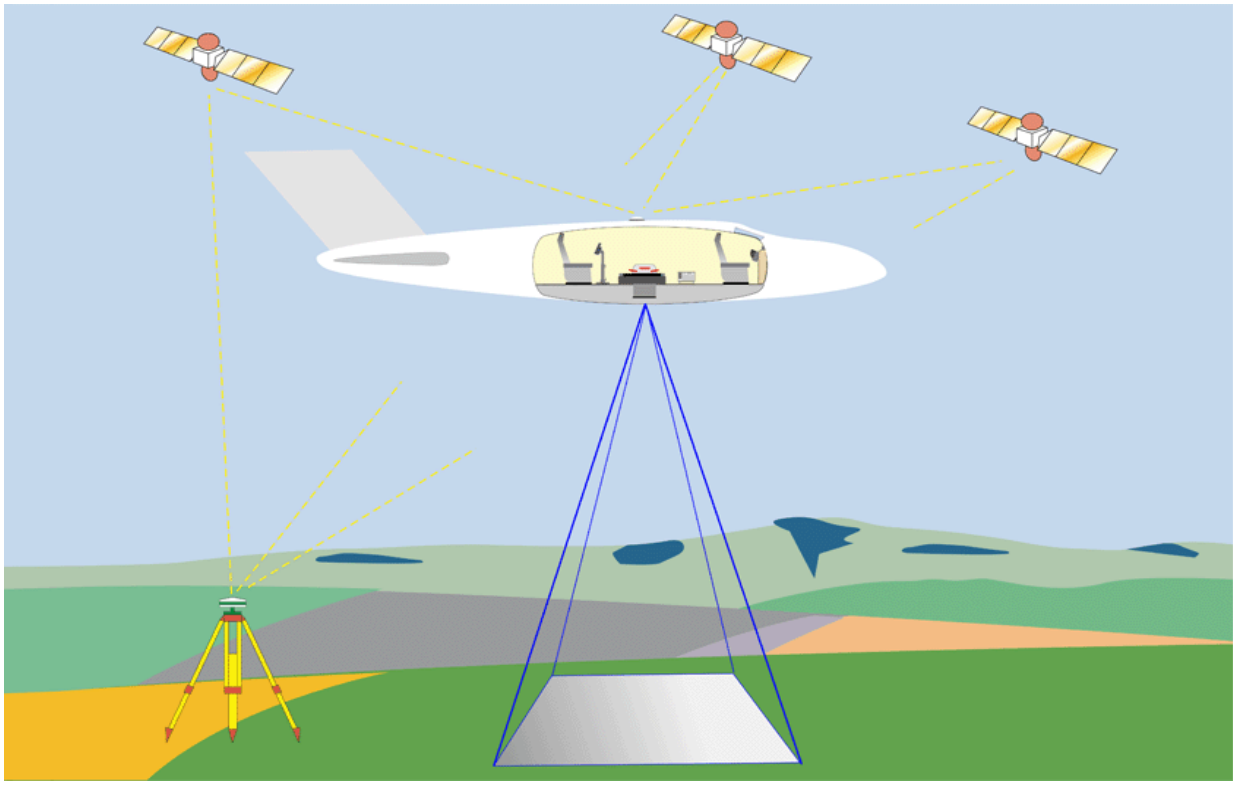
Leica RCD30
Calibration Certificate



	Camera Head	Serial Number	Lens	Serial Number
This certificate is valid for	***CH62***	***62001***	***NAG-D 3.5/50***	***50002***

		Inspector
Calibration certificate issued on	***23 June 2011***	***Udo Tempelmann***

Certificate and calibration data ID

RCD30_Geometry_CameraHead-62001-A-777966_LensSystem-50002-A-785422_DateTime-20110615-144943.xml

Leica Geosystems AG
Heinrich-Wild-Strasse
9435 Heerbrugg
Switzerland

Document code 791649

Additonal Components

Component	Device	Type	Serial Number
GNSS/IMU	Inertial Measurement Unit	LN200	

Sensor layout of tested system

The RGB CCD carries a BGGR Bayer pattern with overlapping spectral bands.
The NIR sensor is a monochrome CCD. It is spectrally separated from RGB through a dichroitic beam splitter device.

Sensor	Pixel size [mm]	Pixel rows	Pixel Columns
RGB	0.006	6732	9000
NIR	0.006, 2 x 2 binned	6732 2x2 binned = 3366	9000 2x2 binned = 4500

Camera Model Parameters of distortion free image

All factory calibration results contain fixed nominal focal lengths and zero principal point offsets.
FramePro applies the grid to create distortion-free images of nominal focal length and fixed pixel size of 0.006 mm. NIR is interpolated to the resolution of RGB during this process.

Symbol	Parameter	Value of distortion free images
C	Focal length	53 mm
x_P, y_P	Principal point	Zero The origin of the pixel coordinate system (0,0) is at the center of the image.
k_0, k_1, k_2	Symmetric radial distortion	Zero
p_1, p_2	Decentering	Zero
b_1, b_2	Non-orthogonality	Zero

Calibration process

Adjustment of optical systems in optical laboratory

		Passed	Date	Inspector
FMC origin	*calibrated*	***ok***	***03.05.2011***	**Bernhard Riedl**
DSNU (Dark Signal Non-Uniformity)	*checked*	***ok***	***03.05.2011***	**Bernhard Riedl**
PRNU (Photo Response Non Uniformity)	*calibrated*	***ok***	***03.05.2011***	**Bernhard Riedl**
CCD Saturation (VNS)	*calibrated*	***ok***	***03.05.2011***	**Bernhard Riedl**
CCD blemish list	*created*	***ok***	***03.05.2011***	**Bernhard Riedl**
Best image plane	*adjusted*	***ok***	***03.05.2011***	**Bernhard Riedl**

Flight and data processing

	Passed	Date	Inspector
Test flight	***ok***	***19.05.2011***	**Kai Lämmer**
Image Quality check	***ok***	***01.06.2011***	**Tauno Saks**
GNSS and IMU data processing	***ok***	***01.06.2011***	**Tauno Saks**
Geometrical calibration	***ok***	***15.06.2011***	**Suqin Lu**

Inspection

Inspectors signatures

Name	**Bernhard Riedl**	***23.06.2011***	
Position	RCD30 Production Manager		
Name	**Udo Tempelmann**	***23.06.2011***	
Position	RCD30 System Engineer		

Leica ADS80 calibration process specification

	Document code
Inspection plan	791755
Leica RCD30 system calibration processes	791757

Maintenance

Last date of service	
Recommendations	

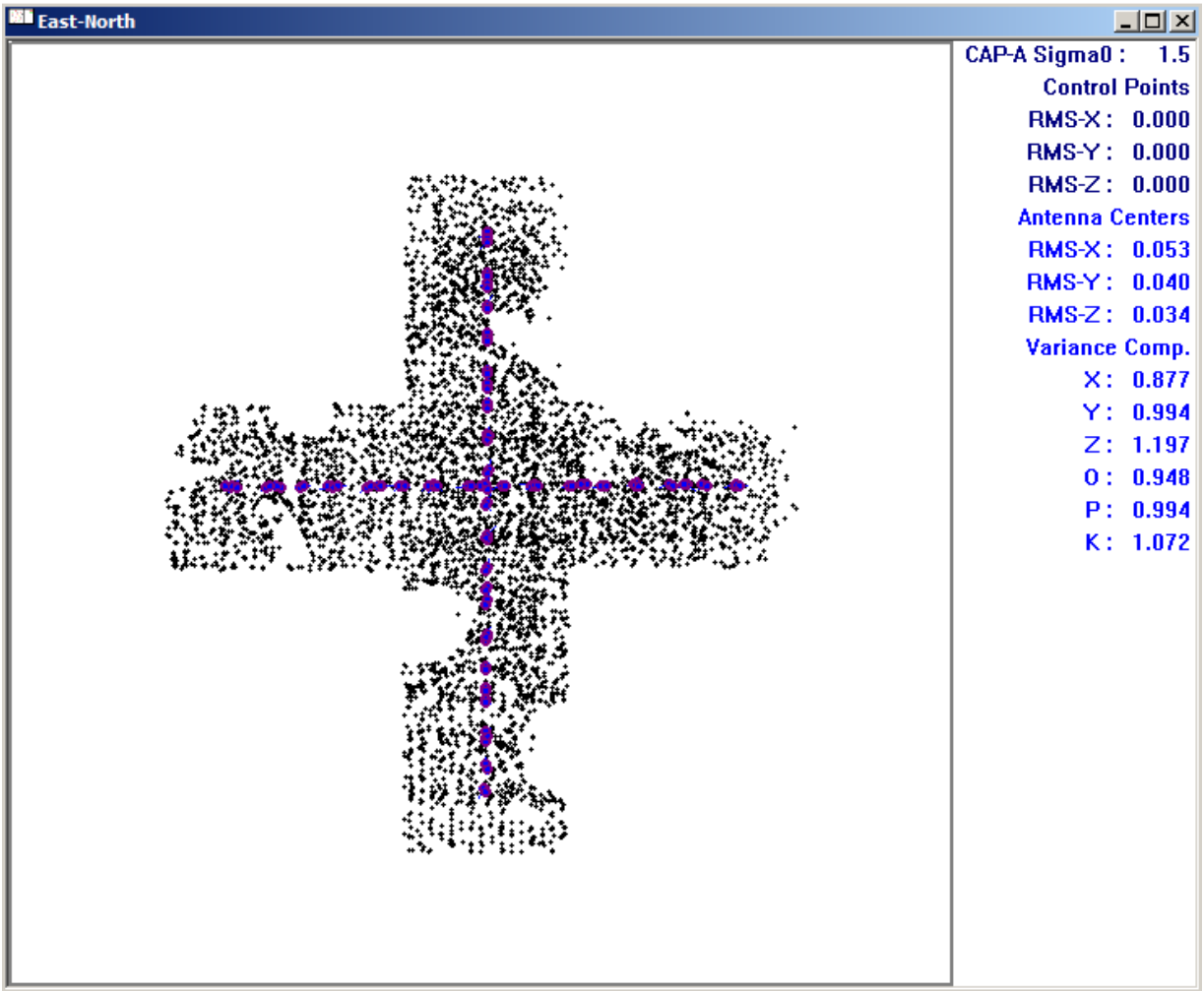
Results of geometrical calibration

The resulting distortion grid file that contains all geometric information about the camera is attached to this certificate. File name see first page and footer of each page.
All factory calibration results contain fixed nominal focal lengths and zero principal point offsets.
FramePro applies the grid to create distortion-free images of nominal focal length and fixed pixel size of 0.006 mm. NIR is interpolated to the resolution of RGB during this process.

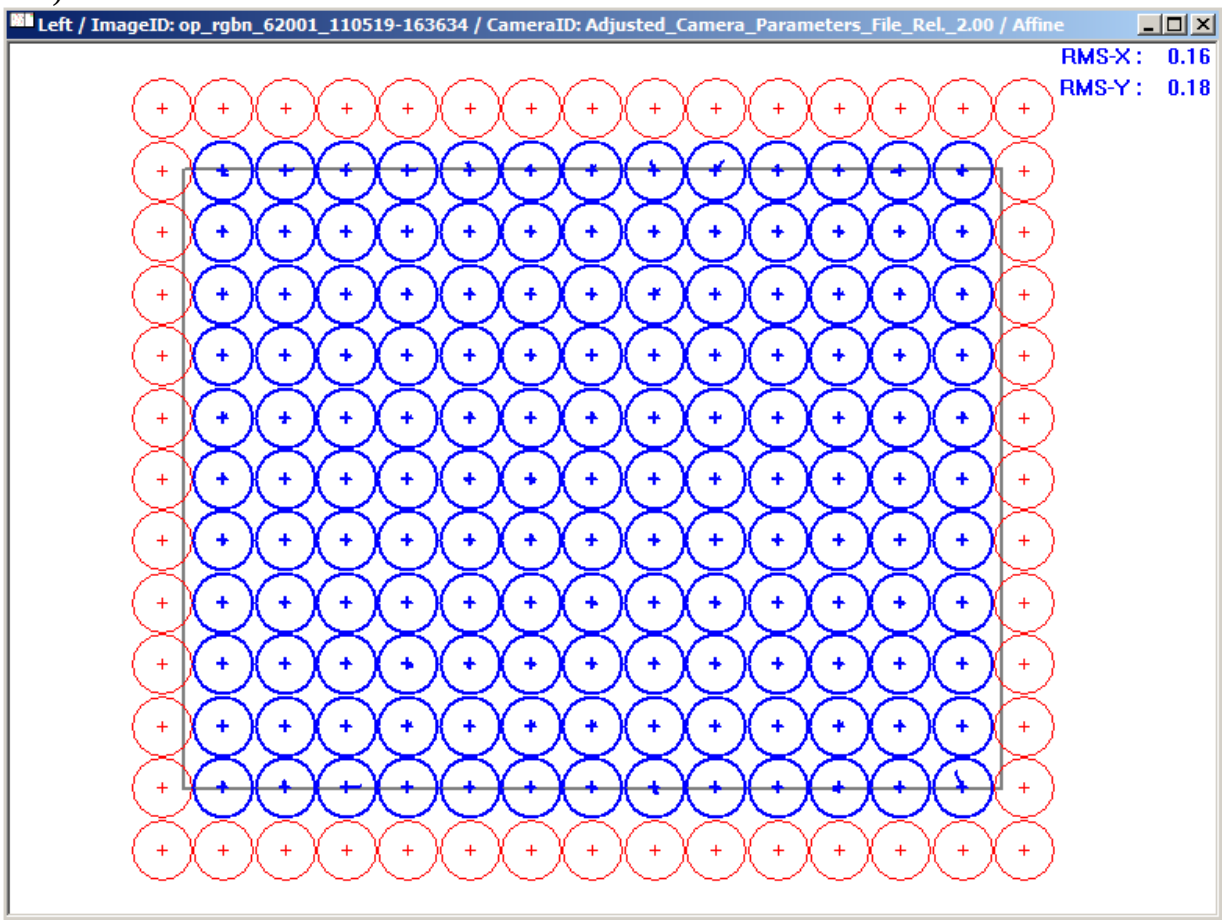
Reference band (green)

Calibration method	Estimation of additional parameters (focal length, principal point, radial symmetric distortion, correction grid) and IMU misalignment in simultaneous bundle adjustment
Resulting sigma naught of bundle adjustment	0.0015 mm

Final bundle adjustment result after elimination of tie point blunders:



Remaining image space residuals after applying the calibration result (radius of circles is 0.001 mm):



Other spectral bands

Calibration method	Estimation of additional parameters (correction grid), based on the result for green in simultaneous bundle adjustment
Co-registration to green better than	0.002 mm

IMU misalignment

Misalignment results [degr]

	Angle	Standard deviation
ω	0.00425	0.057296
ϕ	0.03917	0.057296
κ	0.03738	0.057296