

Geometric Calibration Verification Certificate

Digital Mapping Camera (DMC)

DMC Serial Number: **DMC01-0053**

CBU Serial Number: **01000053**

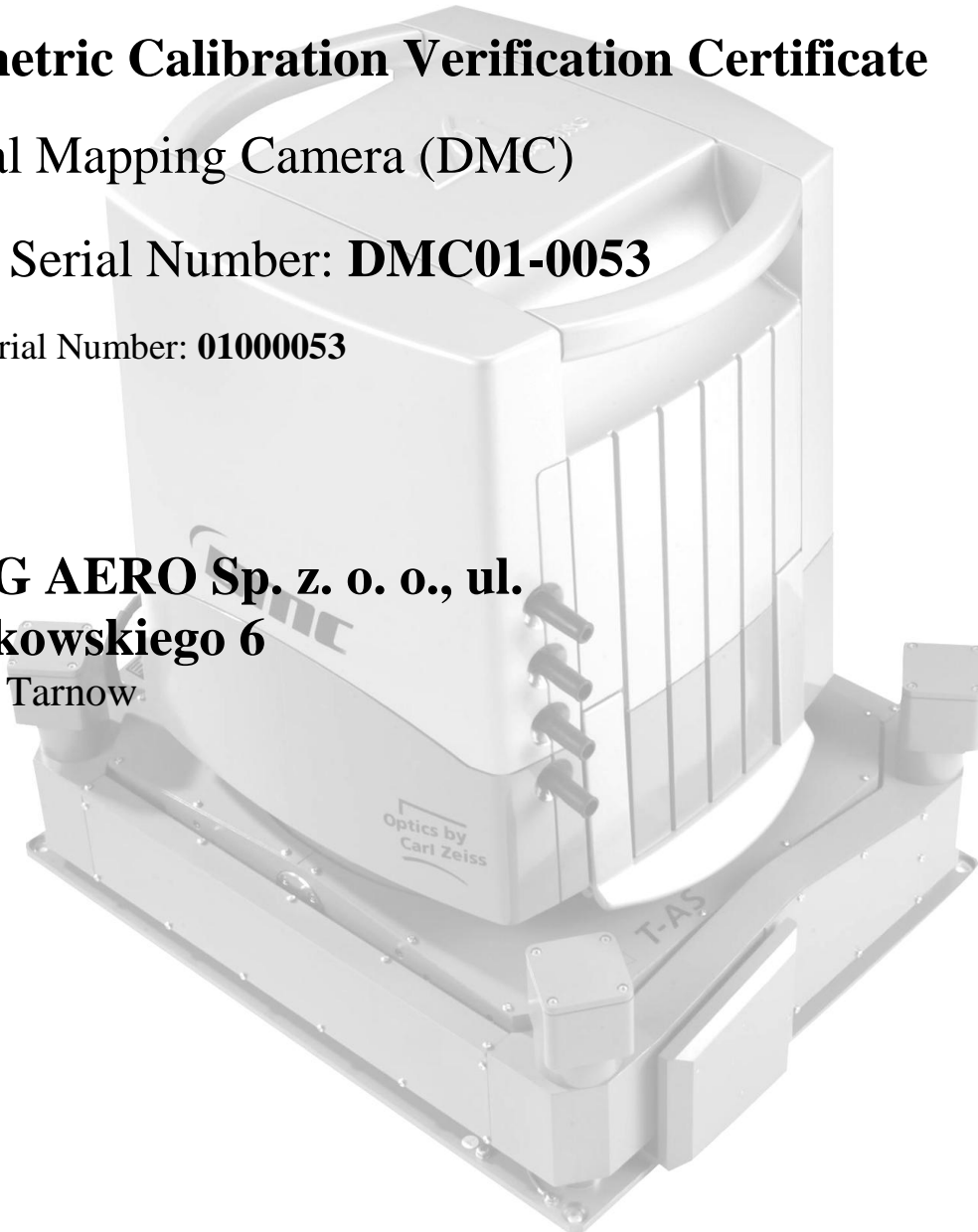
For

MPPG AERO Sp. z. o. o., ul.

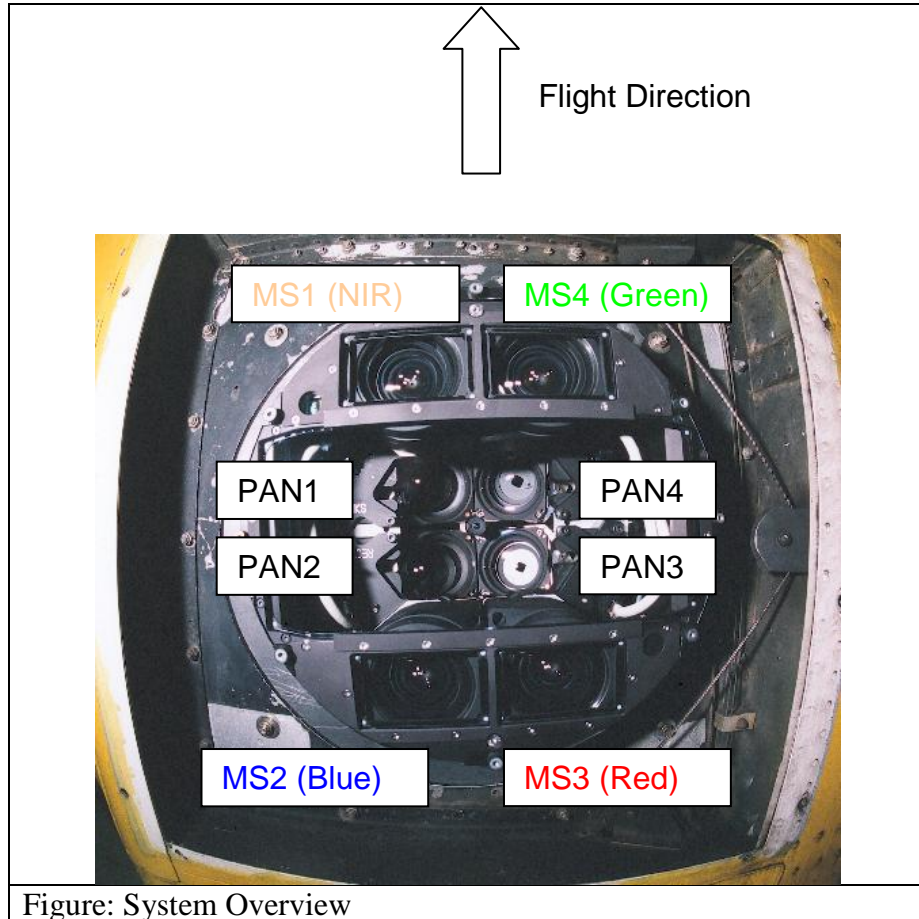
Kaczkowskiego 6

33-100 Tarnow

Poland



System Overview



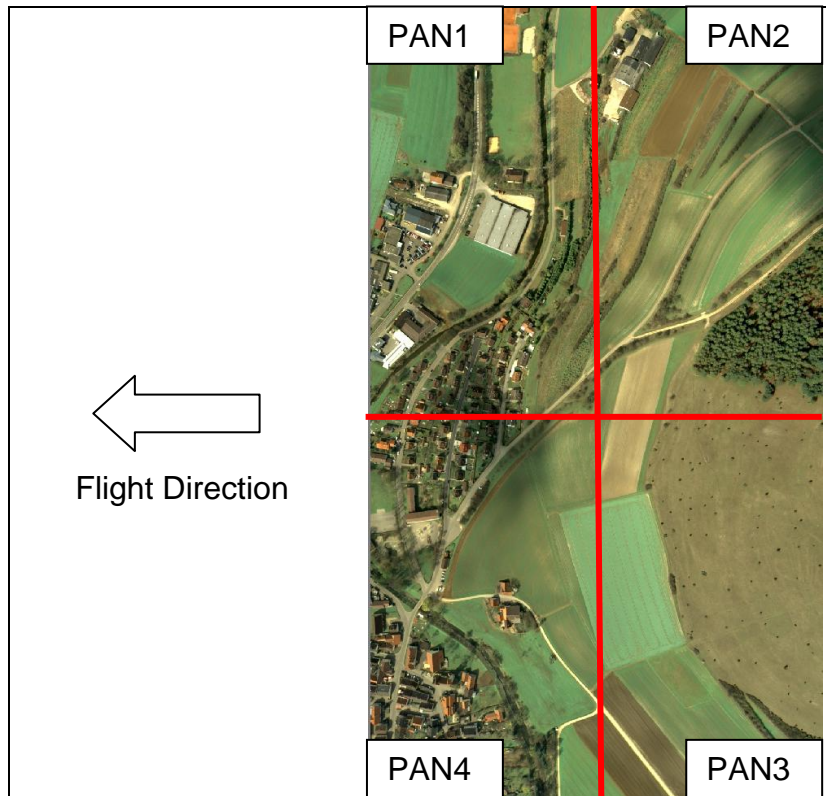


Figure: Image Overview (Pan Camera)

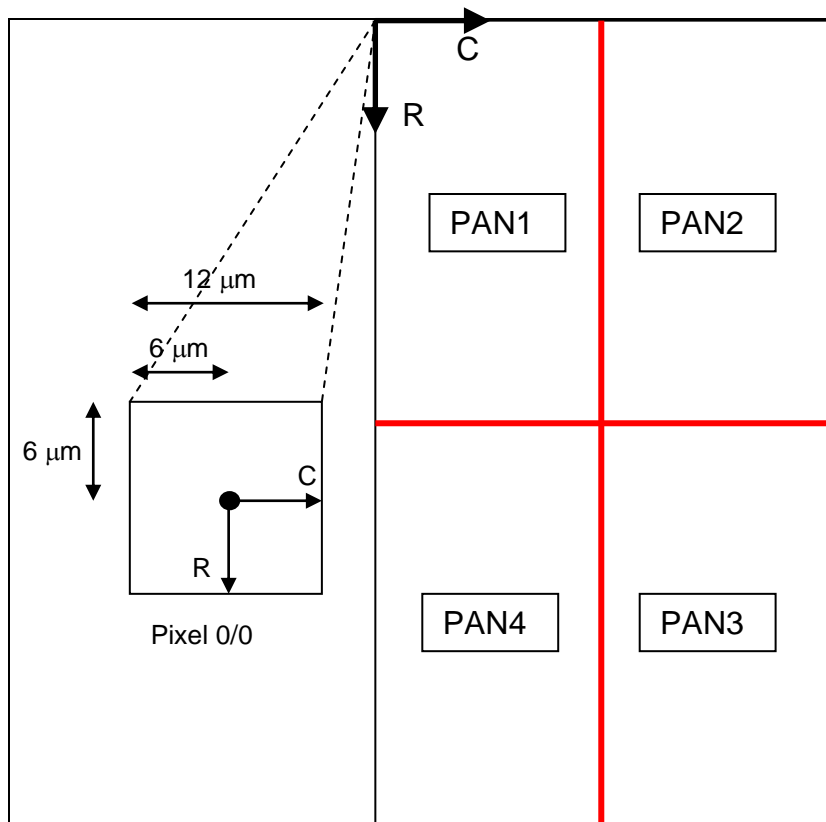


Figure: Image Coordinate System (Pan Camera)

Camera Parameter for Virtual Image (High Resolution)

Virtual Focal Length [mm]	120
Virtual Sensor Size [Pixel]	13824 x 7680
Virtual Pixel Size [μm]	12
Virtual Principle Point [mm]	$x_p = 0.0, y_p = 0.0$

Camera Parameter for Virtual Image (Color Resolution) before Version PPS 5.0.10.3

Virtual Focal Length [mm]	120 / 4.75
Virtual Sensor Size [Pixel]	3072 x 2048
Virtual Pixel Size [μm]	12
Virtual Principle Point [mm]	$x_p = -0.646, y_p = 0.646$

Camera Parameter for Virtual Image (Color Resolution) after Version PPS 5.1.10.3

Virtual Focal Length [mm]	30
Virtual Sensor Size [Pixel]	3456x1920
Virtual Pixel Size [μm]	12
Virtual Principle Point [mm]	$x_p = 0.0, y_p = 0.0$

Camera Serial Number and test flights

	Burn-in Flight: 21.05.2007	
	Calibration Test Flight: 14.11.2010	
Camera	Serial Number	Calib. Date
PAN1	00114289	13.12.2006
PAN2	00115722	14.02.2007
PAN3	00115726	12.02.2007
PAN4	00115778	29.01.2007
MS1 (NIR)	00115710	19.02.2007
MS2 (Blue)	00115818	14.02.2007
MS3 (Red)	00115823	14.03.2007
MS4 (Green)	00115715	14.02.2007

Camera Orientation PAN-Cameras (Test Flight 14.11.2010)

Camera (Serial Number)	X [m] (Standard Deviation)	Y [m] (Standard Deviation)	Z [m] (Standard Deviation)	Omega [Deg] (Standard Deviation)	Phi [Deg] (Standard Deviation)	Kappa [Deg] (Standard Deviation)
PAN1 (00114289)	0.064 (0)	-0.079 (0)	1000 (0)	18.002482 (0.001)	10.056622 (0.001)	86.773028 (0.001)
PAN2 (00115722)	-0.064 (0)	-0.079 (0)	1000 (0)	17.899816 (0.001)	-10.244281 (0.001)	93.390598 (0.001)
PAN3 (00115726)	-0.064 (0)	0.079 (0)	1000 (0)	-17.994183 (0.001)	-10.047415 (0.001)	-93.075532 (0.001)
PAN4 (00115778)	0.064 (0)	0.079 (0)	1000 (0)	-17.907001 (0.001)	10.234199 (0.001)	-86.849412 (0.001)

The data is connected to the virtual projection center of the virtual image.

The above Platform calibration values are initial values and are liable to slight fluctuations between project images and between different projects. The rotation axes of the angles are (in this order)

Omega	x-Axis
Phi	y-Axis
Kappa	z-Axis

The results of the Platform calibration were generated with DMC Postprocessing SW (PPS), Version 6.0, from Intergraph Z/I Imaging photogrammetric product suite.

Platform calibration verification performed by:

Z/I Employ Name: Chr. Müller
Dipl. Ing. Christian Müller

11.03.2011
Date

Aerotriangulation Results (Test Flight 14.11.2010)

	Photo Scale	1:6666
	Flying Height [m]	700
	Flying Altitude [m]	800
	Run-Spacing [m]	686
	Base-Length [m]	215
	Number of Exposures	240
	Side-lap [%]	30
	End-lap [%]	60
	Terrain Height [m]	100
	Number of strips	6
	Photos in one strip	6 x 40 E-W
	Photos Used	240
	Control Points Used	5
	Check Points Used	7
	GSD [cm]	7 cm

Statistic results:

Matching results: 0 Weak Areas - covered with clouds																																															
Whole Block	240 exposures used 0 exposures not used																																														
Whole Block	Sigma relativ:	2.318	um																																												
Whole Block	Sigma absolut:	2.482	um																																												
<table border="1"> <thead> <tr> <th>Parameter</th> <th>X/Omega</th> <th>Y/Phi</th> <th>Z/Kappa</th> </tr> </thead> <tbody> <tr><td>RMS Control</td><td>0.044</td><td>0.024</td><td>0.030</td></tr> <tr><td>RMS Check</td><td>0.043</td><td>0.057</td><td>0.060</td></tr> <tr><td>RMS Limits</td><td>0.060</td><td>0.060</td><td>0.080</td></tr> <tr><td>Max Ground Residual</td><td>0.064</td><td>0.037</td><td>0.043</td></tr> <tr><td>Residual Limits</td><td>0.080</td><td>0.080</td><td>0.100</td></tr> <tr><td>Mean Std Dev Object</td><td></td><td></td><td></td></tr> <tr><td>RMS Photo Position</td><td>0.032</td><td>0.020</td><td>0.058</td></tr> <tr><td>RMS Photo Attitude</td><td>0.002</td><td>0.002</td><td>0.006</td></tr> <tr><td>Mean Std Dev Photo Position</td><td></td><td></td><td></td></tr> <tr><td>Mean Std Dev Photo Attitude</td><td></td><td></td><td></td></tr> </tbody> </table>	Parameter	X/Omega	Y/Phi	Z/Kappa	RMS Control	0.044	0.024	0.030	RMS Check	0.043	0.057	0.060	RMS Limits	0.060	0.060	0.080	Max Ground Residual	0.064	0.037	0.043	Residual Limits	0.080	0.080	0.100	Mean Std Dev Object				RMS Photo Position	0.032	0.020	0.058	RMS Photo Attitude	0.002	0.002	0.006	Mean Std Dev Photo Position				Mean Std Dev Photo Attitude				Key Statistics Sigma: 2.5 um RMS Image (x, y): 2.2, 1.5 um Number of iterations: 2 Degrees of Freedom: 33295 Gross Image Blunders: 0 Gross Control Blunders: 0 Image Blunders: 0 Solution Status: Solution Successful.		
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Geometric Calibration Verification
DMC01-0053



The results of the Aerotriangulation were generated with ImageStation Automatic Triangulation (ISAT), Version 6.1, from Intergraph Z/I Imaging photogrammetric product suite.

With this certificate we confirm that DMC [serial number] is within geometric accuracy.

Aerotriangulation performed by:

Z/I Employ Name:


Dipl. Ing. Christian Müller

11.03.2011

Date