



EROS Imagery Products Guide

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About ImageSat

ImageSat International N.V. is an international company and a commercial provider of high-resolution, satellite earth-imagery collected by its Earth Remote Observation Satellites (EROS).

On December 5, 2000 ImageSat successfully launched its first satellite, EROS A, aboard a Russian Start-1 launch vehicle. In so doing, ImageSat became the second company in the world to successfully deploy a commercially owned high-resolution imaging satellite.

On April 25, 2006 ImageSat successfully launched its second satellite, EROS B using the same type of Start-1 launcher. Both satellites are working as expected and have a life expectancy of more than 10 years from launch.

One of the few global service providers in the high-resolution satellite imagery niche, ImageSat is distinguished by:

- Exclusive service packages, including exclusive use of the EROS satellite over a designated footprint
- Flexible imaging parameters
- International operation
- Fast image acquisition and delivery
- Competitive pricing
- No Risk - Pay only for services received

Among the diverse applications for EROS imagery are:

- Air Forces
- Naval Forces
- Ground Forces
- Homeland Security / Border Control
- Infrastructure
- Mapping
- Environment and Disaster Control

ImageSat International N.V. is a Netherlands Antilles company with offices in Limassol, Cyprus and Tel Aviv, Israel. The Company's offices in Tel Aviv supervise the construction of the EROS family of satellites and the operation of ImageSat's main Ground Control Station.

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EROS Satellites

EROS satellites are lightweight LEO satellites with a single electro optical camera system. EROS satellites acquire high-resolution panchromatic image data.

EROS satellites are designed to maximize operator flexibility in the creation and adaptation of the daily image acquisition plan. EROS 's high maneuverability enables it to be quickly pointed to image customer-specified sites on Nadir or at oblique angles of up to 45 degrees. Oblique viewing enables the satellite to view virtually any site on earth as often as two to three times per week.

The orbital period of the EROS satellites, for one revolution around the Earth, is 94-96 minutes. The satellites complete approximately 15 revolutions around the Earth every 24 hours, with two daylight passes per day through the footprint of a typical Ground Receiving Station.



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Product definition

ImageSat International offers various types of panchromatic images characterized either by:

- **Imaging Technique** - the manner in which the satellite payload is used to acquire the imagery data; or
- **Processing Level** - the level of post processing performed on the ground after acquisition and reception of the imagery at the ground station.

The tables below summarize the basic product types classified according to the Image Acquisition technique. All products listed are available. A more detailed description of ImageSat products and processing options follows the table.

Imaging Technique - EROS A

Panchromatic Images	Dimensions	Remarks
Basic Image	14 km x 14 km	1.9 meter ground sampling distance (GSD) at nadir for an orbit of 510km. It is possible to acquire longer "vector" scene, up to ~200 km, depends on resolution and destination (On Board Recorded image or directly acquired).
Stereo Pair	14 km x 14 km	Two overlapped images of the same scene, acquired at symmetric or non-symmetric different viewing angles (fore and aft) during the same pass.
Triplet	14 km x 14 km & 10 km x 10 km	Two Stereo images + one overhead image: Standard or Hypersampled-factor-2, of the same scene, acquired during the same pass. It is possible to acquire multiple images of the same scene in basic mode (for example two stereo pairs) in the same pass.
Mosaic	25 km x 25 km	Two adjoined images acquired during the same pass with small overlapping.
Polygon coverage	Any shape and size	The polygons will be defined by "shape files" of the "Arc View" software or by a set of coordinates. The polygon will be bigger than one basic scene.
2-Axis Hypersampled	10 km x 10 km	Approximately 1. -meter ground sampling distance (GSD) at nadir for Factor 2 Hypersampling, and 1-meter ground sampling distance (GSD) at nadir for Factor 4 Hypersampling
One-axis Hypersampled	14 km x 14 km	1.9-meter x 1.4-meter (GSD) at nadir
One-axis Undersampling	Variable	Reduced resolution imaging mode (up to 10-meter GCD) allows collection of extensive coverage by nearly synchronous scanning.



Imaging Parameters – EROS A

The imaging performances of the EROS A panchromatic camera will be as follows:

Scanning	Push-broom
Imaging sunlight conditions	Sun-over-horizon angle more than 10°
Sensor type	CCD
Spectral band	0.5 to 0.9
Sampling Depth transmitted	10 bits
Ground Sampling Distance	1.9 m at Nadir from 510 km
Swath Width	14 km at Nadir from 510 km
Inclination	97.2°
Local time in descending node	09:45

Imaging Technique - EROS B

Panchromatic Images	Dimensions	Remarks
Basic Image	7 km x 7 km	0.7 meter ground sampling distance (GSD) at nadir using TDI level 8 for an orbit of 510km. It is possible to acquire longer “vector” scene, up to ~480 km, depends on resolution, scanning direction, and destination (On Board Recorded image or directly acquired)
Stereo pair	7km x up to 21 km	Two overlapped images of the same scene, acquired at symmetric or non-symmetric different viewing angles (fore and aft) during the same pass.
Triplet	7 km x 14 km	Two Stereo images + one overhead Standard image of the same scene, acquired during the same pass. It is possible to acquire multiple images of the same scene in basic mode (for example two stereo pairs) in the same pass.
Mosaic	28 km x 26 km	Four adjoined images acquired during the same pass with small (500 m) overlapping.
Polygon coverage	Any shape and size	The polygons will be defined by “shape files” of the “Arc View” software or by a set of coordinates. The polygon will be bigger than one basic scene.

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Imaging Parameters – EROS B

The imaging performances of the EROS B panchromatic camera will be as follows:

Scanning	Push-broom, maximum scanning rate of 2400 lines/sec
Imaging sunlight conditions	Sun-over-horizon angle more than 10°
Sensor type	CCD-TDI, Selectable 1,4,8,16,32,48,64,96
Spectral band	0.5 to 0.9
Sampling Depth transmitted	10 bits
Ground Sampling Distance	0.7 m at Nadir from 510 km for TDI stages 1,4,8 0.8 m at Nadir from 510 km for all other TDI stages
Swath Width	7 km at Nadir from 510 km
Inclination	97.2°
Local time in descending node	13:45

Geolocation accuracy (without external GCP) is better than 50m:

Accuracy	EROS B
Mean CE	21.8 m
CE90	34.6 m
Mean CERMS	5.2 m
CERMS 90	10 m

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Processing Options EROS A and EROS B

Processing Level	Processing Designation	Remarks
Raw Imagery	Level 0A	Four image data channels ('rulers') are assembled, however, raw imagery is provided in completely unprocessed format just as it is received directly from the spacecraft. Provided only per customer request.
Radiometric System Correction	Level 1A	Raw imagery in 11-bit raw format is calibrated and gain adjusted to correct for known radiance response characteristics of the camera sensor system + ruler-overlap correction.
Geometric System Correction	Level 1B	Known sensor or acquisition (ephemeris) based geometric corrections are applied to compensate for camera optics and scanning distortions. Level 1B products are both radiometric and geometrically.
Orthorectified & Other Value Added Products		Available by special request

Formats

As a default EROS A and EROS B imagery processed to 1A and 1B levels and provided in 16 Bit Tiff (GeoTiff) formats.

Following images formats are available per customer request:

1A level products - 8 Bit Tiff (revision 6.0), or RAW.

1B level products – 8 Bit GeoTiff (revision 2.1)

Qualified Images

ImageSat is committed to the customer satisfaction with the quality of its products. The QA process of ImageSat is designated to find any anomalies in the products and to verify that the product meets the specifications. Qualified image is processed to radiometric and/or geometric corrected image.

QA specifications – the product should meet the quality specifications in a way that the product is clear of any anomaly (haze, BER, geometric distortion, etc.) and located within the requested area by the customer.

Cloud Cover (CC) assessment is done by using the ArcView tool and by calculating the number of pixels with a "above threshold" color out of all the product pixels (image or a polygon).

The validation criteria is 80% clouds free product.

EROS A & EROS B Satellite Orbit Performance Parameters

Definitions

1. Mean Response Time

Mean Response Time for a defined set of acquisition parameters means the average time interval that elapses up to the instant of the first opportunity to acquire the image of any object over the observed area at confidence level of 97%.

2. Mean Revisit time

Mean Revisit Time for a defined set of acquisition parameters means the average time interval that elapses between two consequent opportunities to acquire the image of any object over the observed area at confidence level of 97%.

3. Maximum Revisit Gap

Maximum Revisit Gap for a defined set of acquisition parameters means the maximum time interval that occurs between two successive opportunities to acquire the image of the same object.

4. Accuracy

The Systematic Geolocation Accuracy is measured as a deviation of the calculated geographic coordinates of certain pixel on an image, using camera, satellite, orbit and ground elevation data available, from its truth ground location. The distance between the calculated location and the truth ground location is called Circular Error. CE90 = M, means that in 90% of instances, the Circular Error of any pixel on any image is less than M meters. CERMS = N, means that on a specific image in 67% of instances, the deviation of any Circular Error on the image from the Mean Circular Error of the image is less than N meters.

The same definition:

Horizontal accuracy (represented as CE90) is a horizontal measurement on the ground defining the radius of a circle within which an object of known coordinates should be found on an image. The probability of a point in the image meeting the recorded accuracy is 90% for CE90. This parameter is expressed in meters.



Orbit Parameters

The EROS A & EROS B Satellites operates in a circular sun-synchronous orbit at an altitude of 510kms +/- 40 km. The local time of the descending node is 09:45 am for EROS A and 13:45 for EROS B.

Revisit (per Satellite)

The revisit for 510 km altitude of any geographical point at 30 deg latitude will be as following:

Imaging Angle	Maximum gap	Mean response time	Mean Revisit Time
15 deg cone	12 days	5.2 days	9.5 days
30 deg cone	5 days	2.7 days	3.7 days
45 deg cone	4 days	2 day	2.1 days

The coverage and revisit capability are a function of orbital Keplerian rules, season and geo-location of the scene.

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New acquisition request

ImageSat International offers various types of priorities to its clients. The client will receive the ordered images according to his request by CD/DVD or/and FTP download.

Normal Priority Service

The Normal priority Service provides a service to the client that, within 90 days, ImageSat will fulfill its image acquisition request on a best effort basis.

ImageSat commits to attempt to acquire the specified location on a best efforts basis in the context of the Satellite capacity and other higher priority orders in the queue.

The procedure for the Normal priority Acquisition Request Service order is as follows:

- Customer submits his geographic coordinates of the area of interest (AOI).
- ImageSat places the order in the imaging queue and attempts to acquire an image of the specified location.
- After acquisition of an image ImageSat conducts a quality control (QA) of the image (i.e. the image should have up to 20% cloud cover and shouldn't have any anomaly) subject to the following:
 - a) If the image complies with ImageSat's QA, the image is shipped to the customer immediately.
 - b) If the image not complies with ImageSat's QA, ImageSat will make more attempts to acquire the image.
 - c) After every attempt the customer will get a notification with the imaging results and a "Thumbnails" of the acquired image.

Rush Services

ImageSat offers to allow the client to activate rush acquisition of a scene of an area at the earliest possible time. The rush Acquisition service provides a service to the client that within 10 days ImageSat will task the satellite to fulfill its image acquisition request (first attempt).

ImageSat commits to attempt to acquire the specified location at least once every 10 days until the image passes the QA and delivered to the customer. In addition, ImageSat offers the Customers to reserve the use of an EROS satellite for imaging a specific geographic location at a designated orbit, date and time.

The procedure for a Rush order is as follows:

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- Customer submits his geographic coordinates of the area of interest (AOI).
- ImageSat's places the order in the imaging high priority list queue and attempts to acquire an image of the specified location in the nearest available opportunity (In case the customer asks for a specific orbit or date, it will be checked according to imaging opportunities and agreed with the customer).
- After acquisition of an image ImageSat conducts a quality control (QA) of the image (i.e. the image should have up to 20% cloud cover and shouldn't have any anomaly) subject to the following:
 - a) If the image complies with ImageSat's QA, the image is shipped to the customer immediately.
 - b) If the image not complies with ImageSat's QA, ImageSat will make more attempts in the next available opportunities to acquire the image.
 - c) After every attempt the customer will get a notification with the imaging results and a "quick look" of the acquired image.

Acquisition

"Acquisition" is defined as "One Shot" of the Satellite camera, taking an image of a specific location defined by a coordinate of the center point, regardless of cloud coverage. For every acquisition of the Satellite/s the Satellite operators plan, program and upload the commands to the Satellite. The result of an acquisition is digital data transmitted by the Satellite/s to an EROS Compatible Ground Receiving Station and processed to radiometric and/or geometrically corrected level..

One acquisition is defined by the programming of a "basic scene" (7 X 7 Km for EROS B and 14x14 Km for EROS A).

Notifications - After every attempt to acquire an image the customer receives a notification with the imaging results and a quick look (JPG) of the image. The notification indicates whether the product passes the QA. In case the product passes the QA procedure the product will be sent to the customer by FTP/Courier. In a case the customer is not satisfied with the product (even after the product was delivered) ImageSat will credit the customer for this product.

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Archived images

ImageSat offers data from the entire archive of EROS data. Requested archived images will be supplied to the customer no later than 72 hours after request is received by ImageSat (by courier or FTP). Archived image is defined as an image older than 6 month.

Order Desk- ImageSat has an order desk (orders@imagesatintl.com) to handle all customer requests and orders.

How to order

To order EROS imagery contact ImageSat order desk by orders@imagesatintl.com. AOI should be defined by geographic coordinates (Lat/Lon) in WGS84.

For point (basic or stereo pair) target center point coordinate should be provided.

For ordering coverage of an area bigger than one basic scene polygon definition shall be provided by shape file, or two opposite corner coordinates, or list of vertexes defining the polygon.

Permanent customers ordering large amount of data will be requested to keep special order format to enable automatic handling and fast response.

Minimum order size

Minimum order size for new acquisition and archived data is one basic scene:

EROS A – 14km x 14km

EROS B – 7km x 7km.

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