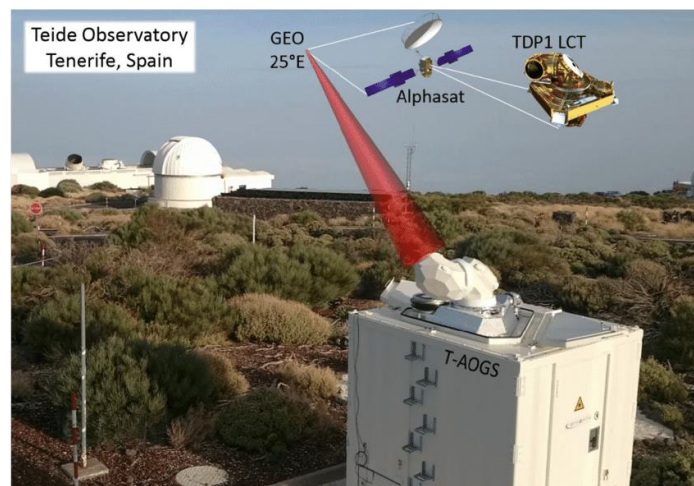


## TESAT Spacecom, Alphasat/TDP1

The Technology Demonstration Payload No.1 (TDP1) testbed is an excellent platform for supporting optical high-data-rate communication through atmosphere. The system consists of the Transportable Adaptive Optical Ground Station (T-AOGS), currently located in Zimmerwald (Switzerland), a Laser Communication Terminal (TDP1-LCT), a Ka-Band payload for downlink on board of Alphasat and the complementary RF-Ground segment (Remote Sensing Data Center in Oberpfaffenhofen, Germany) for the data- and telemetry-reception of the LCT via the TDP1-Ka-Band-Downlink.



### A: Brief Information

<b>Testbed Title</b>	TESAT Spacecom, Alphasat/TDP1
<b>Start Point</b>	GEO Satellite Alphasat (Position (25° E))
<b>End point</b>	Optical Ground Station (T-AOGS) in Zimmerwald [CH]
<b>Institution/Organization</b>	TESAT and DLR
<b>Contact</b>	Fabian Reichert: <a href="mailto:Fabian.Reichert@tesat.de">Fabian.Reichert@tesat.de</a> Thomas Marynowski: <a href="mailto:Thomas.Marynowski@TESAT.de">Thomas.Marynowski@TESAT.de</a> Michael Lutzer: <a href="mailto:Michael.Lutzer@DLR.de">Michael.Lutzer@DLR.de</a>
<b>Status</b>	active

### B: Technical Information

<b>Type of Transmission</b>	free space
<b>Length [km]</b>	~ 38000 km
<b>Losses [dB]</b>	Please refer to the last entry in the table: <i>Other Comments / Information</i>
<b>Supported Wavelengths [nm]</b>	1064 nm
<b>Type of Fiber</b>	n.a.
<b>Type of Deployment</b>	n.a.

<b>Polarization Stabilization</b>	n.a.
<b>Free Aperture adaptive Optics</b>	TDP1: 135 mm, no AO; T-AOGS: Rx 270mm with AO into SM fibre
<b>Quantum Communication Infrastructure</b>	<ul style="list-style-type: none"> <li>• Tx: AM beam, fast beam deflection</li> <li>• Rx: no single photon detector, sensitivity of nominal detectors tbc</li> </ul>
<b>Available Infrastructure for external Parties</b>	<ul style="list-style-type: none"> <li>• yes, 3rd parties use TDP1/T-AOGS regularly:</li> <li>• an User Agreement with TESAT and DLR necessary</li> <li>• potentially, a TM visualization Tool (I4S) is available (consignee statement necessary)</li> </ul>

### C: Additional Information

<b>Linked Projects</b>	<ul style="list-style-type: none"> <li>• Alphasat - TDP1: <a href="https://connectivity.esa.int/projects/alphasat-tdp1-broadband-data-relay">https://connectivity.esa.int/projects/alphasat-tdp1-broadband-data-relay</a></li> </ul>
<b>Press Release and Publications</b>	<ul style="list-style-type: none"> <li>• <a href="#">Alphasat - TDP1</a></li> <li>• <a href="#">6 Jahre erfolgreicher Tests und Experimente des Tesat Laser Communication Terminals TDP1 auf ALPHASAT</a></li> <li>• <a href="#">Optical Inter-Satellite Communication: the Alphasat and Sentinel-1A in-orbit experience</a></li> <li>• <a href="#">SGL Activities with Uplink Communication from Switzerland with the T-AOGS</a></li> <li>• <a href="#">TDP1-TESTBED APPLICATIONS</a></li> <li>• <a href="#">Status of the laser communication TDP1 program and its contribution to science and industry</a></li> <li>• <a href="#">Quantum measurements of signals from the Alphasat TDP1 laser communication terminal</a></li> </ul>
<b>Demonstrated Milestone</b>	<p>Lasercommunication since ~2013 with</p> <ul style="list-style-type: none"> <li>• LEO Satellites</li> <li>• multiple Optical Ground stations</li> <li>• a broad palette of parameters can be adjusted (due to experimental character of the demonstrator payload)</li> <li>• QKD experiment support:             <ol style="list-style-type: none"> <li>a. BayernQSat</li> <li>b. MPI experiments</li> </ol> </li> </ul> <p>The links were executed in different seasons during the years and under different atmospheric conditions with various experimental aspects. The TDP1-LCT is a system with 1064 nm and BPSK-coding. The T-AOGS performs links beacon-less and with a master-slave method</p>

<b>Outlook</b>	<ul style="list-style-type: none"><li>• a variety of experiments with the Laser Communication Terminal will be conducted until at least end of 2028.</li></ul>
<b>Suggested Use Cases</b>	<ul style="list-style-type: none"><li>• Possibility for 25 kHz LCT telemetry, e.g. for research of receive signal on TDP1-LCT</li><li>• TDP1 commanded &amp; T-AOGS operated by TESAT (full control of the T-AOGS); different parameters can be applied, new devices can be connected and tested</li><li>• TDP1/T-AOGS optical link can be used by 3rd party on ground, different steps of acquisition can be tested consecutively</li><li>• New ground stations or LCTs can be tested within testbed</li></ul>
<b>Other Comments/ Information</b>	<ul style="list-style-type: none"><li>• GEO to ground (from laser source -via space terminal - via space and atmosphere - via ground terminal -into fiber): ~ -78dB, assuming -2.6 dB due to atmospheric effects</li><li>• Ground to GEO (from laser source -via ground terminal - via atmosphere and spec - via space terminal - onto tracking detector): ~-79dB, assuming 3dB due to atmospheric effects</li><li>• Reference: Mahn et al.: <a href="#">“SGL Activities with Uplink Communication from Switzerland with the T-AOGS”</a></li></ul>

