INDEX

3C 273 159

Aberration, see orbit
Accelerometer package 240
Accuracy, actual 6
—, planned 6
Acoustic sound pressure 18
Alenia Spazio 8
Altitude, see orbit
Analogue mode, see detectors
Announcement of Opportunity for consortia 8
Anomalies, satellite 337-348
Antennae, switching 94
Apogee boost motor, effect of residuals 22
—, failure investigations 87-88
—, firing attempts 85-87
Apogee, see orbit
Archiving of satellite data, see data archiving
Ariane 4, see launch
Atmospheric drag, see torques
Attitude and orbit control system 174, 237-256, 320
—, block diagram 239
Attitude control, magnetic torquers 21
—, see also gyros
Attitude determination, angular resolution 245
—, anomaly detector 241
—, control concept 21
—, fine attitude estimation 272, 313
—, full sky matching 312
—, ground real-time 297
—, innovations 259, 283
—, Kalman filtering 258-259, 275
—, loss of real-time control 122
—, modified attitude prediction 264
—, on-ground 265, 313
—, orbital oscillator 148, 254, 263
—, partitioning of celestial sphere 156
—, precise 266
—, quality flag 174
—, real-time algorithm 262
—, real-time concept 14, 22, 256
—, real-time definitions 261
—, real-time initialisation 99, 313
—, real-time performance 281
—, slit distinction 265, 267, 312
—, thruster on-time calculation 255
—, thruster on-time coefficients 177
Attitude, jitter 150
—, smoothing 150
Auto-collimation sources 48

Background, high altitude count rates 105
—, low altitude count rates 105
—, monitoring 181
Baffles 35, 75
—, assemblies 76
—, external 75
—, internal 77
—, structure 47
—, subsystem 43
—, unit 47
Basic angle 12, 176, 182, 199, 232-235, 278
—, calibration 275
—, evolution 183
—, rigidity 13
—, variations 234
Batteries 25
—, depth of discharge 129, 213
Beam combiner mirror, see optics
Bibliography 351-377
Bremsstrahlung, see radiation
Bright stars 150, 268
BT, see Tycho BT

Calibration, 103-115, 179-207
—, cubic terms 206
—, geometric model 194
—, in-orbit 328

—, longitudinal detector offset 111
—, main grid 50
—, payload 101, 103-116, 182
—, plan 103-104
—, routine 179-207
—, star mapper grid 108
—, temporal evolution 200-205
—, transverse detector offset 111
Carbon fibre structure 41, 80, 227
Central processing electronics 239
Cerenkov radiation 20, 55, 57, 135-136
—, shielding 77, 83
Chromaticity, see optics
Coil current calibration matrix 109-110, 175
Cold gas, see thrusters
Commissioning 97
Compression law, see detectors
Computer support 333
Control actuation electronics 22, 238-241
Coordinate systems 194
Cosmic ions, see radiation
Cosmic rays, see radiation
Costs, of European Scientific Participation 381
—, of mission to ESA 379
CRRES satellite 139, 142, 219

Darkening of optics, see radiation
Data analysis, first-look facility 159, 175-176, 182
—, three-step method 7
Data archiving 167, 169, 322
Data compression, on board 70, 328
Data Delivery Interface Document 170-173
Data distribution 168-169
Data gaps, maximum 95
Data handling subsystem 22, 321
Data pre-processing 167
Data rate, downlink 28
Data recovery rates 281-282
Data reduction, interfaces with ESOC 167-177
De-multiplexing on-board patch 251
Dead time 17
Detectors 33, 65-70
—, analogue mode 66, 70
—, background 103-104
—, compression law 70, 173-174
—, detection electronics 69
—, detection subsystem 42
—, detection subsystem block diagram 67
—, sampling frequency 34, 70
—, signal coding 69
Dichroic filter 57, 61-64
Disturbance torques, see torques
Double and multiple stars 156
Dust cover 47

Earth occultations, see occultations
Earth/Sun sensor 237, 241
Eclipses 119, 249, 284
—, duration 89, 119, 121, 175, 213
—, induced attitude jitter 224-226
—, operations during 17
—, periods 89
Electromagnetic environment 18
Electron environment, see radiation
Electron-beam pattern generator machine 53
Electrostatic charging 128
Electrostatic discharge 19
Emergency sun reacquisition 281
End of mission 317-322
—, history 317
—, satellite tests 318-321
ESOC 29-31, 103-116
—, interfaces with reduction consortia 167-177
—, interfaces with INCA Consortium 143-166
—, main control room 395
—, off-line software 30
—, on-line software 30
ESTRACK, see ground stations
Europa 159

Failure rate 323
FAST Consortium 8, 167-177
—, see also first-look facility
First-look facility, see data analysis
Flat folding mirror, see optics
Flight control 331
Flight dynamics 332
Flight dynamics team 29
Fluorescence, see radiation
Focal-plane assembly 39, 58, 82
Focus 190, 199
—, activation 112, 339
—, evolution 175, 185-192
—, mechanism 71-73, 319
—, monitoring 181
—, pre-launch prediction of variation 188
—, variation 186
Fuel consumption 252, 255
Fully observable stars, see observing programme

Gas consumption, see fuel consumption
Geostationary orbit 17
Geostationary transfer orbit 117
Global programme, see observing programme

GOES satellite 137, 142
Goldstone, see ground stations
Gravity gradient torques, see torques
Grid, 47-56
—, calibration 50, 53
—, deflector mounts 56
—, imperfections 151
—, main 33, 47-49, 54
—, medium-scale irregularities 50, 52, 198
—, optical micrographs 54
—, reference marks 49-50, 110
—, rotation 176, 182, 199
—, scan fields 48, 52
—, slit geometry 50
—, slit period 34
—, slit width variation 51, 53
—, small-scale irregularities 50, 52
—, star mapper 48-49, 54
—, star mapper specifications 50
—, star mapper vertical slit 108
—, unit 49
Ground segment 29-31
—, operating principle 168
Ground stations 92
—, availability 94
—, coverage 89, 93-94, 121
—, coverage percentage 95
—, ESTRACK network 91
—, Goldstone 29, 91, 94
—, Kourou 29, 91-94
—, Malindi 91-94
—, Odenwald 29, 91-94
—, Perth 29, 91-94
—, time scale 172
—, utilisation 91-94
—, Villafranca 91-94
Gyro 1 247
Gyro 2 247
Gyro 3 247
Gyro 4 247
Gyro 5 248
Gyros 237-256
—, attitude control 21
—, combination of 246
—, configuration 246
—, correction 265, 267, 312
—, drifts 99, 240, 245, 249, 280, 285
—, glitches 248
—, ground investigations 249
—, heaters 321
—, input axes 246
—, mechanical noise 22
—, misalignment 176
—, on-board system 244-245
—, other satellite missions 251
—, oversampling 320
—, performances 245
—, projection matrices 285
—, ROSAT experience 251
—, running hours 246
—, spikes 251
—, spin-down 251

Heaters 71, 228-229
Helium 98, 241
HEOS-2 satellite 123
Hibernation, see suspended operations
Hipparcos Input Catalogue 107, 143, 160
—, updates 143, 157, 160, 284
Hipparcos Science Team 324
Historical background, see mission
Hot gas, see thrusters
Housekeeping data 174
Hydrazine 241
—, fuel dump 98
—, propellant mass 244
—, sun acquisition 98
—, thrusters 237

Iapetus 159
IDT, see image dissector tube
Image dissector tube 67, 318
—, analogue mode 339
—, file 173
—, photon counting mode 66, 70
—, piloting 107, 111, 158
—, piloting currents 109
—, piloting quality 165
—, piloting status 180
—, relay lens 56-58
—, response 185
—, shutter 319
—, signal 14-16
—, spectral transmission 35
INCA Consortium, see Input Catalogue Consortium
Inertial reference unit 244-245
Initial star pattern recognition 265
Input Catalogue Consortium 8, 143-166, 177
Instantaneous field of view 33, 66
—, pointing 183
—, profile 113
Internal star pattern assembly 59, 110, 319

Jitter, see attitude

Johnson B, V 15
Jupiter, see Europa

Kourou, see ground stations

Large solar simulator 390, 393-394
Large-amplitude variable stars, ephemerides 156
Latching valve 321
Launch team 331
Launch vii, 85, 379, 396
Light overload 71
Light-emitting diodes 49
Lunar occultations, see occultations

Magnetic tape, production 171-172
Magnitude monitoring 158
Main control room, see ESOC
Main detection chain 66
Major planets, ephemerides 159
Mass, launch budget 28
Matra Marconi Space 8, 177, 251, 256, 291, 322
Measurement principle 12
Mechanical design 25-26
Mechanical environment 18
Mechanical properties 210
Mechanisms 42, 71
—, drive electronics 71, 319
—, flip-flop 74
—, shutter 42, 71, 104
—, shutter, automatic closure 115
—, switching mirror 42, 71
Memory, on-board 290
Micrometeoroids 22, 123
—, Perseids 126
—, simulations 123
Minor planets 159
Mirrors, see optics
Mission, overall concept 11-31
—, acceptance by ESA 5-7
—, analysis 332
—, evolution of the project 5-7
—, historical background 1-4
—, overall success 329
—, planning 94
Modulating grid, see grid
Modulation coefficients 103, 113, 181, 185, 190
—, degradation of 190
Moisture release 183-188
Moon occultations, see occultations
Moon, see occultations
Multiple star transits 268

NDAC Consortium 8, 167-177
Network support 334
NGC 2516 162
Nitrogen gas, see cold gas
Nitrogen thrusters, see thrusters
Nominal scanning law 145, 257, 281
—, initialisation 265, 271
—, parameters 148, 259
Non-visibility periods 162
Normal mode controller 252-255
Normal mode software patch 255-256
Nutation damping 98

Observation frame 24, 151
Observing programme 150-166
—, accuracy test vectors 157
—, alternating strategy 162
—, completeness 6
—, distribution of observations 150
—, ecliptic latitude 158
—, FGS support 162
—, flow of programme stars 153
—, fully observable stars 152, 155
—, global observation time 150
—, global observing programme 143, 151
—, initial covariance matrices 157
—, limiting magnitude 6, 107
—, minimum observation time 151
—, modulation strategy 163-166
—, number of stars 6
—, observational history 152
—, observing sequence 155
—, performance assessments 165
—, performance index 155
—, revised modulation strategy 165
—, sparse programme star file 162
—, time allocation 154-155
Occultations 12, 17, 89, 121, 162, 284, 303
—, interruption limit 77
—, moon 121
Odenwald, see ground stations
On-board algorithm 254
On-board clock 145
On-board computer 22, 317
On-board data compression 70, 328
On-board disturbance torque modelling 253
On-board patch 251
On-board software 291
On-board time 172
On-board torque model 298
On-ground attitude determination, see attitude determination

On-ground software 294, 311
Operational concept 24-25
Operational experience 315
Operational functions 23
Operational life 325
Operational phase 149
Operational principle 11, 68
Operational requirements 289
Operations Team (ESOC) 331-336
Operations Team, revised mission 335
Optics 33-64
Optics, beam combiner 11, 41, 44-46, 385
—, beam combiner aspherical figuring 44
—, beam combiner manufacture 46
—, chromaticity 45, 103, 114
—, chromaticity filter 42, 62, 71, 318
—, darkening 183
—, deformation 191, 206
—, differential defocus 185, 190
—, differential grid rotation 327
—, differential scale 206
—, diffraction 35
—, distortion 109
—, encircled energy 60
—, field of view separation 265, 269
—, field-to-grid transformation 198-199
—, filters 61-64
—, flat folding mirror 41, 45
—, focal length 34
—, mirror mounts 82
—, mirror surface accuracy 34
—, mirrors 43-47
—, overview 33-64
—, primary mirror diameter 34
—, reflective coating 43
—, relay 41
—, scale 34, 199
—, schematic 58
—, Schmidt configuration 11, 33, 43, 45
—, spectral range 34
—, spectral reflectivity 44
—, spherical mirror 41, 46, 386
—, surface quality 41
—, transmission curves 63
—, wavefront error test 385
—, weight reduction of mirrors 45
Opto-coupler 317
Orbit 91, 117-126
—, aberration effects 118
—, apogee 91, 117-118
—, argument of perigee 117
—, ascending node 117
—, data on 118, 174
—, eccentricity 117, 120
—, electron/proton environment, see radiation
—, inclination 117-118, 120
—, manoeuvres 97
—, orbital elements 117
—, perigee height 118
—, period 117
—, period adjustment 98
—, perturbing torques 325
—, ranging 118
—, reconstruction 118
—, see also occultations
—, semi-major axis 118
—, transfer 85
Outgassing, see moisture release
Over-observed stars, see star observing strategy

Partially observable stars, see star observing strategy
Payload 33-83
—, calibration, see calibration
—, diagram 38
—, electrical block diagram 39
—, electronics 71-75
—, geometrical evolution 179-207
—, hardware 40
—, heater locations 231
—, heaters 230
—, modelling 193-207, 327
—, monitoring 175, 179
—, overview 33-64
—, photographs 385-388
—, photometric evolution 179-207
—, structure 41, 79, 227
Perigee, altitude 91, 117-118
—, control of satellite during 255
—, passages 95, 121
—, raising manoeuvres 97
—, region 300
—, scan-rate control 293
—, see also orbit
Perseids, see micrometeoroids
Perth, see ground stations
Perturbing torques 122
Phase A study 7
Photometric evolution 193
Photomultiplier, count rates 106
—, relay lens 57
—, see also star mapper
—, tube 69
—, tube signal 16
Power, budget 28

—, loss 215
—, primary supply 25
—, requirements 28
—, subsystem degradation 211
Primary detection system 34
Primary mirror, see optics
Programme star file 17, 22, 153, 160, 177
Proton environment, see radiation

Radiation effects, interpretation 137
Radiation pressure torque, see torques
Radiation, background 127-142
—, belt models 128
—, belts 91
—, bremsstrahlung 135-136
—, cosmic ions 131
—, cosmic rays 128, 130
—, daily proton fluence 133
—, damage 128
—, damage 211, 287
—, darkening of optics 20
—, dose absorbed by the satellite 132
—, dose depth curves 132
—, dose levels 192
—, dynamic nature of belts 130
—, effects on optics 183
—, effects on telescope mirrors 190
—, electron/proton flux profiles 129
—, electron environment 128, 130
—, environment 119, 128
—, equivalent electron fluences 135
—, fluorescence 135-136
—, geomagnetic index 141
—, geomagnetic shielding 130
—, geomagnetic sub-storms 129
—, injection events 140
—, irradiance dose/depth curve 192
—, irradiation effects 193
—, lower radiation belt 105
—, model 214
—, predicted dose 134
—, proton fluences 135
—, proton flux 131
—, proton irradiations 216
—, protons 130
—, secondary emission 135-136
—, sector analysis 132
—, semiconductor lifetime 19
—, shielding 136
—, single event upset 19, 128, 130, 338
—, upper radiation belt 105
—, van Allen belts 88-89, 105, 127-142
Radio frequency transmitter 320
Reaction control assembly 241-244
Reaction wheels 21
Real-time attitude determination, see attitude determination
Reference frame, telescope 144
Reference stars, rejection criteria 284
References 349-350
Refocus, see focus
Relay optics, see optics
Reliability, of satellite 323
Revised mission, definition 88
RGO 176-177, 303, 313

Sampling period, see star observations
Satellite, design and development 322
—, development 379
—, electrical design 25-26
—, exploded view 26
—, launch configuration 27
—, margins 324
—, operations 379
—, photographs 383-396
—, position and velocity determination 21, 119
—, positional accuracy 118
—, reliability 322
—, testing 392
—, velocity accuracy 118
Saturn, see Iapetus, Titan
Scan fields, see grid
Scanning law 143-146
—, acquisition 100
—, average precession rate 145
—, description 145
—, deviations from nominal 146
—, heliotropic reference frame 145
—, mean scanning frequency 158
—, motion 14, 146
—, precession angle 145
—, revolving scanning angle 145
—, velocity 107
Schmidt telescope, see optics
Schmidt-Kerber profile, see optics
Science operations 379
Scientific involvement 8
SCOS 31
Semiconductor lifetime, see radiation
Sensitivity 103
Service electronics units 39, 42
Shade structure 25
Shutters, see mechanisms
Single event upset, see radiation

Single-slit response, see star mapper
Small-scale grid irregularities, see grid
Software support 333
Software support team 29
Solar activity 132
Solar array 25, 209, 320
—, cell performance 209, 216
—, charge array 209
—, charge/discharge cycle 211-212
—, cover glass adhesive degradation 221
—, degradation 214-224
—, electrical properties 210
—, GaAs/Ge 223
—, I-V-characteristics 221
—, in-orbit data 217
—, laboratory experiments 214
—, maximum power margin 212
—, maximum power output 223
—, open circuit voltage 218
—, performance 209-226
—, shadowing test 320
—, short circuit current 218
—, Si arrays 223
—, transmission characteristics 222
Solar aspect angle 148
Solar cells, see solar array
Solar eruptions 130
Solar flare 130
Solar maximum 128
Solar panel, see solar array
Solar particle events 127-128
Solar proton event 137
Solar simulation 391
Solar system objects 159
—, see Europa, Iapetus, Titan
—, see minor planets
Spacecraft control team 29
Spacecraft performance evaluation system 181
Spectral range, see optics
Spherical mirror, see optics
Spin rate 28, 145
—, anomalies 251
—, nominal 99
Spin reversal 327
Spin-stabilised phase 237
Spin-up manoeuvre 321
SRON, Utrecht 175-176
Star mapper 14
—, Tycho system 34
—, grid, see grid
—, background 115
—, background signal 137-138
—, data 268
—, deflectors 55
—, detection chain 69
—, file 174
—, filtering 265-266
—, photometric response 184
—, see also photomultipler, Tycho
—, sensitivity 207
—, shutter 319
—, signal 15
—, single-slit response 103, 106, 108
—, slit calibration 108
—, spectral transmission 36
Star observing strategy 24, 150-166
—, expected transit time 107
—, frame period (T4) 151
—, interlacing period (T3) 151, 154
—, over-observed stars 163
—, partially observable stars 152, 155
—, priority index 154
—, repositioning period (T2) 151
—, sampling period (T1) 151
—, see also observing programme
—, selection index 151
—, slots 151
—, star-dependent parameters 151
—, target covariances 163
—, target observation time 151, 157
—, transit time (T5) 151
—, under-observed stars 163
Star pattern matching 99, 265, 269
Star pattern monitoring 271, 273
Star pattern offset matching 299
Star pattern recognition 147
Star positions 107
Star selection 154
Straylight 77, 103, 115
—, attenuation curves 79
—, test configuration 78
Structure, satellite 80-81
—, stress release 190
Sun acquisition 99
Sun acquisition sensor 241, 281, 311, 337
Suspended operations 207, 305-316
—, period 119, 149, 184
Switching mirror mechanism, see mechanism
Switching prism 57

Tait-Bryan angles 258-265, 272-280
TDAC Consortium 8, 167-177
Technical involvement 8
Telemetry and telecommand electronics 238

Telescope assembly 35
Thermal anomalies 232-235
Thermal control 227-235
—, active 228, 230
—, anomalies 231
—, electronics 71, 228, 319
—, history 229
—, law 228
—, subsystem 42
Thermal environment 18
Thermal stability 227
Thermal vacuum tests 188
Thermistors 71, 228
Thermoelastic effects 249
Three-axis stabilised phase 238
Three-gyro configuration 257-285
Three-gyro operations 300
Thruster, calibration 176
—, cold gas 21-22, 144
—, cold gas mass 244
—, cold gas reaction control assembly 242
—, despin using 99
—, firing 264
—, hot gas reaction control assembly 241
—, monitoring 255-256
—, specific impulse 243
Timing, internal ground station delay 172
—, propagation delay 172
—, time tagging 22
Titan 159
Torques 176, 259
—, atmospheric drag 122, 253
—, calibration 255
—, disturbance 255-256
—, gravity gradient 122, 253
—, magnetic 122, 253
—, radiation pressure 253
Transfer orbit, see orbit
Transit time, see star observations
Transmission curves, see optics
Transmitter 320
Transverse offset 111
Two-gyro operations 147, 287-303
Tycho BT 36
Tycho Catalogue 14
Tycho data file 174
Tycho VT 36

Under-observed stars, see star observing strategy
Uplink data rate 28

Van Allen belts, see radiation
Variable stars, ephemerides 157
—, large-amplitude 157, 168
Vibration tests 389
Villafranca, see ground stations
VT, see Tycho VT

Wavefront error test, see optics

Zero-gyro configuration 147, 305-316