

Table 1: Summary of Spacecraft Transmitters.

| Launch                                    | Satellite            | Object             | Size | Radio  | Frequency                              | Satellite Service             | Power            | TNC   | Protocol                                       | Baud Rate/Modulation       | Downloaded                        | Lifetime                   | Antenna              | Status                 | Date             |            |
|---|----------------------|--------------------|------|--|--|-------------------------------|------------------|-------|--|----------------------------|-----------------------------------|----------------------------|----------------------|------------------------|------------------|------------|
| Eurockot launch<br>30 June 2003           | AAU1 CubeSat         | 27846              | 1U   | Wood & Douglas SX450                                     | 437.475 MHz                            | amateur                       | 500 mW           | MX909 | AX.25, Mobitex                                 | 9600 baud GMSK             | 1 kB                              | 3 months                   | dipole               | Dead                   | April 2013       |            |
|   | DTUsat-1             | 27842              | 1U   | RFMD RF2905  | 437.475 MHz                            | amateur                       | 400 mW           |       | AX.25  | 2400 baud FSK              | 0 <sup>1</sup>                    | 0 days                     | canted turnstile     | DOA                    | April 2013       |            |
|   | CanX-1               | 27847              | 1U   | Melexis  | 437.880 MHz                            | amateur                       | 500 mW           |       | Custom   | 1200 baud MSK              | 0 <sup>1</sup>                    | 0 days                     | crossed dipoles      | DOA                    | April 2013       |            |
|   | Cute-1 (CO-55)       | 27844              | 1U   | Alinco DJ-C4 (data)<br>Maki Denki (beacon)               | 437.470 MHz<br>436.8375 MHz            | amateur<br>amateur            | 350 mW<br>100 mW |       | MX614<br>PIC16LC73A                            | AX.25<br>CW                | 1200 baud AFSK                    | >10 MB <sup>2</sup><br>N/A | 118+ months          | monopole<br>monopole   | Alive            | April 2013 |
|   | QuakeSat-1           | 27845              | 3U   | Tekk KS-960  | 436.675 MHz                            | amateur                       | 2 W              |       | BayPac BP-96A                                  | AX.25 <sup>3</sup>         | 9600 baud FSK                     | 423 MB                     | 7 months             | turnstile              | Dead             | April 2013 |
|   | XI-IV (CO-57)        | 27848              | 1U   | Nishi RF Lab (data)<br>Nishi RF Lab (beacon)             | 437.490 MHz<br>436.8475 MHz            | amateur<br>amateur            | 1 W<br>80 mW     |       | PIC16C622<br>PIC16C716                         | AX.25<br>CW                | 1200 baud AFSK<br>50 WPM          | >11 MB <sup>2</sup><br>N/A | 118+ months          | dipole<br>dipole       | Alive            | April 2013 |
| SSETI Express<br>27 Oct 2005              | XI-V (CO-58)         | 28895              | 1U   | Nishi RF Lab (data)<br>Nishi RF Lab (beacon)             | 437.345 MHz<br>437.465 MHz             | amateur<br>amateur            | 1 W<br>80 mW     |       | PIC16C622<br>PIC16C716                         | AX.25<br>CW                | 1200 baud AFSK<br>50 WPM          | N/A                        | 90+ months           | dipole<br>dipole       | Alive            | April 2013 |
|   | NCube-2              | 28897 <sup>4</sup> | 1U   |  | 437.505 MHz                            | amateur                       |                  |       | AX.25  | 1200 baud AFSK             | 0 <sup>1</sup>                    | 0 days                     | monopole             | DOA                    | April 2013       |            |
|   | UWE-1                | 28892              | 1U   | PR430  | 437.505 MHz                            | amateur                       | 1 W              |       | HSS/2674R <sup>5</sup>                         | AX.25                      | 1200/9600 baud AFSK               |                            | 3 weeks              | end-fed dipole         | Dead             | April 2013 |
| M.V.-8<br>22 Feb 2006                     | Cute-1.7+APD (CO-56) | 28941              | 2U   | Alinco DJ-C5<br>Telemetry (beacon)                       | 437.505 MHz<br>437.385 MHz             | amateur<br>amateur            | 300 mW<br>100 mW |       | CMX589A<br>HSS/2328 <sup>5</sup>               | AX.25/SRLLCW               | 1200 AFSK/9600 GMSK<br>50 WPM     | <1 MB<br>N/A               | 2.5 months           | dipole<br>dipole       | Deorbited        | April 2013 |
| Minotaur-1<br>11 Dec 2006                 | GeneSat-1            | 29655              | 3U+  | Microhard MHX-2400<br>Stensat (beacon) <sup>7</sup>      | 2.4 GHz<br>437.067 MHz                 | experimental<br>amateur       | 1 W<br>500 mW    |       | Integrated <sup>6</sup><br>PIC12C617           | Proprietary<br>AX.25       | 500 kB<br>N/A                     | 3 months                   | patch<br>monopole    | Deorbited              | April 2013       |            |
| Dunye-2<br>17 Apr 2007                    | CSTB1                | 31122              | 1U   | Yaesu VX-2R  | 400.0375 MHz                           | experimental                  | 300 mW           |       | PIC  | Proprietary                | 1200 baud AFSK                    | 6.77 MB                    | 18 months            | dipole                 | Dead             | April 2013 |
|   | AeroCube-2           | 31133              | 1U   | FreeWave FGRM  | 915 MHz                                | experimental                  | 2 W              |       | Integrated <sup>6</sup>                        | Proprietary                | 38.4 kbaud                        | 500 kB                     | 1 week               | patch                  | Dead             | April 2013 |
|   | CP4                  | 31132              | 1U   | TI CC1000/RF2117   | 437.325 MHz                            | amateur                       | 1 W              |       | PIC18LF6720                                    | AX.25                      | 1200 baud FSK                     | 487 kB                     | 2 months             | dipole                 | Dead             | April 2013 |
|   | Libertad-1           | 31128              | 1U   | Stensat  | 437.405 MHz                            | amateur                       | 400 mW           |       |  | AX.25                      | 1200 baud AFSK                    | 0 <sup>8</sup>             | 1 month              | monopole               | Dead             | April 2013 |
|   | CAPE1                | 31130              | 1U   | TI CC1020  | 435.245 MHz                            | amateur                       | 1 W              |       | PIC16LF452                                     | AX.25                      | 9600 baud FSK                     | 0 <sup>9</sup>             | 4 months             | dipole                 | Dead             | April 2013 |
|   | CP3                  | 31129              | 1U   | TI CC1000/RF2117   | 436.845 MHz                            | experimental                  | 1 W              |       | PIC18LF6720                                    | AX.25                      | 1200 baud FSK                     | 2.0 MB <sup>2</sup>        | 19+ months           | dipole                 | Dead             | April 2013 |
|   | MAST <sup>10</sup>   | 31126              | 3U   | Microhard MHX-2400                                       | 2.4 GHz                                | experimental                  | 1 W              |       | Integrated <sup>6</sup>                        | Proprietary                | 15 kbps                           | >2 MB                      | 0.75 months          | monopole               | Dead             | April 2013 |
| NLS-4/PSLV-C9<br>28 Apr 2008              | DelFi-C3 (DO-64)     | 32789              | 3U   | Custom (transponder)<br>Custom (beacon)                  | 145.9-435.55 MHz<br>145.870 MHz        | amateur<br>amateur            | 200 mW<br>400 mW |       | N/A<br>PIC18LF4680                             | Linear<br>AX.25            | 40 kHz wide<br>1200 baud BPSK     | N/A<br>60 MB <sup>11</sup> | 60+ months           | turnstile<br>turnstile | Alive            | April 2013 |
|   | Seeds-2 (CO-66)      | 32791              | 1U   | Musashino Electric (data)<br>Musashino Electric (beacon) | 437.485 MHz<br>437.485 MHz             | amateur<br>amateur            | 450 mW<br>90 mW  |       |  | AX.25<br>CW                | 1200 baud AFSK                    | 500 kB <sup>2</sup><br>N/A | 60+ months           | monopole<br>monopole   | Alive            | April 2013 |
|   | CanX-2               | 32790              | 3U   | Custom S-Band  | 2.2 GHz                                | space research                | 500 mW           |       | Integrated                                     | NSP                        | 16-256kbps BPSK                   | 250 MB                     | 60+ months           | patch                  | Active           | April 2013 |
|   | AAUSAT-II            | 32788              | 1U   | Holger Eckhardt (DF2FQ)                                  | 437.425 MHz                            | amateur                       | 610 mW           |       | PIC18LF6680                                    | AX.25                      | 1200 baud MSK                     | 8 MB <sup>12</sup>         | 60+ months           | dipole                 | Alive            | April 2013 |
|   | Compass-1            | 32787              | 1U   | Holger Eckhardt (data)<br>BC549 (beacon)                 | 437.425 MHz<br>437.275 MHz             | amateur<br>amateur            | 300 mW<br>200 mW |       | C8051F123, FX614<br>PIC12F629                  | AX.25<br>CW                | 1200 baud AFSK/MSK<br>15 WPM      | <1 MB <sup>2</sup><br>N/A  | 60+ months           | dipole<br>dipole       | Alive            | April 2013 |
| Minotaur-1<br>19 May 2009                 | AeroCube-3           | 35005              | 1U   | FreeWave FGRM  | 915 MHz                                | experimental                  | 2 W              |       | Integrated                                     | Proprietary                | 77 kbaud GFSK                     | 52 MB                      | 7 months             | patch                  | Deorbited        | April 2013 |
|   | CP6                  | 35003              | 1U   | CC1000/RF2117  | 437.365 MHz                            | amateur                       | 1 W              |       | PIC18LF6720                                    | AX.25                      | 1200 baud FSK                     |                            | 4 months             | dipole                 | Deorbited        | April 2013 |
|   | HawtSat-1            | 35004              | 1U   | Microhard MHX-425  | 437.345 MHz                            | amateur                       | 1 W              |       | Integrated                                     | Proprietary                | 10 kbps                           | 0 kB                       | 0 days               | monopole               | DOA              | April 2013 |
|   | PharmaSat            | 35002              | 3U+  | Microhard MHX-2400<br>Stensat (beacon) <sup>7</sup>      | 2.4 GHz<br>437.465 MHz                 | experimental<br>amateur       | 1 W<br>500 mW    |       | Integrated<br>Integrated                       | Proprietary<br>AX.25       | 1200 baud AFSK                    | 650 kB<br>N/A              | 10 days<br>1 month   | patch<br>monopole      | Deorbited        | April 2013 |
| ISL launch 01/<br>PSLV-C14<br>23 Sep 2009 | BEESAT-1             | 35933              | 1U   |  | 436.000 MHz                            | amateur <sup>13</sup>         | 500 mW           |       | CMX909B  | Mobitex                    | 4800/9600 baud GMSK               |                            | 43+ months           | monopole               | Alive            | April 2013 |
|   | UWE-2                | 35934              | 1U   | Custom   | 437.385 MHz                            | amateur                       |                  |       | AX.25  | 1200 baud AFSK             |                                   | 1 week                     | dipole               | Dead                   | April 2013       |            |
|   | ITUpsAT-1            | 35935              | 1U   | Microhard MHX-425<br>BeeLine/CC1050                      | 437.325 MHz<br>437.325 MHz             | amateur<br>amateur            | 1 W<br>350 mW    |       | Integrated                                     | Proprietary<br>CW          | 19200 baud                        | 0 kB <sup>8</sup><br>N/A   | 43+ months           | dipole<br>monopole     | Alive            | April 2013 |
|   | SwissCube            | 35932              | 1U   | Butler oscillator/RF5110G<br>RF2516 (beacon)             | 437.505 MHz<br>437.505 MHz             | amateur<br>amateur            | 1 W<br>100 mW    |       | MSP430F1611                                    | AX.25<br>CW                | 1200 baud FSK<br>10 WPM           | 6 MB<br>N/A                | 43+ months           | monopole<br>monopole   | Active           | April 2013 |
| H-IIA F17<br>20 May 2010                  | Hayato               | 36573              | 1U   | Custom   | 13.275 GHz                             | Earth exploration             | 100 mW           |       | Integrated                                     |                            | 10 kbps/1 Mbps BPSK               | 0 kB <sup>8</sup>          | 18 days              | patch                  | Deorbited        | April 2013 |
|   | Waseda-SAT2          | 36574              | 1U   | TXE430-301A<br>TXE430-301A (beacon)                      | 437.485 MHz<br>437.485 MHz             | amateur<br>amateur            | 150 mW<br>100 mW |       | H8/3052F <sup>5</sup><br>H8/3052F <sup>5</sup> | AX.25<br>CW                | 9600 baud FSK                     | 0 kB<br>N/A                | 0 days               | monopole<br>dipole     | DOA<br>Deorbited | April 2013 |
|   | Negai-Star           | 36575              | 1U   | Data<br>Beacon Radio                                     | 437.305 MHz<br>437.305 MHz             | amateur<br>amateur            | 150 mW<br>100 mW |       |  | AX.25<br>CW                | 1200 baud FSK<br>50 WPM           | N/A                        | 1 month              | dipole<br>dipole       | Deorbited        | April 2013 |
| NLS-6/<br>PSLV-C15<br>12 July 2010        | Tlsat-1              | 36799              | 1U   | Alinco DJ-C6<br>CC1010 (beacon)                          | 437.305 MHz<br>437.305 MHz             | amateur<br>amateur            | 500 mW<br>400 mW |       | MSP430F169<br>MSP430F169                       | AX.25<br>CW                | 1200 baud AFSK<br>15-110 WPM      | N/A                        | 33+ months           | monopole<br>monopole   | Active           | April 2013 |
|   | StudSat              | 36796              | 1U   | CC1020<br>MAX1472 (beacon)                               | 437.505 MHz<br>437.860 MHz             | amateur<br>amateur            | 500 mW<br>10 mW  |       | UC3A0512 <sup>5</sup><br>UC3A0512 <sup>5</sup> | Custom AX.25<br>CW         | 4800 baud FSK<br>22 WPM           | 0 kB <sup>8</sup><br>N/A   | 5 days               | monopole<br>monopole   | Dead             | April 2013 |
| STP-S26<br>19 Nov 2010                    | RAX-1                | 37223              | 3U   | Lithium-1  | 437.505 MHz                            | amateur                       | 750 mW           |       | Integrated                                     | AX.25                      | 9600 baud GMSK                    | 4.8 MB                     | 2 months             | turnstile              | Dead             | April 2013 |
|   | O/OREOS              | 37224              | 3U+  | Microhard MHX-2400<br>Stensat (beacon) <sup>7</sup>      | 2.4 GHz<br>437.305 MHz                 | experimental<br>amateur       | 1 W<br>500 mW    |       | Integrated<br>Integrated                       | Proprietary<br>AX.25       | Variable<br>1200 baud AFSK        | 8 MB<br>N/A                | 29+ months           | patch<br>monopole      | Alive            | April 2013 |
|   | NanoSail-D2          | 37361              | 3U+  | Microhard MHX-2400<br>Stensat (beacon) <sup>7</sup>      | 2.4 GHz<br>437.270 MHz                 | experimental<br>amateur       | 1 W<br>500 mW    |       | Integrated<br>Integrated                       | Proprietary<br>AX.25       | Variable<br>1200 baud AFSK        | N/A                        | 5 days <sup>14</sup> | patch<br>monopole      | Deorbited        | April 2013 |
| Falcon 9-002<br>8 Dec 2010                | Perseus (4)          | 37251              | 1.5U |  |  | government                    |                  |       |  |                            |                                   | 1 month                    | dipole               | Deorbited              | April 2013       |            |
|   | Qbx (2)              | 37249              | 3U   | TTC  | 450 MHz                                | government                    | 1 W              |       |  |                            | 9600 baud GMSK                    |                            | 1 month              | quadraflar helix       | Deorbited        | April 2013 |
|   | SMDC-ONE             | 37246              | 3U   | Pericle  | UHF                                    | government                    |                  |       |  |                            |                                   | 1 month                    | turnstile            | Deorbited              | April 2013       |            |
|   | Mayflower            | 37252              | 3U   | Microhard MHX-425<br>Stensat (beacon) <sup>7</sup>       | 437.000 MHz<br>437.600 MHz             | unlicensed<br>unlicensed      | 1 W<br>1 W       |       | Integrated<br>Integrated                       | Proprietary<br>AX.25       | Variable<br>1200 baud AFSK        | 0 kB <sup>8</sup><br>N/A   | 2 days               | dipole                 | Deorbited        | April 2013 |
| PSLV-C18<br>12 Oct 2011                   | Jugnu                | 37839              | 3U   | CC1070/RF5110G<br>MAX1472 (beacon)                       | 437.505 MHz<br>437.505 MHz             | amateur<br>amateur            | 1 W<br>10 mW     |       | AX.25<br>CW                                    | 2400 baud FSK<br>20 WPM    | N/A                               | 18+ months                 | monopole<br>monopole | Alive                  | April 2013       |            |
| ElaNa-3/<br>NPP<br>28 Oct 2011            | AnubisSat-1          | 37854              | 1U   | Melexis THT2011  | 437.475 MHz                            | amateur                       | 800 mW           |       | ATmega1281 <sup>4</sup>                        | CW                         | 20 WPM                            | 0 kB                       | 18+ months           | dipole                 | Alive            | April 2013 |
|   | DICE (2)             | 37851              | 1.5U | L3 Cadet   | 465 MHz                                | meteorological                | 1 W              |       | Integrated                                     | Proprietary                | 1.5 Mbps BPSK                     |                            | 18+ months           | dipole                 | Active           | April 2013 |
|   | HRBE                 | 37855              | 1U   | CC1000   | 437.505 MHz                            | amateur                       | 850 mW           |       |  | AX.25                      | 1200 baud FSK                     | <sup>11</sup>              | 18+ months           | monopole               | Active           | April 2013 |
|   | M-CubeD              | 37855              | 1U   | Lithium-1  | 437.485 MHz                            | amateur                       | 1 W              |       | Integrated                                     | AX.25                      | 1200 baud FSK                     | 0 kB <sup>8</sup>          | 18+ months           | monopole               | Alive            | April 2013 |
|   | RAX-2                | 37853              | 3U   | Lithium-1  | 437.345 MHz                            | amateur                       | 1 W              |       | Integrated                                     | AX.25                      | 9600 baud GMSK                    | 242 MB                     | 18+ months           | turnstile              | Active           | April 2013 |
| Vega VV01<br>13 Feb 2012                  | Xatcoeco             | 38082              | 1U   | GomSpace U482C   | 437.365 MHz                            | amateur                       | 500 mW           |       | Integrated                                     | AX.25/CW                   | 1200 baud MSK/20 WPM              |                            | 14+ months           | turnstile              | Active           | April 2013 |
|   | ROBUSTA              |                    | 1U   | MC12181/MAX2608  | 437.325 MHz                            | amateur                       | 800 mW           |       | PIC18F4580 <sup>5</sup>                        | AX.25                      | 1200 baud AFSK                    | 0 kB <sup>15</sup>         | 2 days               | dipole                 | Dead             | April 2013 |
|   | e-st@r               | 38079              | 1U   | BHX2-437-5   | 437.445 MHz                            | amateur                       | 500 mW           |       | PIC16  | AX.25                      | 1200 baud AFSK                    | 0 kB <sup>8</sup>          | 3 days               | dipole                 | Dead             | April 2013 |
|   | Goliat               | 38085              | 1U   | Alinco DJ-C7<br>Microhard MHX-2420                       | 437.485 MHz<br>2.4 GHz                 | amateur                       | 500 mW<br>1 W    |       | FX614/MSP430<br>Proprietary                    | AX.25/CW<br>Proprietary    | 1200 baud AFSK/20 WPM<br>Variable | 0 kB <sup>15</sup>         | 1 week               | monopole<br>patch      | Dead             | April 2013 |
|   | PW-Sat               | 38083              | 1U   | ISIS TRXU2   | 145.900 MHz                            | amateur                       | 200 mW           |       | Integrated                                     | AX.25/CW                   | 1200 baud BPSK/12 WPM             |                            | 10 months            | dipole                 | Dead             | April 2013 |
|   | Masat-1              | 38081              | 1U   | Si4432   | 437.345 MHz                            | amateur                       | 100/400 mW       |       | PIC18F33F <sup>5</sup>                         | Custom/CW                  | GFSK/120 CPM                      | 305 MB                     | 14+ months           | monopole               | Active           | April 2013 |
|   | UniCubeSat-GG        |                    | 1U   | AstroDev Custom  | 437.305 MHz                            | amateur                       | 500 mW           |       | Integrated                                     | AX.25/CW                   | 9600 baud GFSK                    | 0 kB <sup>8</sup>          | 2 days               | dipole                 | Dead             | April 2013 |
| ElaNa-6/NROL-36<br>13 Sep 2012            | SMDC-ONE (2)         | 38766              | 3U   | Pericle  | UHF                                    | government                    |                  |       |  |                            |                                   |                            |                      |                        | Alive            | April 2013 |
|   | AeroCube-4 (3)       | 38767              | 1U   | FreeWave MM2<br>CC1101                                   | 915 MHz<br>915 MHz                     | experimental<br>experimental  | 2 W<br>1.3 W     |       | Integrated<br>Integrated                       | Proprietary<br>Proprietary | 38.4 kbaud<br>500 kbps FSK        |                            | 8+ months            | patch<br>patch         | Active           | April 2013 |
|   | Aeneas               | 38760              | 3U   | MHX-425<br>Stensat (beacon) <sup>7</sup>                 | 437.000 MHz<br>437.600 MHz             | experimental<br>amateur       | 1 W<br>1 W       |       | Integrated<br>Integrated                       | Proprietary<br>AX.25       | Variable<br>1200 baud FSK         | N/A                        | 8+ months            | monopole<br>monopole   | Alive            | April 2013 |
|   | CSSWE                | 38761              | 3U   | Lithium-1  | 437.345 MHz                            | experimental                  | 1 W              |       | Integrated                                     | AX.25                      | 9600 baud GFSK                    | 60 MB                      | 8+ months            | monopole               | Active           | April 2013 |
|   | CP5                  | 38763              | 1U   | CC1000/RF2117  | 437.405 MHz                            | amateur                       | 500 mW           |       | PIC18LF6720                                    | AX.25                      | 1200 baud FSK                     | 500 kB                     | 4 months             | dipole                 | Dead             | April 2013 |
|   | CXBN                 | 38762              | 2U   | Lithium-1  | 437.525 MHz                            | amateur                       | 1 W              |       | Integrated                                     | AX.25                      | 9600 baud GFSK                    |                            | 8+ months            | turnstile              | Active           | April 2013 |
|   | CINEMA               | 38764              | 3U   | Emhiser  | 2200 MHz                               | space research                | 1 W              |       | FPGA   | Proprietary                | 1 Mbps FSK                        |                            | 8+ months            | patch                  | Active           | April 2013 |
|   | Re                   | 38765              | 3U   | Helium-100   | 915 MHz                                | government                    | 1 W              |       | Integrated                                     | AX.25                      | 57.6 kbps FSK                     |                            |                      | dipole                 | Deorbited        | April 2013 |
| ISS<br>4 Oct 2012                         | FITSat-1             | 38853              | 1U   | High-speed Custom<br>Custom (data)<br>Custom (beacon)    | 5.84 GHz<br>437.445 MHz<br>437.250 MHz | amateur<br>amateur<br>amateur | 2 W<br>10 mW     |       | PIC16F886<br>PIC16F1519<br>PIC16F1519          | AX.25<br>CW                | 115.2 kbps FSK<br>1200 baud AFSK  | N/A                        | 6+ months            |                        |                  |            |