Table 11.5

Some Radio Transmissions Observed in the 136- to 138-MHz Band Between 1978 and 1984

All identifications are tentative. The table is based on articles by G. Roberts in *Orbit* and *OSCAR NEWS* (see Table 11.6 for full references), "Satellite Situation Report" (NASA) and several other sources.

International designation	*Satellite name*	*Period (minutes)*	*Inclination*	*Apogee km*	*Perigee km*	*Frequencies*	*Comments*
62A Alpha 1	Tiros 5	100.1	58.1°	939	588	136.230, 136.920	Continuous tone but periodic pulsing, occasional hiccoughs
62B Alpha 1	Alouette 1	105.3	80.5°	1026	993	136.980	
62 Upsilon 1	Relay 1	185.1	47.5°	7436	1323	136.140, 136.620	
64 03A	Relay 2	194.7	46.4°	7476	2025	136.140, 136.620	Continuous tone
64 83D	Transit 5B-5	106.2	89.8°	1083	1018	136.650	Musical sequence, fm
65 32A	Explorer 27	107.7	41.1°	1313	933	136.740	
65 51A	Tiros 10	100.5	98.3°	824	735	136.230, 136.920	Continuous tone but slow frequency variations apart from Doppler
65 98A	Alouette 2	120.3	79.8°	2888	502	136.980	
66 77B	EGRS 7 (Secor 7)	167.5	89.9°	3698	3673	136.800	Typical EGRS multi-tone sequence, fm
66 77C	ERS 15	167.6	89.9°	3698	3681	136.440	Modulated fm
66 89B	EGRS 8 (Secor 8)	167.6	90.3°	3694	3688	136.830	
66 110A	ATS-1 [1]	1436.2	9.7°	35,792	35,786	136.470, 137.350	See note 1.
67 40D	ERS 20 (OV5 3)	2840	32.9°	111,529	8619	136.260	Modulated signal having period of 4.56 seconds
67 65A	EGRS 9 (Secor 9)	172.1	89.8°	3937	3801	136.840	
67 100A	OSO 4	94.3	33.0°	493	472	136.710	
67 111A	ATS-3 [1]	1436.1	8.3°	35,856	35,719	136.470, 137.350	See note 1.
69 09A	ISIS 1	128.2	88.4°	3514	577	136.410, 136.080, 136.590	Continuous tone
69 37B	EGRS 13 (Secor 13)	107.2	99.5°	1128	1068	136.800	Standard EGRS fm signal
69 46B	OV5-6	3114.8	32.9°	113,084	15,460	136.380	
69 82B	Timation 2	103.3	70.0°	931	900	137.380	Musical tones, fm
69 82E	—	103.4	70.0°	934	902	137.410	Continuous tone
70 09A	Sert 2	106.1	99.1°	1047	1039	136.920, 136.230, 136.928	Rapid periodic pecking, fm
70 25A	Nimbus 4	107.1	99.6°	1102	1091	136.500, 136.797	Operating illuminated passes only?
70 25B	TOPO 1	106.9	99.7°	1086	1082	136.840	
71 24A	ISIS 2	113.6	88.1°	1426	1360	136.410, 136.080, 136.590	.410-continuous tone .590 occasionally fm
71 30A	Tournesol	96.2	46.4°	697	457	136.630	
71 71A	Eole 1	100.5	50.2°	891	672	136.350	
71 80A	Shinsei	113.2	32.1°	1869	873	136.694	Continuous tone
71 96A	Explorer 45	326.8	3.5°	18,315	362	136.830	
71 110A	—	104.8	69.9°	989	984	136.800	
71 110C	—	104.8	70.0°	992	982	137.080	
71 110D	—	104.8	70.0°	992	982	136.320	
71 110E	—	104.8	70.0°	991	982	137.050	
72 65A	Copernicus	99.5	35.0°	742	731	136.260, 136.440	Modulated fm carrier
72 97A	Nimbus 5	107.2	99.8°	1105	1092	136.500	Operating illuminated passes only?
73 78A	Explorer 50	17,462	51.1°	230,086	203,072	137.980, 136.800	
74 33A	SMS 1	1437.2	4.4°	35,822	35,795	136.380	
74 39A	ATS-6	1435.8	2.2°	35,796	35,767	136.230, 136.112	
74 101A	Symphonie-1	1436.1	1.1°	35,801	35,775	137.020	Modulated fm carrier

Russian Molniya satellites are of special interest since they're generally operated during both Eurasian and North American apogees. They usually use earth coverage antennas and typically provide about 30-dBw EIRP in your direction. TVRO terminal operators in most of the U.S., with a few extra decibels in margin, can catch these transmissions by searching for spacecraft using nominal values for height (35,800 km) and subsatellite latitude (62° N). Azimuth and elevation settings for a search from your location can be computed using the techniques outlined in Chapters 8 and 9. Downlinks are primarily in the range 3.75 to 3.95 GHz, with 3.895 GHz being most common. The video format is compatible with U.S. systems so you won't have any trouble obtaining a picture. Decoding the color information is complex, however, so most experimenters settle for black-and-white viewing.

Let's look more closely at how the downlink signal from a domestic 4-GHz TV satellite is decoded. The output of the TVRO terminal detector (Fig. 11-3) consists of (1) a video waveform, (2) a frequency modulated audio subcarrier and (3) a triangular energy dispersal waveform. The *baseband* video waveform, which contains components from dc to 4.2 MHz, is similar to the signal provided by video cameras and video tape recorders. It can be fed directly into a studio monitor or into an rf modulator for viewing on standard TVs. Since video monitors are relatively expensive, most people use the rf-modulator-to-TV approach. Video recorder owners generally patch the excellent rf modulators in these units into the TVRO setup. The fm audio subcarrier is usually at 6.8 MHz or 6.2 MHz. With a peak deviation of 75 kHz it's so similar to standard fm broadcast-band (88-108 MHz) signals that some homemade TVRO systems use modified fm broadcast receivers to tune across the low i-f looking for subcarrier signals.

The 30-Hz triangular energy dispersal waveform, which has a peak deviation of 750 kHz, needs some explanation. Its sole

International designation	Satellite name	Period (minutes)	Inclination	Apogee (km)	Perigee (km)	Frequencies	Comments
75 04A	Landsat 2	103.2	99.1°	919	904	137.860	Modulated fm carrier
75 11A	SMS 2	1436.0	0.4°	35,810	35,763	136.380	
75 27A	GEOS 3	101.7	114.9°	863	821	136.320	Strong modulated fm carrier
75 33A	Aryabhata	96.1	50.7°	591	553	137.440	Strong modulated rasping fm carrier
75 49B	SRET 2	736.4	64.0°	40,504	763	137.530	Broad modulated fm carrier (see note 2)
75 52A	Nimbus 6	107.4	99.9°	1116	1105	136.500	
75 72A	COS B	2202.5	96.5°	89,407	9985	136.950	Modulated fm carrier
75 77A	Symphonie-2	1436.1	1.6°	35,840	35,734	136.800	Modulated fm carrier
75 100A	GOES 1	1425.5	0.0°	35,591	35,566	136.380	
75 107A	Explorer 55	93.6	19.6°	449	447	137.230	
76 23D	Solrad 11B	7333.8	28.0°	119,817	117,505	136.530	
77 48A	GOES 2	1436.2	0.7°	35,809	35,770	136.380	
77 80A	Sirio	1437.6	1.6°	37,049	34,582	136.140	Strong, fm modulation
77 108A	Meteosat 1	1436.2	0.2°	35,803	35,774	137.080	Strong, fm modulation
77 117A	Meteor 2-3	102.3	81.2°	887	850	137.300	Soviet APT
78 12A	IUE	1435.4	28.3°	45,691	25,856	136.860	Modulated carrier, fm
78 26A	Landsat 3	103.1	99.0°	917	898	137.860	Modulated carrier, fm
78 41A	HCMM	—	97.7°	—	—	137.170	Continuous tone, cw
78 44A	OTS 2	1436.1	0.0°	35,796	35,779	137.050	Strong fm modulation
78 62A	GOES 3	1436.0	0.0°	35,795	35,776	136.380	
78 71A	ESA GOES	1436.0	0.4°	35,814	35,757	137.200	Modulated carrier, fm
78 87A	Jiki'ken	473.4	31.1°	27,215	268	136.695	
78 96A	Tiros-N	102.0	99.0°	876	839	137.620 (APT), 137.770, 136.770	
78 99A	Intercosmos 18	94.6	82.9°	618	375	137.850	Strong wide fm, slow tone sequence, about 1 min/frame
78 99C	Magion	94.9	82.9°	648	382	137.150	Pulses (about 1 sec)
79 14A	Corsa-B	95.5	29.9	554	527	136.725	Strong carrier
79 21A	Meteor 2-4	102.2	81.2	891	833	137.300	Soviet APT
79 47A	UK 6	97.0	55.0°	651	585	136.560, 137.560	Strong, fm modulation
79 51A	Bhaskar	95.0	50.7°	529	509	137.230	Strong, fm modulation
79 57A	NOAA-6	101.2	98.7°	824	807	137.500 (APT), 136.770	
79 95A	Meteor 2-5	102.5	81.2°	894	874	137.300	Soviet APT
80 15A	Tansei 4	95.9	38.7°	606	520	137.725	Continuous carrier
80 51A	Meteor 30	97.5	97°	640	—	137.150, 137.130	Soviet APT (Experimental?)
80 73A	Meteor 2-6	102.3	81.2°	899	851	137.400	Soviet APT
81 12A	Kiku 3	563.7	28.2°	32,128	322	136.112	
81 17	Astro 1	96.1	31.3°	598	546	136.725	
81 43A	Meteor 2-7	102.4	81.3°	899	859	137.400	Soviet APT
81 57A	Meteosat 2	1436.2	0.0°	35,792	35,787	137.080	
81 57C	Ariane LO3	627.	10.°	35,838	202	136.610	(see note 3)
81 59A	NOAA-7	101.9	99.0°	856	836	137.620 (APT) 136.770	
81 65A	Meteor 31	97.8	97.8°	670	630	137.130	Soviet APT
81 115A	Bhaskara 2	94.9	50.6°	524	502	137.260	
81 122A	Marecs A	1436.1	0.6°	35,805	35,722	137.170	
82 25A	Meteor 2-8	104.0	82.5°	958	936	137.850	Soviet APT
82 116A	Meteor 2-9	102.3	81.2°	910	850	137.300	Soviet APT
83 22A	NOAA-8	101.2	98.7°	826	802	136.770	
83 33A	Rohini 3	95.9	46.6°	829	388	137.400	
83 109A	Meteor 2-10	101.2	81.2°	885	749	137.400	Soviet APT
84 72A	Meteor 2-11	104.1	82.5°	962	945	137.300	Soviet APT
84 81A	ECS-2	1436	0°	35,800	35,800	137.140	

[1]ATS-1 (149° W) and ATS-3 (105° W) have operational transponders on 149.195/135.575 MHz, 149.220/135.600 MHz and 149.245/135.625 MHz. NASA allocates transponder time slots for imaginative experimental proposals deemed worthwhile. For information request "ATS VHF Experiments Guide," ATS Experiments Manager, Office of Applications, Code ECS, NASA, Washington, DC 20546.

[2]For additional information see G. Roberts "Radio Tracking of SRET 2," *OSCAR NEWS*, no. 28, Winter 1979, pp. 27-30.

[3]For about three days after launch a beacon (a two-tone carrier switching every 8 to 9 seconds) was in operation on the indicated frequency. Speculation is that it was on the rocket and used for tracking. Whether future Ariane launches will also carry tracking beacons at this frequency is not known, but it's worth checking.

purpose is to move the carrier around when no modulation is present. This reduces the rf energy density at any single frequency and helps prevent interference to terrestrial microwave links that share the 4-GHz band. At the ground station, our main interest is in removing the energy dispersal waveform, an easily accomplished task.

12-GHz Direct Broadcast Satellites

Geostationary Direct Broadcast Satellites will use the 12-GHz band (11.7 to 12.5 GHz in U.S.). Experiments with this service began in the late 1970s with CTS in North America (also known as Hermes), BSE in Japan and OTS in Europe. Projections call for activating operational systems in Japan (about 1983), in Europe (about 1984) and in the U.S. (about 1986). Since the 12-GHz TV downlinks are meant to be a broadcast service to ground stations numbering in the tens of millions, the economics dictate designing the spacecraft to minimize ground-terminal cost. The projected price of a typical ground station, including antenna (roof-mounted 75-cm diameter dish) and all electronics, is under $500. These cost estimates are based on a satellite EIRP per channel of 60 dBw, a figure 25 dB higher than that of the 4-GHz service.

Since these satellites will be similar in size and power budget to the 4-GHz models currently in operation, where will this extra power come from? By restricting the number of channels to four, the power available per channel could be raised to 30 watts, a 7.8-dB increase. The additional 17-dB EIRP needed will be attained by high-gain spot-beam antennas. A 17-dB change roughly equals a 50-fold reduction in coverage: from the entire U.S. to a circular area approximately 300 km in diameter.

How these channels will be used is not clear. Some proposals call for a service similar to that currently being operated at 4 GHz. Others suggest adopting a new high-resolution TV system that would produce better pictures than the three major systems