

# IO-117 and Digipeat success rate

Testing on a non-congested pass

By OZ9AAR – 2023-04-13

**IO-117**  
 AZ: 220,1° EL: 52,1°  
 LOS: 00:28:18 (Max. EI: 60,8)

**OZ9AAR**  
 JO45ts  
 LOS: 00:28:17  
 220,1° 52,0°  
 Rng 6541 km F1T -1695/+1695

Time (UTC)	From	To	Message	Delay
05:10:43	GreenCube	ALL	[TLR: eps/obc/radio boot=159/8334/503, Vbat=8,279V]	0 (100 %)
05:10:50	OZ9AAR	TEST	TEST	0 (100 %)
05:10:53	OZ9AAR	TEST	TEST	0 (100 %)
05:10:54	OZ9AAR	TEST	TEST	0 (100 %)
05:10:56	OZ9AAR	TEST	TEST	0 (100 %)
05:10:57	OZ9AAR	TEST	TEST	0 (100 %)
05:11:00	OZ9AAR	TEST	TEST	0 (100 %)
05:11:01	OZ9AAR	TEST	TEST	0 (100 %)
05:11:09	OZ9AAR	TEST	TEST	0 (100 %)
05:11:13	OZ9AAR	TEST	TEST	0 (100 %)
05:11:16	OZ9AAR	TEST	TEST	0 (100 %)
05:11:22	OZ9AAR	TEST	TEST	0 (100 %)
05:11:25	OZ9AAR	TEST	TEST	0 (100 %)
05:11:28	GreenCube	ALL	[TLR: eps/obc/radio boot=159/8334/503, Vbat=8,298V]	0 (100 %)
05:11:29	OZ9AAR	TEST	TEST	0 (100 %)
05:11:32	OZ9AAR	TEST	TEST	0 (100 %)
05:11:37	OZ9AAR	TEST	TEST	0 (100 %)
05:11:40	OZ9AAR	TEST	TEST	0 (100 %)
05:11:45	IMF2B	CQ	TEST	0 (100 %)
05:11:48	UN7CL	CQ	M044Gm	5 (100 %)
05:11:51	OZ9AAR	TEST	TEST	0 (100 %)
05:11:54	OZ9AAR	TEST	TEST	0 (100 %)
05:12:00	UN7CL	CQ	M044Gm	5 (100 %)
05:12:02	OZ9AAR	TEST	TEST	0 (100 %)
05:12:03	UN7CL	CQ	M044Gm	0 (100 %)
05:12:04	OZ9AAR	TEST	TEST	0 (100 %)
05:12:10	OZ9AAR	TEST	TEST	0 (100 %)
05:12:13	GreenCube	ALL	[TLR: eps/obc/radio boot=159/8334/503, Vbat=8,307V]	0 (88 %)
05:12:13	OZ9AAR	TEST	TEST	0 (100 %)
05:12:18	430D	CQ	LH0B	0 (100 %)
05:12:21	OZ9AAR	TEST	TEST	0 (100 %)
05:12:24	OZ9AAR	TEST	TEST	0 (100 %)
05:12:30	IMF2B	CQ	IK PHB ic9700	0 (100 %)



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## Introduction

Most users of IO-117/GreenCube knows it can be a problem to get packets digipeated on busy passes. Most also knows that if a pass is NOT busy, you can get all you packets digipeated (pretty much). There has been some rumor/speculations about IO-117 getting “bad” after a change from 2400 back to 1200 baud, as if something “else” has been changed on the sat configuration. I tried to make a test on a non-congested pass to get some results and measurements.

## Equipment used.

ICOM IC-9700 running with 30W at the antenna feedpoint.

Antenna used is a 15 element RHCP polarized antenna (with mast mounted preamp, 0.8 dB NF)

UZ7HO Andy Soundmodem version 0.10b (<http://uz7.ho.ua/packetradio.htm>)

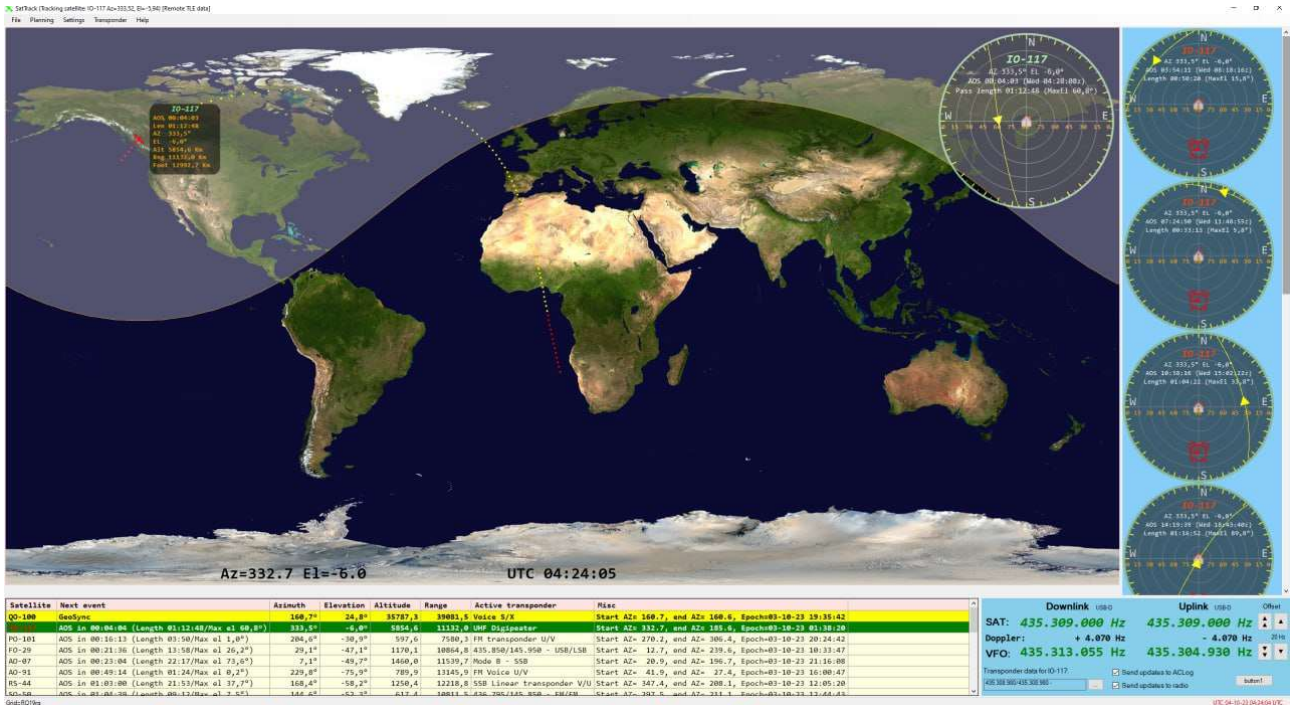
OZ9AAR Greencube Terminal program (<https://www.moonbounce.dk>)

## Tests performed.

During a pass on October 4<sup>th</sup> 2023 in the early (local) morning, I did a number of transmissions to the IO-117 satellite to gauge how many digipeats were possible. The pass was coming from the North of OZ going south. Max elevation was 61 degrees.

## The pass

The pass I used for the test is shown below (yellow dotted line). It started at my QTH around 06.30 local (EU) time and lasted 1h12m in total. AOS Az around 330 and LOS Az around 185 deg.





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## The test

During the pass, I did several transmissions in groups. The messages were just simple “TEST” messages. I knew beforehand that this was a bit risky as I would possibly upset some of the (relatively few) users that would be on the satellite. Most users took it very nicely 😊

## At AOS

The first group of tests were done right after AOS (1 minute after AOS, around 1 deg elevation). This test lasted around 2 minutes, and even brought two QSOs and a new grid 😊

The screenshot shows the GreenCube Terminal interface for station IO-117. The top right displays station information: OZ9AAR JO45ts, LOS: 01:09:44, 331,9° 4,7°, and Ring 9934 km R/T +4039/-4039. A graph on the right shows signal strength over time, with a peak around 1.9 minutes. The main window displays a log of transmissions with columns for Time (UTC), From, To, Message, and Delay. The log shows several test messages and two QSOs: one with K8BCR (EM79UF QSL?) and one with N6UTC (DM03 California qsl?). The bottom status bar shows the digipeater is on, soundmodem connected, and ACLog connected.

Time (UTC)	From	To	Message	Delay
04:28:43	GreenCube	ALL	[TLM: eps/obc/radio boot=159/8334/503, Vbat=8,298V]	0 (100 %)
04:28:46	K5ENG	JH8FIH	73 from TEXAS EL29	5 (100 %)
04:28:52	JH8FIH	K5ENG	TU CU Op Shige	0 (88 %)
04:29:01	K5ENG	WC7V	599 EL29 fm Charlie	5 (100 %)
04:29:08	OZ9AAR	TEST	TEST	0
04:29:11	OZ9AAR	TEST	TEST	0 (100 %)
04:29:12	OZ9AAR	TEST	TEST	0
04:29:15	OZ9AAR	TEST	TEST	0 (100 %)
04:29:15	OZ9AAR	TEST	TEST	0
04:29:18	OZ9AAR	TEST	TEST	0 (100 %)
04:29:19	OZ9AAR	TEST	TEST	0
04:29:22	OZ9AAR	TEST	TEST	0 (100 %)
04:29:22	OZ9AAR	TEST	TEST	0
04:29:25	K8BCR	OZ9AAR	EM79UF QSL?	2 (100 %)
04:29:26	OZ9AAR	TEST	TEST	0 (100 %)
04:29:27	JH8FIH	K5ENG	TU CU Op Shige	0 (100 %)
04:29:28	GreenCube	ALL	[TLM: eps/obc/radio boot=159/8334/503, Vbat=8,279V]	0 (56 %)
04:29:29	OZ9AAR	TEST	TEST	0
04:29:32	OZ9AAR	TEST	TEST	0 (100 %)
04:29:34	OZ9AAR	K8BCR	JO45	0
04:29:38	OZ9AAR	K8BCR	JO45	0
04:29:41	OZ9AAR	K8BCR	JO45	0 (94 %)
04:29:48	WC7V	K5ENG	UR 599 DN46	2 (94 %)
04:29:51	OZ9AAR	TEST	TEST	0
04:29:56	N6UTC	OZ9AAR	DM03 California qsl?	0 (100 %)
04:29:57	OZ9AAR	TEST	TEST	0
04:30:00	OZ9AAR	TEST	TEST	0
04:30:03	OZ9AAR	TEST	TEST	0 (100 %)
04:30:06	OZ9AAR	N6UTC	R73	0
04:30:09	OZ9AAR	N6UTC	R73	0 (94 %)
04:30:12	K5ENG	JH8FIH	73 from TEXAS EL29	5 (100 %)
04:30:15	K8BCR	OZ9AAR	R 73 Logged>LOTW	2 (100 %)
04:30:19	N6UTC	OZ9AAR	RR73 de DM03	0 (100 %)
04:30:21	OZ9AAR	K8BCR	R73	0
04:30:24	OZ9AAR	K8BCR	R73	0 (100 %)
04:30:28	GreenCube	ALL	[TLM: eps/obc/radio boot=159/8334/503, Vbat=8,307V]	0 (94 %)
04:30:35	OZ9AAR	TEST	TEST	0
04:30:38	OZ9AAR	TEST	TEST	0 (100 %)
04:30:39	K5ENG	WC7V	73 from TEXAS EL29	5 (100 %)
04:30:39	OZ9AAR	TEST	TEST	0
04:30:42	OZ9AAR	TEST	TEST	0 (100 %)
04:30:43	OZ9AAR	TEST	TEST	0
04:30:46	OZ9AAR	TEST	TEST	0 (100 %)
04:30:47	OZ9AAR	TEST	TEST	0
04:30:50	OZ9AAR	TEST	TEST	0 (100 %)
04:30:50	OZ9AAR	TEST	TEST	0
04:30:53	OZ9AAR	TEST	TEST	0 (100 %)
04:30:58	GreenCube	ALL	[TLM: eps/obc/radio boot=159/8334/503, Vbat=8,298V]	0 (100 %)
04:31:04	OZ9AAR	TEST	TEST	0
04:31:04	WC7V	K5ENG	73! LOTW op Kerry	2 (100 %)
04:31:07	OZ9AAR	TEST	TEST	0 (100 %)

During this test, I was pretty much “alone” with NA and part of northern Europe, and a small chunk of Japan. Most of Europe was out of footprint at that time. Also, the time (04.30 UTC) means that it was late in the evening for US. During this 2 minute period right at AOS, I had a digipeat success rate of 84%. It does (almost) not get better than that! We were also only 6 active users during that period, so the high digipeat rate was to be expected.

Right after this first page of digipeats, I continued the test for another 3 minutes:

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The screenshot shows the GreenCube Terminal interface for station IO-117. The top right corner displays station information: OZ9AAR, JO45ts, LOS: 01:05:28, 330,3° 11,7°, and Rng 9230 km R/T +3928/-3928. A small graph shows signal strength over time. The main window displays a log of transmissions with columns for Time (UTC), From, To, Message, and Delay. The log shows a high success rate for digipeat transmissions, with many entries showing 0 (100%) delay. The bottom status bar indicates the current mode is 'Normal' and shows the local time as 22:33 +/- DST.

Time (UTC)	From	To	Message	Delay
04:31:07	OZ9AAR	TEST	TEST	0 (100 %)
04:31:23	K5ENG	WC7V	TU 73 Charlie EL29	5 (100 %)
04:31:24	WC7V	OZ9AAR	UR 599 DN46	2 (100 %)
04:31:43	GreenCube	ALL	[TLM: eps/obc/radio boot=159/8334/503, Vbat=8,298V]	0 (100 %)
04:32:01	WC7V	OZ9AAR	UR 599 DN46	2 (100 %)
04:32:04	KB8CR	CQ	EM79UF Ohio	2 (100 %)
04:32:09	W6BVB	CQ	DM13 South CA	0 (100 %)
04:32:10	DJ7NT	KB8CR	599 J030 QSL?	0 (100 %)
04:32:10	OZ9AAR	WC7V	R73	0
04:32:13	OZ9AAR	WC7V	R73	0 (100 %)
04:32:21	OZ9AAR	TEST	TEST	0
04:32:23	KB8CR	DJ7NT	R 73 Logged>LOTW	2 (100 %)
04:32:24	OZ9AAR	TEST	TEST	0 (100 %)
04:32:28	RA9DA	CQ	M017	0 (100 %)
04:32:28	JH8FIH	DJ7NT	599 QN14qi	0 (100 %)
04:32:35	DJ7NT	KB8CR	599 J030 LotW OK R73	0 (100 %)
04:32:36	WC7V	OZ9AAR	73! LOTW op Kerry	2 (100 %)
04:32:37	W6AER	CQ	CM87	1 (100 %)
04:32:40	KJ7SXR	RA9DA	CN86SX, QSL?	0 (100 %)
04:32:48	N6PAZ	DJ7NT	DM05 CA	2 (100 %)
04:32:48	RA9DA	KJ7SXR	RRR/ 599 M017	0 (100 %)
04:32:55	KJ7SXR	RA9DA	Logged. Thanks, 73	0 (100 %)
04:32:56	N6UTC	DJ7NT	DM03 California qsl?	0 (100 %)
04:33:00	KD6RF	CQ	EM22 TEXAS	0 (100 %)
04:33:01	OZ9AAR	TEST	R73	0
04:33:03	RA9DA	KJ7SXR	QSL 73	0 (100 %)
04:33:06	R4WR	N6UTC	599 L066ck	0 (100 %)
04:33:09	OZ9AAR	WC7V	R73	0
04:33:12	OZ9AAR	WC7V	R73	0 (100 %)
04:33:13	GreenCube	ALL	[TLM: eps/obc/radio boot=159/8334/503, Vbat=8,298V]	0 (100 %)
04:33:15	OZ9AAR	TEST	TEST	0
04:33:18	OZ9AAR	TEST	TEST	0 (100 %)
04:33:19	KB8CR	RA9DA	EM79UF QSL?	2 (100 %)
04:33:23	DJ7NT	N6UTC	599 J030 LotW OK R73	0 (100 %)
04:33:24	N6UTC	R4WR	RR73 de DM03	0 (100 %)
04:33:27	RA9DA	KB8CR	RRR/ 599 M017	0 (100 %)
04:33:28	R4WR	N6UTC	RR 599 73!	0 (100 %)
04:33:35	KB8CR	RA9DA	R 73 Logged>LOTW	2 (100 %)
04:33:41	N6PAZ	DJ7NT	DM05 CA	2 (100 %)
04:33:45	RA9DA	KB8CR	QSL 73	0 (100 %)
04:33:49	DJ7NT	JH8FIH	599 J030 LotW OK R73	0 (100 %)
04:33:50	R4WR	CQ	L066	0 (100 %)
04:33:57	JH8FIH	DJ7NT	TU Logged 73	0 (100 %)
04:33:58	GreenCube	ALL	[TLM: eps/obc/radio boot=159/8334/503, Vbat=8,307V]	0 (100 %)
04:34:03	K5ENG	RA9DA	599 EL29 fm Charlie	5 (100 %)
04:34:08	AL7ID	CQ	BP64 Alaska	0 (100 %)
04:34:13	OZ9AAR	TEST	TEST	0
04:34:15	KB8CR	R4WR	EM79UF QSL?	2 (100 %)
04:34:16	OZ9AAR	TEST	TEST	0 (100 %)
04:34:16	OZ9AAR	TEST	TEST	0
04:34:19	OZ9AAR	TEST	TEST	0
04:34:22	OZ9AAR	TEST	TEST	0 (100 %)

The digipeat success for these two “pages” of transmission was at the time 71% success. The number of users on the satellite was now 17.

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I then waited around 7 minutes, and did another page of transmissions:

Time (UTC)	From	To	Message	Delay
04:41:02	XE1UYS	CQ	EK19	1 (100 %)
04:41:09	R4WR	CQ	LO66	0 (100 %)
04:41:12	UN7CL	CQ	MO44GW	5 (100 %)
04:41:12	K8DP	UY7VV	EN62	0 (100 %)
04:41:27	K6VHF	UY7VV	DM43 AZ?	0 (100 %)
04:41:28	GreenCube	ALL	[TLM: eps/obc/radio boot=159/8334/503, Vbat=8,270V]	0 (100 %)
04:41:34	I8IGS	CQ	JM78tc	1 (100 %)
04:41:35	OZ9AAR	TEST	TEST	0
04:41:38	OZ9AAR	TEST	TEST	0 (100 %)
04:41:40	OZ9AAR	TEST	TEST	0
04:41:44	OZ9AAR	TEST	TEST	0
04:41:48	OZ9AAR	TEST	TEST	0
04:41:51	OZ9AAR	TEST	TEST	0 (100 %)
04:41:59	I8IGS	CQ	JM78tc	1 (100 %)
04:42:00	N0JE	I8IGS	DN86 North Dakota	0 (100 %)
04:42:02	N6PAZ	I8IGS	DM05 CA	2 (100 %)
04:42:04	OZ9AAR	TEST	TEST	0
04:42:06	RA9DA	CQ	MO17	0 (100 %)
04:42:08	OZ9AAR	TEST	TEST	0
04:42:13	GreenCube	ALL	[TLM: eps/obc/radio boot=159/8334/503, Vbat=8,298V]	0 (100 %)
04:42:15	W6AER	I8IGS	CM87 QSL?	1 (100 %)
04:42:18	OZ9AAR	TEST	TEST	0
04:42:18	DG9MA	WC7V	JN58 QSL?	1 (100 %)
04:42:22	OZ9AAR	TEST	TEST	0 (100 %)
04:42:24	W6BVB	I8IGS	DM13 QSL?	1 (100 %)
04:42:26	OZ9AAR	TEST	TEST	0
04:42:31	OZ9AAR	TEST	TEST	0
04:42:32	I8IGS	W6AER	599 JM78TC ?	1 (100 %)
04:42:35	OZ9AAR	TEST	TEST	0 (100 %)
04:42:36	DJ7NT	UN7CL	599 JO30 QSL?	0 (100 %)
04:42:37	OZ9AAR	TEST	TEST	0
04:42:40	OZ9AAR	TEST	TEST	0
04:42:43	OZ9AAR	TEST	TEST	0
04:42:47	W6AER	I8IGS	RR Logged 73	1 (100 %)
04:42:48	OZ9AAR	TEST	TEST	0
04:42:50	UN7CL	DJ7NT	RR 599 MO44GW	5 (100 %)
04:42:51	OZ9AAR	TEST	TEST	0 (100 %)
04:42:58	GreenCube	ALL	[TLM: eps/obc/radio boot=159/8334/503, Vbat=8,307V]	0 (100 %)
04:42:58	K6VHF	I8IGS	DM43 AZ?	0 (100 %)
04:42:59	KB8CR	I8IGS	EM79UF QSL?	2 (100 %)
04:43:00	OZ9AAR	TEST	TEST	0
04:43:04	OZ9AAR	TEST	TEST	0
04:43:10	K9UO	UY7VV	EN70 IN	0 (100 %)
04:43:11	OZ9AAR	TEST	TEST	0
04:43:14	OZ9AAR	TEST	TEST	0 (100 %)
04:43:15	K8DP	UY7VV	EN62	0 (88 %)
04:43:20	N0JE	I8IGS	DN86 North Dakota	0 (100 %)
04:43:21	OZ9AAR	TEST	TEST	0
04:43:27	IW1FZR	CQ	JN45	0 (100 %)
04:43:28	OZ9AAR	TEST	TEST	0
04:43:31	OZ9AAR	TEST	TEST	0 (100 %)
04:43:33	W6BVB	I8IGS	DM13 OSI ?	1 (100 %)

Again, almost perfect digipeat success was the result!



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10 Minutes later, a new round of test messages was sent:

Time (UTC)	From	To	Message	Delay
04:53:23	OZ9AAR	TEST	TEST	0 (100 %)
04:53:26	OZ9AAR	TEST	TEST	0
04:53:28	GreenCube	ALL	[TLM: eps/obc/radio boot=159/8334/503, Vbat=8,298V]	0 (100 %)
04:53:29	OZ9AAR	TEST	TEST	0
04:53:32	OZ9AAR	TEST	TEST	0 (100 %)
04:53:37	IW1FZR	K5ENG	599 JN45BJ K	0 (100 %)
04:53:41	K6VHF	DG9MA	TU 73 Logged	0 (100 %)
04:53:42	OZ9AAR	TEST	TEST	0
04:53:49	UN7CL	I8IGS	599M044gw	5 (100 %)
04:53:50	OZ9AAR	TEST	TEST	0
04:53:54	OZ9AAR	TEST	TEST	0 (100 %)
04:54:01	WC7V	CQ	DN46 MT	2 (100 %)
04:54:04	4J6D	CQ	LN50	0 (100 %)
04:54:10	OZ9AAR	TEST	TEST	0
04:54:12	I8IGS	UN7CL	RR 73 TU/LOTW	1 (100 %)
04:54:13	GreenCube	ALL	[TLM: eps/obc/radio boot=159/8334/503, Vbat=8,279V]	0 (100 %)
04:54:14	OZ9AAR	TEST	TEST	0 (100 %)
04:54:17	RA9DA	CQ	MO17	0 (100 %)
04:54:26	W7QL	4J6D	599 DN40 Utah QSL?	2 (100 %)
04:54:27	K8DP	CQ	EN62vt	0 (100 %)
04:54:32	IW1FZR	K5ENG	599 JN45BJ K	0 (100 %)
04:54:33	OZ9AAR	TEST	TEST	0
04:54:36	OZ9AAR	TEST	TEST	0 (100 %)
04:54:40	KD6RF	CQ	EM22 TEXAS	0 (100 %)
04:54:45	4J6D	W7QL	R LN50 73	0 (100 %)
04:54:49	UN7CL	I8IGS	QSL TU 73	5 (100 %)
04:54:50	N7MJ	4J6D	WY DN71	0 (100 %)
04:54:58	GreenCube	ALL	[TLM: eps/obc/radio boot=159/8334/503, Vbat=8,298V]	0 (100 %)
04:54:58	I1FQH	K8DP	5nn JN45	5 (100 %)
04:55:01	K8DP	UY7VV	EN62	0 (100 %)
04:55:03	OZ9AAR	TEST	TEST	0
04:55:06	4J6D	W7QL	R LN50 73	0 (100 %)
04:55:07	OZ9AAR	TEST	TEST	0
04:55:10	UN7CL	CQ	MO44GW	5 (100 %)
04:55:11	OZ9AAR	TEST	TEST	0
04:55:14	W7QL	4J6D	RR 73 Log LoTW	2 (100 %)
04:55:15	OZ9AAR	TEST	TEST	0 (100 %)
04:55:21	K8DP	I1FQH	RRR EN62 QSL?	0 (100 %)
04:55:23	4J6D	W7QL	TU73 LOGD	0 (100 %)
04:55:36	K5ENG	UY7VV	TU 73 Charlie EL29	5 (100 %)
04:55:39	OZ9AAR	TEST	TEST	0
04:55:43	GreenCube	ALL	[TLM: eps/obc/radio boot=159/8334/503, Vbat=8,298V]	0 (100 %)
04:55:44	OZ9AAR	TEST	TEST	0
04:55:47	OZ9AAR	TEST	TEST	0 (100 %)
04:55:51	4J6D	N7MJ	R LN50 73	0 (100 %)
04:55:57	OZ9AAR	TEST	TEST	0
04:56:00	OZ9AAR	TEST	TEST	0 (100 %)
04:56:00	I1FQH	K8DP	5nn JN45	5 (100 %)
04:56:05	OZ9AAR	TEST	TEST	0
04:56:06	IW1FZR	K5ENG	599 JN45BJ K	0 (38 %)
04:56:07	OZ9AAR	TEST	TEST	0 (100 %)

Again, a perfect digipeat result with only a few missing digipeats (even with very few users there will be collisions, can also happen with telemetry packets from the satellite).

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The number of users active on the satellite at that time:

Call	Grid	T.Since	#CQ	Ele	State	LoTW
4Z1JJ	KM71	00:09	2	15,0°		*
I8IGS	JM78	00:17	4	34,8°		*
K8DP	EN62	00:24	3	16,8°	MI	*
N7MJ	DN71	00:27	0	3,8°	WY	*
KD6RF	EM22	00:35	4	2,1°	TX	*
4J6D	LN50	00:36	1	12,6°		*
IW1FZR	JN45	00:45	3	49,1°		*
I1FQH	JN45	00:53	0	49,1°		*
WC7V	DN46	01:03	6	4,6°	MT	*
UN7CL	M044	01:10	11	13,7°		*
KB8CR	EM79	01:20	1	15,0°	OH	*
YO3APJ	KN25	02:10	3	35,5°		*
K9UO	EN70	02:44	2	14,6°	IN	*
K5ENG	EL29	04:23	0	-0,2°		*
W7QL	DN40	04:45	0	0,0°	UT	*
RA9DA	M017	05:42	8	18,7°		*
K6VHF	DM43	06:18	1	-5,3°	AZ	*
YO2CMI	KN05	06:37	0	38,8°		*
DG9MA	JN58	07:04	0	50,8°		*
K9JKM	EN52	07:20	0	13,7°	IL	*
R4WR	LO66	08:20	8	23,8°		*
DJ7NT	J030	09:43	0	56,7°		*
W0JW	EN31	10:27	0	10,5°	IA	*
W6AER	CM87	10:32	2	-7,8°	CA	*
N0JE	DN86	11:07	0	8,8°	ND	*
N6PAZ	DM05	12:15	2	-6,8°	CA	*
AL7ID	BP64	12:35	2	6,0°	AK	*
XE1UYS	EK19	14:26	3	-8,9°		*
W6BVB	DM13	14:49	1	-8,1°	CA	*
N6RVI	DM12	15:12	0	-8,9°	CA	*
UY7VV	--	20:13	0	--		*
KJ7SXR	CN86	22:02	0	0,6°	WA	*
JH8FIH	QN14	24:00	2	-17,5°		*
N6UTC	DM03	26:35	0	-9,0°	CA	*

g connected Dupe Grid Initial COSI UTC 04-10-23 04:59:58 UTC

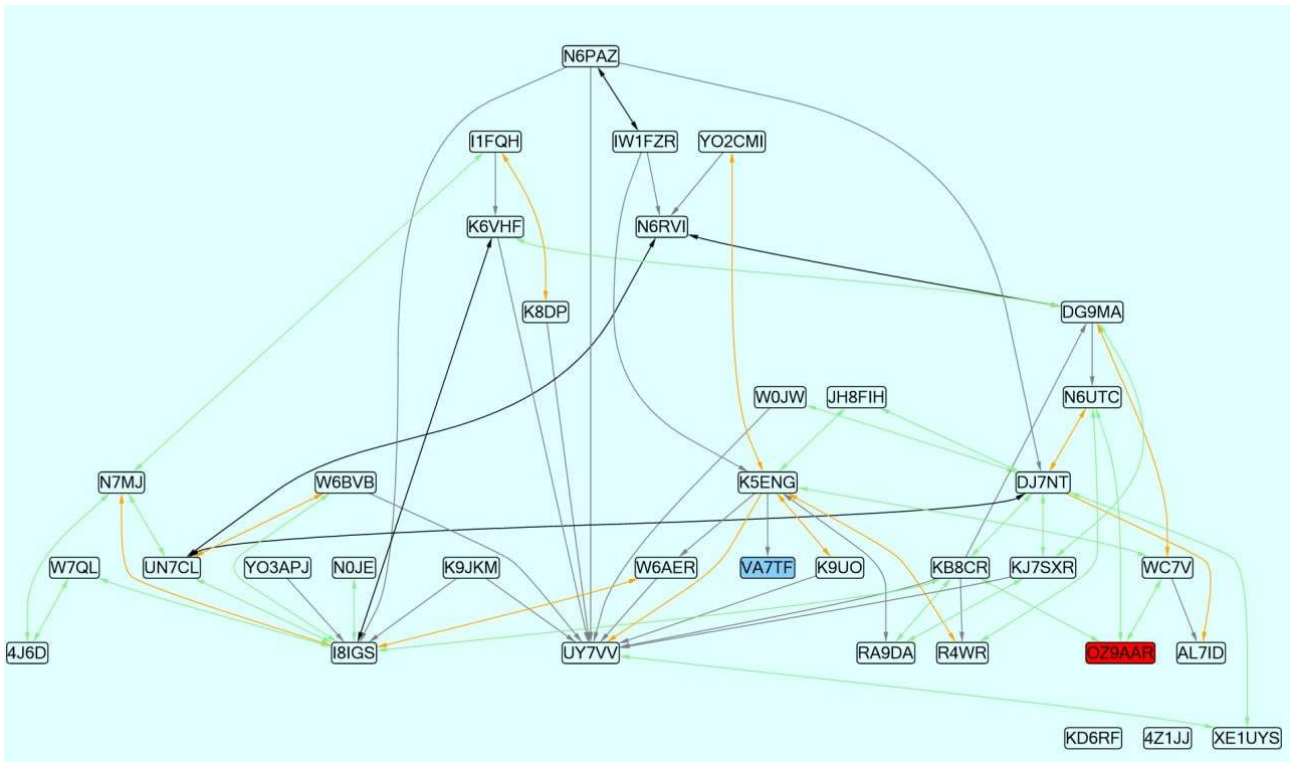


# IO-117 and Digipeat success rate

Testing on a non-congested pass

By OZ9AAR – 2023-04-13

The QSO's that had been made at that point:



# IO-117 and Digipeat success rate

Testing on a non-congested pass

By OZ9AAR – 2023-04-13

## At TCA

At maximum elevation (around 35 minutes since AOS), another round of transmission was done:

The screenshot shows the GreenCube Terminal interface with the following statistics:

- Station info: IO-117, OZ9AAR, JO45ts, LOS: 00:35:38, 256,2° 60,7°, Rng 6254 km R/T -159/+159
- Statistics: Unique call signs: 35, My own TX: 13 (00:00:11), My own RX: 9 (00:00:08), My digipeat success: 69.2%, My RCQ: 0 (---), Dispeated pkt. RX: 32, Telemetry pkt. RX: 4, GC Terminal users: 22, Average Signal Quality: 98.0%, TLM RX RQ value: 98.9%

The main log table shows the following data:

Time (UTC)	From	To	Message	Delay
05:02:13	IW1FZR	CQ	JN45	0 (100 %)
05:02:23	UN7CL	CQ	M044GN	5 (100 %)
05:02:28	GreenCube	ALL	[TLM: eps/obc/radio boot=159/8334/503, Vbat=8,298V]	0 (100 %)
05:02:28	I3BUI	ALL	CQ JN55TR	0 (100 %)
05:02:30	OZ9AAR	TEST	TEST	0
05:02:37	OZ9AAR	TEST	TEST	0
05:02:40	OZ9AAR	TEST	TEST	0 (100 %)
05:02:45	OZ9AAR	TEST	TEST	0
05:02:47	DG9MA	CQ	JN58	1 (100 %)
05:02:48	OZ9AAR	TEST	TEST	0 (100 %)
05:02:57	OZ9AAR	TEST	TEST	0
05:02:58	N7MJ	I3BUI	WY DN71	0 (81 %)
05:03:01	OZ9AAR	TEST	TEST	0
05:03:04	OZ9AAR	TEST	TEST	0
05:03:07	OZ9AAR	TEST	TEST	0 (100 %)
05:03:08	KC7V	CQ	DN46 MT	2 (100 %)
05:03:12	DG9MA	I1FQH	R JN58 QSL?	1 (100 %)
05:03:13	GreenCube	ALL	[TLM: eps/obc/radio boot=159/8334/503, Vbat=8,298V]	0 (100 %)
05:03:16	OZ9AAR	TEST	TEST	0
05:03:18	I1FQH	DG9MA	5nn JN45	5 (100 %)
05:03:19	OZ9AAR	TEST	TEST	0 (100 %)
05:03:22	I1FQH	DG9MA	5nn JN45	5 (100 %)
05:03:28	UN7CL	CQ	M044GN	5 (100 %)
05:03:29	K8DP	CQ	EN62vt	0 (100 %)
05:03:33	I8IGS	YO3APJ	599 JM78TC ?	1 (100 %)
05:03:36	OZ9AAR	TEST	TEST	0
05:03:39	OZ9AAR	TEST	TEST	0 (100 %)
05:03:39	DG9MA	I1FQH	R JN58 QSL?	1 (88 %)
05:03:44	YO3APJ	CQ	KN25	0 (100 %)
05:03:52	I8IGS	YO3APJ	599 JM78TC ?	1 (100 %)
05:03:52	4J6D	CQ	LN50	0 (100 %)
05:03:54	I1FQH	DG9MA	QSL LOTW	5 (100 %)
05:03:58	GreenCube	ALL	[TLM: eps/obc/radio boot=159/8334/503, Vbat=8,307V]	0 (88 %)
05:03:58	R4WR	CQ	LO66	0 (100 %)
05:04:08	DG9MA	I1FQH	R TU 73! Lotw	1 (100 %)
05:04:09	IW1FZR	I8IGS	599 JN45BJ K	0 (100 %)
05:04:16	4Z1JJ	CQ	KN71mv	0 (100 %)
05:04:17	OZ9AAR	TEST	TEST	0
05:04:20	OZ9AAR	TEST	TEST	0
05:04:23	OZ9AAR	TEST	TEST	0 (100 %)
05:04:29	DG9MA	I1FQH	R TU 73! Lotw	1 (100 %)
05:04:43	GreenCube	ALL	[TLM: eps/obc/radio boot=159/8334/503, Vbat=8,298V]	0 (100 %)
05:04:46	UN7CL	CQ	M044GN	5 (100 %)
05:04:48	OZ9AAR	ALL	SRI for all TEST, checking congestion :)	0
05:04:52	OZ9AAR	ALL	SRI for all TEST, checking congestion :)	0 (100 %)
05:04:57	I8IGS	IW1FZR	599 JM78TC ?	1 (100 %)
05:04:59	OZ9AAR	ALL	SRI for all TEST, checking congestion :)	0
05:05:03	OZ9AAR	ALL	SRI for all TEST, checking congestion :)	0 (100 %)
05:05:07	OZ9AAR	TEST	TEST	0
05:05:09	I3BUI	ALL	CQ JN55TR	0 (100 %)
05:05:10	OZ9AAR	TEST	TEST	0 (100 %)

The right-hand table shows a list of active users with columns: Call, Grid, T.Since, #CQ, Ele, State, LoTW.

The digipeat rate for this session was 69%, still a very good number. There were now 36 active users on the satellite.

# IO-117 and Digipeat success rate

Testing on a non-congested pass

By OZ9AAR – 2023-04-13

5 minutes later, a new round (on this you can also see the coverage of the satellite at the time of the test)

The screenshot displays a satellite tracking application. The main window shows a world map with a satellite's ground track. A callout box for IO-117 provides the following data: LOS: 00:28:18, Az: 220.1°, El: 52.1°, Range: 6541 km, and a range rate of -17.6°.

At the bottom of the map, the current satellite position is shown as Az=220.2 El=52.1 and UTC 05:12:39.

On the right side, there are two circular diagrams showing the satellite's elevation and azimuth coverage. Below these is a status window for OZ9AAR JO45ts, showing a signal strength of 84.0% and a range of 6541 km.

The bottom portion of the screenshot shows a log of received messages. The log table is as follows:

Time (UTC)	From	To	Message	Delay
05:10:43	GreenCube	ALL	[TLR: eps/obc/radio boot=159/8334/503, Vbat=8,279V]	0 (100 %)
05:10:50	OZ9AAR	TEST	TEST	0
05:10:53	OZ9AAR	TEST	TEST	0 (100 %)
05:10:54	OZ9AAR	TEST	TEST	0 (100 %)
05:10:56	OZ9AAR	TEST	TEST	0 (100 %)
05:10:57	OZ9AAR	TEST	TEST	0
05:11:00	OZ9AAR	TEST	TEST	0 (100 %)
05:11:01	OZ9AAR	TEST	TEST	0
05:11:09	OZ9AAR	TEST	TEST	0
05:11:13	OZ9AAR	TEST	TEST	0 (100 %)
05:11:16	OZ9AAR	TEST	TEST	0 (100 %)
05:11:22	OZ9AAR	TEST	TEST	0 (100 %)
05:11:25	OZ9AAR	TEST	TEST	0 (100 %)
05:11:28	GreenCube	ALL	[TLR: eps/obc/radio boot=159/8334/503, Vbat=8,298V]	0 (100 %)
05:11:29	OZ9AAR	TEST	TEST	0
05:11:32	OZ9AAR	TEST	TEST	0 (100 %)
05:11:37	OZ9AAR	TEST	TEST	0
05:11:40	OZ9AAR	TEST	TEST	0 (100 %)
05:11:45	IM1FZR	CQ	test	0 (100 %)
05:11:48	UN7CL	CQ	NO44GM	5 (100 %)
05:11:51	OZ9AAR	TEST	TEST	0 (100 %)
05:11:54	OZ9AAR	TEST	TEST	0 (100 %)
05:12:00	UN7CL	CQ	NO44GM	5 (100 %)
05:12:02	OZ9AAR	TEST	TEST	0
05:12:03	UN7CL	CQ	NO44GM	5 (100 %)
05:12:04	OZ9AAR	TEST	TEST	0
05:12:08	OZ9AAR	TEST	TEST	0
05:12:13	GreenCube	ALL	[TLR: eps/obc/radio boot=159/8334/503, Vbat=8,307V]	0 (88 %)
05:12:13	OZ9AAR	TEST	TEST	0
05:12:18	436D	CQ	UN80	0 (100 %)
05:12:21	OZ9AAR	TEST	TEST	0 (100 %)
05:12:24	OZ9AAR	TEST	TEST	0 (100 %)
05:12:30	IM1FZR	CQ	1% PWR ic9700	0 (100 %)

Again, almost perfect digipeat success, 85%. Number of users still 36.



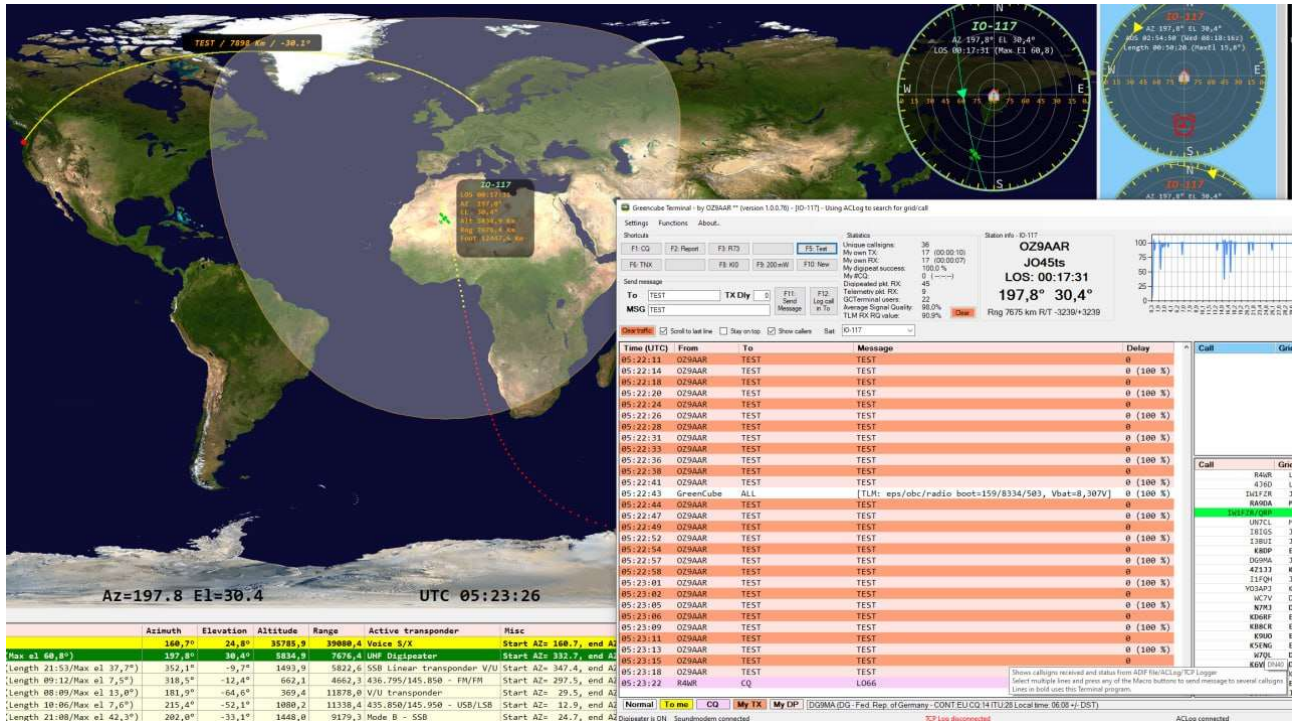
# IO-117 and Digipeat success rate

Testing on a non-congested pass

By OZ9AAR – 2023-04-13

## At LOS

Satellite was now closer to LOS, approx. 15 min before LOS I did another test:



This yielded a success rate of 100%, all my transmitted packets were digipeated! You can also see that I am almost completely alone on the satellite during this test.

# IO-117 and Digipeat success rate

Testing on a non-congested pass

By OZ9AAR – 2023-04-13

Next test, 7 min to LOS:

The screenshot shows a radio software interface with a world map on the left and a control panel on the right. The map displays a satellite pass over Europe and Africa, with a call sign 'IO-117' and a 'TEST' message. The control panel shows station information for 'OZ9AAR JO45ts' and a log of digipeat messages. The log table is as follows:

Time (UTC)	From	To	Message	Delay
05:32:25	OZ9AAR	TEST	TEST	0 (0 %)
05:32:45	OZ9AAR	TEST	TEST	0
05:32:48	OZ9AAR	TEST	TEST	0 (81 %)
05:32:49	OZ9AAR	TEST	TEST	0
05:32:51	OZ9AAR	TEST	TEST	0 (100 %)
05:32:52	OZ9AAR	TEST	TEST	0
05:32:55	OZ9AAR	TEST	TEST	0 (75 %)
05:32:56	OZ9AAR	TEST	TEST	0
05:32:58	OZ9AAR	TEST	TEST	0 (69 %)
05:33:02	OZ9AAR	TEST	TEST	0 (75 %)
05:33:03	OZ9AAR	TEST	TEST	0
05:33:05	OZ9AAR	TEST	TEST	0 (94 %)
05:33:06	OZ9AAR	TEST	TEST	0
05:33:09	OZ9AAR	TEST	TEST	0 (94 %)
05:33:10	OZ9AAR	TEST	TEST	0 (100 %)
05:33:13	OZ9AAR	TEST	TEST	0
05:33:13	OZ9AAR	TEST	TEST	0 (100 %)
05:33:16	OZ9AAR	TEST	TEST	0 (100 %)
05:33:17	OZ9AAR	TEST	TEST	0
05:33:20	OZ9AAR	TEST	TEST	0 (100 %)
05:33:24	OZ9AAR	TEST	TEST	0 (100 %)
05:33:24	OZ9AAR	TEST	TEST	0 (100 %)
05:33:26	OZ9AAR	TEST	TEST	0
05:33:27	OZ9AAR	TEST	TEST	0 (100 %)
05:33:28	GreenCube	ALL	[TLR: eps/obc/radio boot=159/8334/50], Vbat=8,307V]	0 (100 %)
05:33:29	OZ9AAR	TEST	TEST	0 (100 %)
05:33:32	OZ9AAR	TEST	TEST	0
05:33:33	OZ9AAR	TEST	TEST	0 (100 %)
05:33:36	OZ9AAR	TEST	TEST	0 (94 %)

Again, I'm alone, and 100% digipeat success.

# IO-117 and Digipeat success rate

Testing on a non-congested pass

By OZ9AAR – 2023-04-13

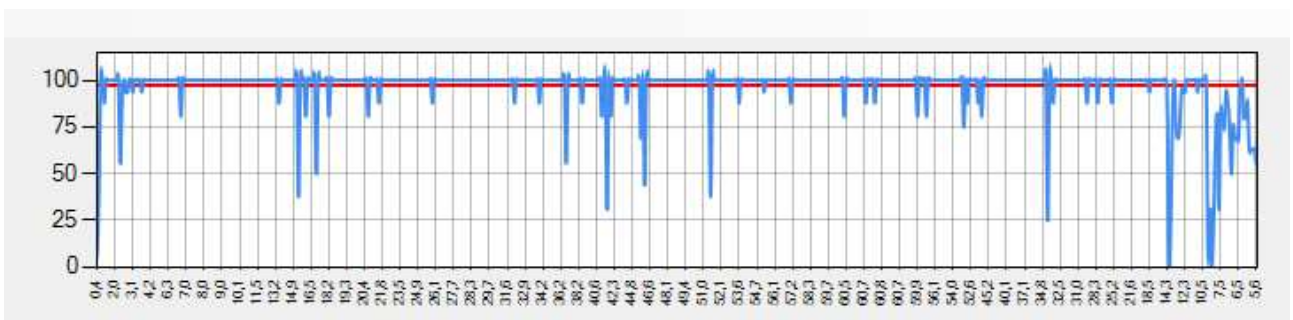
Finally, right at LOS, again I was completely alone:

The screenshot shows the GreenCube Terminal software interface. On the left, a world map displays the satellite path for IO-117, with a callout box showing: LOS 00:03:35, AZ 187.2°, EL 5.5°, Alt 9810.0 km, Range 39880.1 km, Foot 92447.3 km. Below the map, a table lists active transponders with columns for Azimuth, Elevation, Altitude, Range, Active transponder, and Misc. The main window shows a log of messages, with a 'Call' list on the right. The log shows a series of 'TEST' messages from OZ9AAR to various stations, all with a delay of 0. The 'Call' list shows a 100% digipeat success rate for the IO-117 pass.

Azimuth	Elevation	Altitude	Range	Active transponder	Misc
160,7°	24,8°	35785,6	39880,1	Voice S/X	Start AZ= 166
214,9°	1,4°	621,0	2726,8	436.795/145.850 - FH/FH	Start AZ= 297
117,7°	7,5°	5134,4	3910,3	DMR Digipeater	Start AZ= 335
288,7°	37,1°	1517,0	2191,3	558 Linear Transponder V/U	Start AZ= 347
e:1 13,0°	284,6°	-81,1°	365,5	12947,2 V/U transponder	Start AZ= 25
e:1 7,6°	189,8°	-75,4°	1279,5	13615,0 435.850/145.950 - USB/LSB	Start AZ= 12
e:1 42,3°	203,5°	-59,2°	1465,3	12568,7 Mode B - 55B	Start AZ= 24
e:1 13,8°	318,8°	-43,7°	688,5	0661,3 FM Voice 11/U	Start AZ= 114

And again, 100% digipeat success rate!

The signal quality during the complete pass was not “perfect”, there were some fades as the almost always is. But it was not a “perfect unrealistic pass” in any way, I have often seen passes with better signal quality than this:





# IO-117 and Digipeat success rate

Testing on a non-congested pass

By OZ9AAR – 2023-04-13

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## The TX uplink frequency

One of my many good friends in the satellite community, John DK9JC suggested to try and offset the TX frequency to the satellite to see if that would have a large impact on the success. I did some simple tests where I offset only the TX frequency to the satellite. It was adjusted in steps of 50 Hz; I tried both positive and negative offsets. I stopped the tests when I was at +/- 550 Hz. Even with the transmit signal to the satellite 550 Hz too high or 550 Hz too low, the satellite would still digipeat the messages I sent to it.

## What's the bandwidth?

As IO-117 is running (normally) 1200 baud, it is (very) limited how much data can pass the satellite pr time. Its easy to calculate the needed time for a certain amount of data, or just measure the actual "airtime" needed. If sending a simple "OZ9AAR CQ JO45" message out, I measured 591 mS of true data. If we then add 100 mS for TXDelay in Soundmodem (a typical value that is being used), we arrive at approx. 700 mS for one single transmission.

To calculate how many "RX&TX" packets can be handled pr time, we double this amount (as we both TX to the satellite and the satellite TX to ground). We also assume that there is a delay between packets from the satellite of 1 second (as an average). This brings us up to approx. 1.5 seconds pr "TX&RX" frame. Adding overhead, room for telemetry frames etc., we set the time required for a complete "TX&RX" packet to 3 seconds (which is probably a bit optimistic).

The pass shown above had a length of 1h12m (72 minutes = 4320 seconds). This means that we could squeeze  $4320/3 = 1440$  complete frames in this time. This is unrealistic, typical very busy passes sees around half this number of frames from the satellite. Nevertheless, we keep 1400 complete frames as the possible number in a 1h12m pass.

In a busy pass of more than 1 hour length, we often see 60 active users. Some of these users does not have foot print all the time, but to keep things simple, we assume that 50 users can "see" the satellite during the 1h12m pass. Let's also assume that these 50 users send 200 messages each. 200 messages sound like a lot, but from experience, this is not completely unrealistic in a crowded pass where LOTS of packets gets lost due to collisions. This is a total of 10.000 messages transmitted to the satellite.

We just calculated that the maximum possible number of packets from the satellite is 1400. You see the problem? We will have endless amounts of collisions! Due to the nature of the communication (SSB, the modem used etc.) it is so that if 2 stations transmit to the satellite at the same time, the "strongest" station will win. If one stations is not a lot stronger than the other, the satellite simply does not hear any of the stations. This is often the case on busy passes. This can be detected as the satellite is not sending any packets to the ground, this is because all packets sent to the satellite is simply lost because of collisions. The tendency on busy passes is also that all users get frustrated, they send even more packets rapidly in the hopes to get digipeated, leading to even more collisions. It's an endless fight.

# IO-117 and Digipeat success rate

Testing on a non-congested pass

By OZ9AAR – 2023-04-13

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## Conclusion

This is of course only one test performed on 1 pass, but since IO-117/GreenCube became active, I have often tried similar (although at a smaller scale) tests, and always seen the same tendency, when only few users are on, digipeat success was always very high. On passes with many users and/or rare DXCC/Grids, it would become almost impossible to be digipeated.

I would also like to note that on quiet passes, I can get packets digipeated with as little as 200 mW at the antenna feed-point, this corresponds to only 7 Watt EIRP!

**So, from this pass I can conclude that IO-117/Greencube is in excellent shape (as it always has been)!**