

Supplementary decoding outcomes for “Beyond TEMPEST: Workload-Modulated Power-Quality Covert Channels in Air-Gapped Systems

Scope and interpretation

This supplement reports the complete decoding outcomes for the evaluated transmissions. Each table identifies the payload, symbol duration, PSU topology, receiver placement, and receiver feature. Harmonics, power factor, active power, and apparent power are evaluated as alternative observables extracted from the corresponding synchronized voltage-current capture.

The BER values are the fractions of differing bits reported by the decoder for the corresponding frame. Where present, the value in parentheses is the observed number of differing bits. In the “Outcome” column, “Yes” denotes payload recovery with valid Reed–Solomon verification. “No” denotes that a valid payload was not recovered. “RS invalid” denotes a candidate recovery that failed Reed–Solomon verification. RS-invalid entries are excluded from the successful-decode counts reported in the main manuscript.

1 No Power Factor Correction Power Supply

Table 1: Decoding outcomes for Test 4 (ASCII string payload) – no-PFC PSU.

Location	Feature	T_s (s)	SNR (dB)	Observed BER	Outcome
At PSU	3rd dBc	2	6.77	0.5278 (76)	No
At PSU	5th dBc	2	8.30	1	No
At PSU	7th dBc	2	9.11	0.1319 (19)	No
At PSU	11th dBc	2	9.33	1	No
At PSU	3rd RMS	2	20.00	0.0208 (3)	No
At PSU	5th RMS	2	19.34	0.0278 (4)	No
At PSU	7th RMS	2	22.32	0.1528 (22)	No
At PSU	11th RMS	2	19.63	0.0417 (6)	No
At PSU	PF	2	10.00	1	No
At PSU	Apparent power	2	21.42	0	Yes
At PSU	Active power	2	18.97	0.007 (1)	Yes
Office-level	3rd dBc	2	8.8392	1	No
Office-level	5th dBc	2	18.1479	0.042 (6)	No
Office-level	7th dBc	2	19.9559	0.049 (7)	No
Office-level	11th dBc	2	14.1316	0	Yes
Office-level	3rd RMS	2	13.08	0	Yes
Office-level	5th RMS	2	13.31	1	No

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Location	Feature	T_s (s)	SNR (dB)	Observed BER	Outcome
Office-level	7th RMS	2	17.01	0.1528 (22)	No
Office-level	11th RMS	2	19.95	0	Yes
Office-level	PF	2	10.4453	0.0208 (3)	No
Office-level	Apparent power	2	17.1188	0	Yes
Office-level	Active power	2	16.7393	0	Yes

Table 2: Decoding outcomes for Tests 5 and 6 (AES-128 payload, $T_s = 2$ s and $T_s = 1$ s) – no-PFC PSU.

Location	Feature	T_s (s)	SNR (dB)	Observed BER	Outcome
At PSU	3rd dBc	1	5.83	1	No
At PSU	3rd dBc	2	5.83	0.5096 (53)	No
At PSU	5th dBc	1	9.54	1	No
At PSU	5th dBc	2	9.54	0.5547 (71)	No
At PSU	7th dBc	1	11.18	0.3906 (50)	No
At PSU	7th dBc	2	11.18	0	Yes
At PSU	11th dBc	1	11.35	0.3828 (49)	No
At PSU	11th dBc	2	11.35	0.0156 (2)	Yes
At PSU	3rd RMS	1	20.96	0.0078 (1)	Yes
At PSU	3rd RMS	2	20.96	0	Yes
At PSU	5th RMS	1	20.26	0.1250 (16)	No
At PSU	5th RMS	2	20.26	0	Yes
At PSU	7th RMS	1	21.72	0.0078 (1)	Yes
At PSU	7th RMS	2	21.72	0.0313 (4)	No
At PSU	11th RMS	1	19.84	0.1953 (25)	No
At PSU	11th RMS	2	19.84	0	Yes
At PSU	PF	1	11.51	0.3906 (50)	No
At PSU	PF	2	11.51	0.3671 (47)	No
At PSU	Apparent power	1	22.28	0.4062 (52)	No
At PSU	Apparent power	2	22.28	0	Yes
At PSU	Active power	1	19.47	0.3984 (51)	No
At PSU	Active power	2	19.47	0	Yes
Office-level	3rd dBc	1	8.72	0.4766 (61)	No
Office-level	3rd dBc	2	8.72	1	No
Office-level	5th dBc	1	17.26	0	Yes
Office-level	5th dBc	2	17.26	0	Yes
Office-level	7th dBc	1	19.30	0.0156 (2)	Yes
Office-level	7th dBc	2	19.30	0	Yes
Office-level	11th dBc	1	16.04	0.0234 (3)	No
Office-level	11th dBc	2	16.04	0.0938 (12)	No
Office-level	3rd RMS	1	12.80	0	Yes
Office-level	3rd RMS	2	12.80	0	Yes
Office-level	5th RMS	1	12.56	0	Yes
Office-level	5th RMS	2	12.56	0.5391 (69)	No
Office-level	7th RMS	1	19.25	0.2186 (28)	No

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Table 2 – continued from previous page

Location	Feature	T_s (s)	SNR (dB)	Observed BER	Outcome
Office-level	7th RMS	2	19.25	0	Yes
Office-level	11th RMS	1	20.08	0.0781 (1)	Yes
Office-level	11th RMS	2	20.08	0.0469 (6)	No
Office-level	PF	1	10.07	0	RS invalid
Office-level	PF	2	10.07	0.0469 (6)	No
Office-level	Apparent power	1	15.23	0	Yes
Office-level	Apparent power	2	15.23	0	Yes
Office-level	Active power	1	15.07	0	Yes
Office-level	Active power	2	15.07	0	Yes

Table 3: Decoding outcomes for Test 7 (ECDSA secp256k1 secret-key payload) – no-PFC PSU.

Location	Feature	T_s (s)	SNR (dB)	Observed BER	Outcome
At PSU	3rd dBc	2	6.28	1	No
At PSU	5th dBc	2	8.90	0.5039 (129)	No
At PSU	7th dBc	2	10.14	0.004 (1)	Yes
At PSU	11th dBc	2	9.75	0.070 (18)	No
At PSU	3rd RMS	2	21.47	0	Yes
At PSU	5th RMS	2	20.37	0	Yes
At PSU	7th RMS	2	21.18	0.0078 (2)	Yes
At PSU	11th RMS	2	19.76	0	Yes
At PSU	PF	2	9.95	0.4531 (116)	No
At PSU	Apparent power	2	22.93	0	Yes
At PSU	Active power	2	20.03	0	Yes
Office-level	3rd dBc	2	8.47	0.5398 (95)	No
Office-level	5th dBc	2	19.49	0.0508 (13)	No
Office-level	7th dBc	2	19.23	0.1797 (46)	No
Office-level	11th dBc	2	14.33	0	Yes
Office-level	3rd RMS	2	17.11	0	Yes
Office-level	5th RMS	2	17.12	0.1758 (45)	No
Office-level	7th RMS	2	18.55	0.1406 (36)	No
Office-level	11th RMS	2	18.91	0	Yes
Office-level	PF	2	10.10	0.0469 (12)	No
Office-level	Apparent power	2	16.50	0.0078 (2)	Yes
Office-level	Active power	2	15.63	0	Yes

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Table 4: Decoding outcomes for Test 4 (ASCII string payload) – passive-PFC PSU.

Location	Feature	T_s (s)	SNR (dB)	Observed BER	Outcome
At PSU	3rd dBc	2	7.10	0.465 (67)	No
At PSU	5th dBc	2	9.24	0.007 (1)	Yes

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Table 4 – continued from previous page

Location	Feature	T_s (s)	SNR (dB)	Observed BER	Outcome
At PSU	7th dBc	2	9.68	0.097 (14)	No
At PSU	11th dBc	2	9.024	0.0694 (10)	No
At PSU	3rd RMS	2	20.38	0.1944 (28)	No
At PSU	5th RMS	2	18.89	0.0208 (3)	Yes
At PSU	7th RMS	2	14.66	0.0903 (13)	No
At PSU	11th RMS	2	12.63	0.0069 (1)	Yes
At PSU	PF	2	10.21	0.0347 (5)	No
At PSU	Active power	2	19.25	0.007 (1)	Yes
Office-level	3rd dBc	2	9.76	0.0208 (3)	No
Office-level	5th dBc	2	8.43	0.475 (57)	No
Office-level	7th dBc	2	10.13	0.0347 (5)	No
Office-level	11th dBc	2	10.90	0	Yes
Office-level	3rd RMS	2	17.58	0.0138 (2)	Yes
Office-level	5th RMS	2	16.45	0	Yes
Office-level	7th RMS	2	8.23	1	No
Office-level	11th RMS	2	8.78	1	No
Office-level	PF	2	8.62	0.4722 (68)	No
Office-level	Apparent power	2	16.68	0.007 (1)	Yes
Office-level	Active power	2	15.45	0.007 (1)	Yes

Table 5: Decoding outcomes for Tests 5 and 6 (AES-128 payload, $T_s = 2$ s and $T_s = 1$ s) – passive-PFC PSU.

Location	Feature	T_s (s)	SNR (dB)	Observed BER	Outcome
At PSU	3rd dBc	1	6.50	1	No
At PSU	3rd dBc	2	6.50	1	No
At PSU	5th dBc	1	10.37	0.0313 (4)	No
At PSU	5th dBc	2	10.37	0	RS invalid
At PSU	7th dBc	1	11.16	0.008 (1)	Yes
At PSU	7th dBc	2	11.16	0.0781 (10)	No
At PSU	11th dBc	1	9.76	0.0625 (8)	No
At PSU	11th dBc	2	9.76	0.0625 (8)	No
At PSU	3rd RMS	1	21.46	0	Yes
At PSU	3rd RMS	2	21.46	0	Yes
At PSU	5th RMS	1	19.91	0	Yes
At PSU	5th RMS	2	19.91	0	Yes
At PSU	7th RMS	1	15.56	0	Yes
At PSU	7th RMS	2	15.56	0	Yes
At PSU	11th RMS	1	12.75	0.0078 (1)	Yes
At PSU	11th RMS	2	12.75	0	Yes
At PSU	PF	1	12.02	0	Yes
At PSU	PF	2	12.02	0.0078 (1)	Yes
At PSU	Apparent power	1	21.62	0	Yes
At PSU	Apparent power	2	21.62	0	Yes

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Table 5 – continued from previous page

Location	Feature	T_s (s)	SNR (dB)	Observed BER	Outcome
At PSU	Active power	1	19.80	0	Yes
At PSU	Active power	2	19.80	0	Yes
Office-level	3rd dBc	1	10.55	0	Yes
Office-level	3rd dBc	2	10.55	0.008 (1)	No
Office-level	5th dBc	1	8.73	1	No
Office-level	5th dBc	2	8.73	0.1875 (24)	No
Office-level	7th dBc	1	10.79	0.008 (1)	Yes
Office-level	7th dBc	2	10.79	0	Yes
Office-level	11th dBc	1	8.52	0.0156 (2)	Yes
Office-level	11th dBc	2	8.52	0.5 (64)	No
Office-level	3rd RMS	1	19.30	0	Yes
Office-level	3rd RMS	2	19.30	0	Yes
Office-level	5th RMS	1	17.44	0.0078 (1)	Yes
Office-level	5th RMS	2	17.44	0	Yes
Office-level	7th RMS	1	8.39	1	No
Office-level	7th RMS	2	8.39	0.3984 (51)	No
Office-level	11th RMS	1	8.44	0.4922 (63)	No
Office-level	11th RMS	2	8.44	0.4297 (55)	No
Office-level	PF	1	8.73	0.3906 (59)	No
Office-level	PF	2	8.73	0.4772 (42)	No
Office-level	Apparent power	1	17.10	0.0078 (1)	Yes
Office-level	Apparent power	2	17.10	0	Yes
Office-level	Active power	1	15.68	0.0078 (1)	Yes
Office-level	Active power	2	15.68	0	Yes

Table 6: Decoding outcomes for Test 7 (ECDSA secp256k1 secret-key payload) – passive-PFC PSU.

Location	Feature	T_s (s)	SNR (dB)	Observed BER	Outcome
At PSU	3rd dBc	2	7.20	0.5 (124)	No
At PSU	5th dBc	2	9.82	0.0117 (3)	No
At PSU	7th dBc	2	10.64	0.0156 (4)	No
At PSU	11th dBc	2	9.36	0.0039 (1)	Yes
At PSU	3rd RMS	2	21.86	0	Yes
At PSU	5th RMS	2	20.08	0	Yes
At PSU	7th RMS	2	15.11	0.0039 (1)	Yes
At PSU	11th RMS	2	12.44	0.0039 (1)	Yes
At PSU	PF	2	10.88	0.0234 (6)	No
At PSU	Apparent power	2	21.96	0.0742 (19)	No
At PSU	Active power	2	20.00	0	Yes
Office-level	3rd dBc	2	7.20	0.0156 (4)	No
Office-level	5th dBc	2	9.82	0.4 (48)	No
Office-level	7th dBc	2	10.64	0.0156 (4)	No
Office-level	11th dBc	2	9.36	0.0664 (17)	No
Office-level	3rd RMS	2	18.77	0.2188 (56)	No

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Location	Feature	T_s (s)	SNR (dB)	Observed BER	Outcome
Office-level	5th RMS	2	17.72	0	Yes
Office-level	7th RMS	2	8.57	0.4861 (70)	No
Office-level	11th RMS	2	8.50	0.2070 (53)	No
Office-level	PF	2	10.87	0.5903 (85)	No
Office-level	Apparent power	2	21.96	0.2344 (60)	No
Office-level	Active power	2	20.00	0.2305 (59)	No

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Table 7: Decoding outcomes for Test 4 (ASCII string payload) – active-PFC PSU.

Location	Feature	T_s (s)	SNR (dB)	Observed BER	Outcome
At PSU	3rd dBc	2	7.25	0.2708 (39)	No
At PSU	5th dBc	2	8.72	0.0278 (4)	No
At PSU	7th dBc	2	8.46	0.4375 (63)	No
At PSU	11th dBc	2	8.52	0.4931 (71)	No
At PSU	3rd RMS	2	9.03	0.0278 (4)	No
At PSU	5th RMS	2	9.01	0.4931 (71)	No
At PSU	7th RMS	2	8.85	0.4097 (59)	No
At PSU	11th RMS	2	9.09	1	No
At PSU	PF	2	13.20	0.0625 (9)	No
At PSU	Apparent power	2	17.10	0.0278 (4)	No
At PSU	Active power	2	18.56	0.007 (1)	Yes
Office-level	3rd dBc	2	8.215	0.368 (53)	No
Office-level	5th dBc	2	8.1112	0.4861 (70)	No
Office-level	7th dBc	2	7.888	0.490 (51)	No
Office-level	11th dBc	2	8.5633	1	No
Office-level	3rd RMS	2	8.07	1	No
Office-level	5th RMS	2	7.93	0.4861 (40)	No
Office-level	7th RMS	2	7.93	0.5167 (62)	No
Office-level	11th RMS	2	8.50	1	No
Office-level	PF	2	7.47	0.4375	No
Office-level	Apparent power	2	9.34	0	RS invalid
Office-level	Active power	2	11.51	0	Yes

Table 8: Decoding outcomes for Tests 5 and 6 (AES-128 payload, $T_s = 2$ s and $T_s = 1$ s) – active-PFC PSU.

Location	Feature	T_s (s)	SNR (dB)	Observed BER	Outcome
At PSU	3rd dBc	1	6.82	0.2891 (37)	No
At PSU	3rd dBc	2	6.82	0.6406 (82)	No
At PSU	5th dBc	1	8.23	0.0078 (1)	Yes
At PSU	5th dBc	2	8.23	0.4141 (53)	No

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Location	Feature	T_s (s)	SNR (dB)	Observed BER	Outcome
At PSU	7th dBc	1	7.92	0.3438 (44)	No
At PSU	7th dBc	2	7.92	0.3438 (4)	No
At PSU	11th dBc	1	8.19	0.0078 (1)	Yes
At PSU	11th dBc	2	8.19	0.0703 (9)	No
At PSU	3rd RMS	1	9.11	0.0078 (1)	Yes
At PSU	3rd RMS	2	9.11	0	Yes
At PSU	5th RMS	1	9.15	1	No
At PSU	5th RMS	2	9.15	0.5078 (65)	No
At PSU	7th RMS	1	9.05	0.5078 (65)	No
At PSU	7th RMS	2	9.05	0.5268 (59)	No
At PSU	11th RMS	1	9.16	0.4609 (59)	No
At PSU	11th RMS	2	9.16	0.4766 (61)	No
At PSU	PF	1	14.60	0	Yes
At PSU	PF	2	14.60	0	Yes
At PSU	Apparent power	1	17.23	0	Yes
At PSU	Apparent power	2	17.23	0	Yes
At PSU	Active power	1	18.86	0	Yes
At PSU	Active power	2	18.86	0.0078 (1)	Yes
Office-level	3rd dBc	1	8.24	0.0234 (3)	No
Office-level	3rd dBc	2	8.24	0.0078 (1)	Yes
Office-level	5th dBc	1	7.91	0.0156 (2)	No
Office-level	5th dBc	2	7.91	1	No
Office-level	7th dBc	1	7.78	0.0156 (2)	No
Office-level	7th dBc	2	7.78	0.0859 (11)	No
Office-level	11th dBc	1	8.69	1	No
Office-level	11th dBc	2	8.69	1	No
Office-level	3rd RMS	1	8.01	0.6696 (75)	No
Office-level	3rd RMS	2	8.01	0.3281 (42)	No
Office-level	5th RMS	1	7.92	1	No
Office-level	5th RMS	2	7.92	0.6875 (44)	No
Office-level	7th RMS	1	7.96	0.3984 (51)	No
Office-level	7th RMS	2	7.96	0.4688 (60)	No
Office-level	11th RMS	1	8.47	1	No
Office-level	11th RMS	2	8.47	0.3359 (43)	No
Office-level	PF	1	8.46	0.0313 (4)	No
Office-level	PF	2	8.46	0	Yes
Office-level	Apparent power	1	7.88	0.0313 (4)	No
Office-level	Apparent power	2	7.88	0.0156 (2)	No
Office-level	Active power	1	11.15	0.0078 (1)	No
Office-level	Active power	2	11.15	0.0078 (1)	Yes

Table 9: Decoding outcomes for Test 7 (ECDSA secp256k1 secret-key payload) – active-PFC PSU.

Location	Feature	T_s (s)	SNR (dB)	Observed BER	Outcome
At PSU	3rd dBc	2	7.09	0.0898 (23)	No
At PSU	5th dBc	2	8.57	0	Yes
At PSU	7th dBc	2	8.15	0.0313 (8)	No
At PSU	11th dBc	2	8.28	0.0781 (20)	No
At PSU	3rd RMS	2	9.03	0.0156 (4)	No
At PSU	5th RMS	2	9.12	0.4758 (118)	No
At PSU	7th RMS	2	9.03	0.3988 (67)	No
At PSU	11th RMS	2	9.03	0.4875 (78)	No
At PSU	PF	2	13.37	0.0078 (2)	Yes
At PSU	Apparent power	2	17.58	0	Yes
At PSU	Active power	2	18.62	0	Yes
Office-level	3rd dBc	2	8.26	0.1094 (28)	No
Office-level	5th dBc	2	8.20	0.0156 (4)	No
Office-level	7th dBc	2	7.81	0.4688 (120)	No
Office-level	11th dBc	2	8.62	0.4844 (124)	No
Office-level	3rd RMS	2	8.10	0.4866 (109)	No
Office-level	5th RMS	2	8.01	1	No
Office-level	7th RMS	2	8.00	1	No
Office-level	11th RMS	2	8.60	1	No
Office-level	PF	2	7.94	0.082	No
Office-level	Apparent power	2	8.44	0.0039 (1)	Yes
Office-level	Active power	2	11.11	0.0195 (5)	No