Observation of noise in production VPTs at 1.8T

VPTs with bar-codes 1501-8600

Version 2

B W Kennedy

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1. Introduction

This note gives details of noise observations in recent batches of VPTs, covering devices with bar-codes from 1501 to 8600. The analysis will be extended to cover the whole production sample (bar-codes from 501 onwards) as soon as possible.

This note is a revised version of [1], with two modifications. Firstly, extra information has been added to Table 2 to indicate the range of angles where noise was observed. Secondly, an error has been corrected: VPT 7241/3833 has been removed from the list, and replaced by VPT 7305/3835.

2. VPTs displaying discharges

A list of VPTs showing spikes is given in Table 1. This list covers all tubes with bar-codes in the range 1501-8600. The data on VPTs in the range 7901-8600 is preliminary, because these tubes have been measured only once in the RAL test rig; they will be remeasured as soon as possible to confirm the observation of discharges.

Bar-code range	Noisy	Bar-codes of noisy VPTs
1501-1600	7	1503 1508 1546 1550 1553 1559 1571
1601-1700	8	1613 1615 1616 1619 1638 1639 1641 1672
1701-1800	8	1700 1708 1742 1745 1752 1758 1765 1794
1801-1900	8	1808 1829 1837 1846 1852 1853 1855 1875
1901-2000	6	1905 1937 1944 1950 1996 1999
2001-2100	10	2020 2036 2042 2058 2062 2064 2085 2089 2090 2096
2101-2200	4	2134 2156 2174 2179
2201-2300	6	2212 2220 2228 2256 2283 2299
2301-2400	4	2310 2319 2382 2395
2401-2500	5	2400 2413 2448 2456 2461
2501-2600	2	2564 2579
2601-2700	6	2635 2647 2669 2697 2698 2699
2701-2800	2	2712 2719
2801-2900	3	2804 2830 2896
2901-3000	2	2902 2947
3001-3100	3	3065 3070 3086

Bar-code range	Noisy	Bar-codes of noisy VPTs
3101-3200	2	3117 3174
3201-3300	3	3215 3227 3249
3301-3400	4	3322 3339 3368 3373
3401-3500	1	3422
3501-3600	3	3511 3592 3594
3601-3700	3	3610 3647 3663
3701-3800	10	3704 3705 3714 3744 3756 3760 3762 3782 3786 3798
3801-3900	4	3822 3826 3835 3836
3901-4000	13	3903 3904 3907 3909 3911 3928 3930 3932 3946 3951 3956 3985 4000
4001-4100	7	4010 4013 4017 4046 4059 4082 4090
4101-4200	5	4107 4124 4150 4151 4157
4201-4300	5	4205 4210 4212 4221 4281
4301-4400	11	4303 4314 4326 4328 4336 4353 4374 4377 4385 4393 4399
4401-4500	3	4409 4465 4490
4501-4600	8	4508 4509 4517 4519 4550 4563 4565 4568
4601-4700	7	4623 4626 4642 4644 4649 4650 4661
4701-4800	12	4701 4705 4710 4718 4731 4754 4756 4758 4765 4775 4784 4786
4801-4900	6	4833 4844 4848 4867 4899 4900
4901-5000	4	4908 4945 4980 4983
5001-5100	5	5013 5015 5022 5038 5047
5101-5200	5	5143 5145 5156 5168 5186
5201-5300	8	5206 5231 5234 5235 5264 5266 5270 5295
5301-5400	4	5333 5351 5381 5398
5401-5500	1	5432
5501-5600	8	5507 5509 5526 5548 5553 5570 5575
5601-5700	8	5605 5620 5654 5658 5667 5668 5696
5701-5800	7	5715 5737 5747 5749 5768 5769 5791
5801-5900	4	5803 5811 5826 5827
5901-6000	4	5912 5921 5925 5937
6001-6100	6	6002 6003 6008 6022 6029 6030
6101-6200	4	6106 6156 6166 6177
6201-6300	10	6209 6234 6247 6252 6258 6263 6274 6286 6290 6292
6301-6400	6	6320 6329 6353 6362 6385 6398
6401-6500	7	6429 6444 6466 6474 6475 6481 6488
6501-6600	7	6519 6533 6537 6567 6578 6580 6586
6601-6700	5	6613 6623 6640 6663 6696
6701-6800	8	6701 6711 6714 6717 6718 6720 6786 6795
6801-6900	6	6805 6812 6813 6826 6871 6900
6901-7000	4	6915 6923 6968 6969
7001-7100	12	7002 7004 7031 7039 7051 7067 7078 7086 7089 7091 7096 7099
7101-7200	8	7101 7104 7112 7120 7121 7160 7181 7182
7201-7300	3	7205 7249 7260
7301-7400	6	7310 7333 7345 7350 7352 7386
7401-7500	7	7402 7423 7430 7464 7471 7480 7496
7501-7600	10	7510 7521 7542 7551 7554 7566 7568 7580 7586 7594
7601-7700	5	7613 7621 7629 7637 7647
7701-7800	8	7702 7717 7741 7742 7756 7780 7788 7798
7801-7900	11	7805 7807 7824 7841 7842 7845 7847 7848 7862 7863 7868
7901-8000	*1*	*7944*
8001-8100	*7*	*8028 8055 8059 8074 8075 8086 8089*
8101-8200	*10*	*8109 8110 8118 8138 8139 8152 8154 8172 8175 8196*

Bar-code range	Noisy	Bar-codes of noisy VPTs
8201-8300	*6*	*8238 8255 8262 8280 8283 8294*
8301-8400	*5*	*8307 8323 8364 8379 8397*
8401-8500	*6*	*8407 8421 8431 8449 8474 8493*
8501-8600	*5*	*8501 8541 8567 8575 8583*

Table 1. Bar codes of VPTs displaying discharges in a 1.8T magnetic field. VPTs shown *in italic type* have only been measured once in the RAL test rig.

A total of 421 noisy VPTs are listed here, or 5.9% of the devices with bar-codes in the range 1501-8600.

Figure 1 shows the distribution of noisy VPTs as a function of the RIE production number. Each bin in this plot covers a range of 1000 in production number; typically 500-600 VPTs in each bin are delivered to RAL.

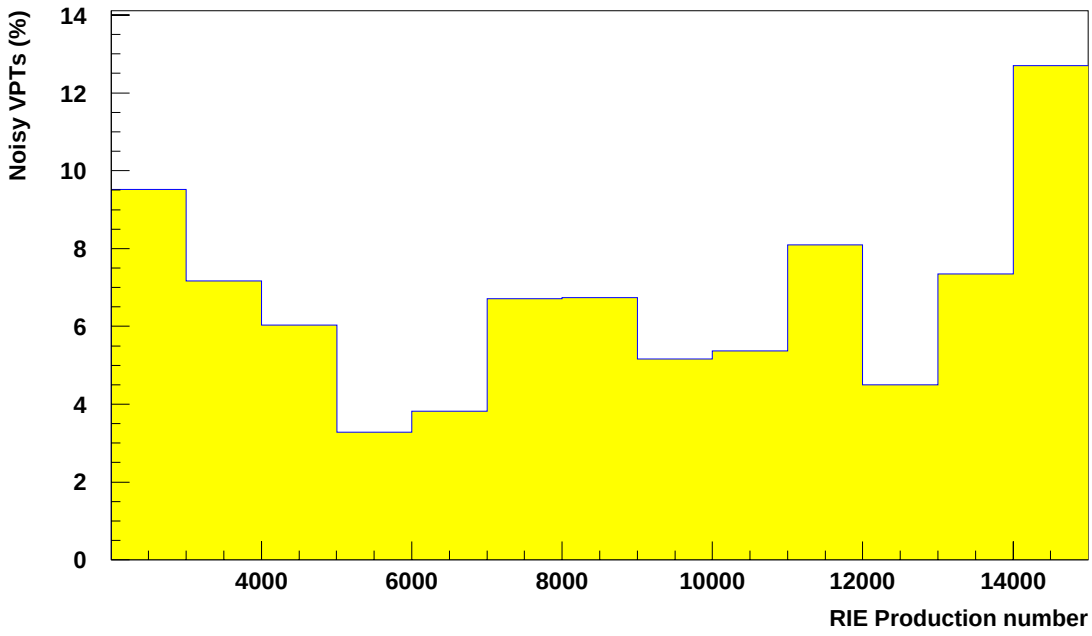

Figure 1. Fraction of noisy tubes as a function of RIE production number. Only VPTs with bar-codes in the range 1501-8600 are included.

Table 2 gives more detailed information on these VPTs, including the angular range in which noise has been observed, considering only angles up to 26°, as in the VPT specification [2]. In this table the VPTs are ordered by the RIE production number rather than the bar code, as this gives more information about the date of manufacture. The angle can be positive or negative, according to the alignment of the VPT in the 1.8T test rig. The information in this table is available as an Excel spreadsheet.

RIE Number	Bar code	Noisy angles (degrees)	Noisy range (degrees)
1625	5022	15 to 21	6
2770	1905	13 to 19	6
2791	1550	-35 to -11	15
2884	3956	11 to 30	15
2982	1508	-35 to -30	0
3042	1503	11 to 15	4
3121	1559	15 only	1
3130	1553	17 to 30	9
3132	1546	-35 only	1
3144	1571	-35 only	1
3176	1619	-35 only	1
3215	1613	-35 to -25	1
3221	1615	-35 to -30	0
3222	1616	-35 to -17	9
3269	1638	11 to 15	4
3270	1639	15 to 30	11
3272	1641	-35 to -30	0
3292	2179	-35 to -9	17
3313	1672	-35 to -21	5
3371	7091	17 to 30	9
3388	1700	-35 to -9	17
3397	1708	-35 only	1
3406	4157	-27 to -21	5
3468	1742	13 to 27	13
3473	1745	15 to 30	11
3492	1765	25 to 27	1
3536	1758	-35 to -9	17
3554	5156	-35 to -9	17
3555	1752	13 to 17	4
3567	1808	17 to 25	8
3571	1794	19 to 30	7
3598	1837	-35 to -30	0
3621	1846	13 to 30	13
3676	1829	-19 to -4	15
3697	1852	11 to 30	15
3708	1853	13 to 19	6
3719	1855	-27 to -25	1
3752	1875	-35 to -30	0
3819	1944	19 to 30	7
3835	1950	19 to 30	7
3842	1937	13 to 15	2
3914	1996	23 to 27	3
3924	1999	17 to 30	9
3950	2042	23 to 30	3
3979	2020	19 to 30	7
3985	2036	9 only	1
4011	8074	-35 to -27	0
4013	2058	-35 only	1
4019	2085	11 only	1
4053	5168	13 to 23	10

RIE Number	Bar code	Noisy angles (degrees)	Noisy range (degrees)
4066	2062	11 only	1
4074	2064	23 only	1
4087	2096	27 to 30	0
4132	2089	19 to 30	7
4133	2090	13 to 23	10
4186	2134	-19 to -15	4
4235	2156	13 only	1
4245	2174	17 to 27	9
4247	3117	-35 only	1
4254	3798	-25 to -21	4
4274	8294	25 to 30	1
4284	2212	27 to 30	0
4294	2228	13 to 30	13
4320	2220	-35 to -30	0
4375	2256	15 to 30	11
4395	2283	17 only	1
4443	2299	17 to 19	2
4453	2319	-30 to -25	1
4562	2310	25 to 30	1
4568	2395	-35 to -17	9
4733	2413	17 to 27	9
4799	2461	-35 to -30	0
4808	2456	11 to 23	12
4918	2382	-35 to -27	0
4922	2400	-35 only	1
4927	2448	-30 to -17	9
4967	2564	-35 only	1
5086	2579	-35 to -30	0
5143	2635	-35 to -19	7
5207	2647	-35 to -25	1
5251	2669	-35 to -27	0
5278	8449	-35 to -17	9
5288	2697	-19 to -7	12
5307	2698	-35 to -25	1
5310	2699	11 to 13	2
5315	2719	-35 to -9	17
5326	7095	-35 only	1
5335	2712	-35 only	1
5467	2896	21 to 30	5
5570	2804	-35 to -30	0
5671	2830	17 to 27	9
5704	2902	11 to 25	14
5747	2947	23 only	1
5794	3907	-35 to -25	1
6046	3086	13 to 23	10
6056	3065	11 to 30	15
6093	3070	15 only	1
6161	3174	19 to 30	7
6259	3322	-35 to -30	0
6287	4303	17 to 21	4

RIE Number	Bar code	Noisy angles (degrees)	Noisy range (degrees)
6293	3786	-35 to -27	0
6312	3249	-35 to -30	0
6413	3215	21 to 27	5
6442	7031	-23 to -11	12
6451	3227	-30 to -13	13
6511	3368	-35 to -27	0
6636	3714	25 to 30	1
6684	3782	-35 only	1
6691	3339	-35 to -30	0
6739	3373	-35 only	1
6811	5145	-30 to -15	11
6815	3511	-35 only	1
6834	3422	-35 to -9	17
6875	7089	-35 to -27	0
6887	3909	13 to 15	2
6923	3911	-35 only	1
6993	3592	-35 only	1
7005	3594	-35 to -25	1
7012	3610	-35 only	1
7019	3663	-35 only	1
7053	4833	-35 to -30	0
7075	3647	-35 only	1
7087	3903	-35 to -11	15
7092	7181	17 to 21	4
7099	3985	21 to 25	4
7134	3705	-30 only	1
7252	3704	-35 to -19	7
7262	4046	-35 only	1
7274	3762	-25 to -5	20
7276	5381	-35 only	1
7279	3760	23 to 30	3
7281	4212	-15 to -5	10
7292	3822	21 to 30	5
7295	3756	13 to 15	2
7298	3744	21 to 30	5
7305	3835	21 to 25	4
7329	3826	-35 to -17	9
7332	4124	-27 only	1
7360	3836	-25 only	1
7371	3904	11 to 25	14
7468	4059	-35 only	1
7539	3928	-1 to 19	20
7556	3930	-35 to -30	0
7561	3932	-35 to -25	1
7576	3946	21 to 27	5
7590	3951	11 to 30	15
7619	4000	-35 only	1
7627	4010	-35 to -13	13
7632	4013	-35 to -23	3
7648	4017	-35 to -27	0

RIE Number	Bar code	Noisy angles (degrees)	Noisy range (degrees)
7673	4082	-35 only	1
7739	4090	5 to 15	10
7802	4107	-23 to -11	12
7843	4150	13 to 30	13
7853	4899	-30 to -17	9
7854	4151	17 to 23	6
7911	7260	-25 to -7	18
7940	4900	23 to 27	3
7959	7182	-35 to -30	0
7983	4210	15 to 17	2
7989	4393	-35 to -30	0
8021	4221	-35 to -30	0
8106	4205	-30 to -27	0
8160	4385	-35 only	1
8165	4281	-35 to 7	33
8194	4326	-35 to 9	35
8196	4314	-35 to -21	5
8215	4328	19 to 30	7
8220	4353	-30 to -17	9
8232	5038	-35 to -11	15
8247	4336	-35 to -21	5
8248	4399	27 to 30	0
8301	4374	-21 to -7	14
8311	4409	-35 to -17	9
8319	4377	17 to 30	9
8325	4983	19 to 30	7
8331	4508	23 to 30	3
8353	4908	19 to 30	7
8376	4465	-35 to -11	15
8381	4509	-25 to -9	16
8396	4490	-35 to -30	0
8426	4517	-27 to -13	13
8438	4519	-35 to -13	13
8443	4550	-35 to -30	0
8453	4786	-35 to -30	0
8454	4642	-35 only	1
8483	4563	17 to 30	9
8514	4565	-35 to -30	0
8581	4710	-35 to -30	0
8623	4718	-30 to -11	15
8707	4568	27 to 30	0
8744	4644	13 to 15	2
8746	4623	15 to 27	11
8773	4626	-35 to -27	0
8784	4649	-35 to -21	5
8785	4650	-30 to -7	19
8798	4661	-27 only	1
8820	4701	-35 to -27	0
8850	4775	17 to 23	6
8855	4754	13 to 23	10

RIE Number	Bar code	Noisy angles (degrees)	Noisy range (degrees)
8871	4705	-35 to -7	19
8891	4731	-35 to -27	0
8901	4756	21 to 30	5
8904	4758	23 to 30	3
8928	4765	-35 to -30	0
8931	4848	-27 to -7	19
8945	4784	-35 only	1
9232	5047	-35 to -23	3
9248	4844	9 to 19	10
9259	4867	23 to 30	3
9296	5654	17 to 30	9
9303	4945	17 to 19	2
9348	5013	9 to 30	17
9355	5015	-35 to -11	15
9364	4980	-35 to -30	0
9372	5398	15 to 30	11
9404	5231	-35 to -13	13
9434	7067	-35 only	1
9455	5143	17 to 21	4
9487	5234	15 to 21	6
9500	5235	15 to 30	11
9502	5186	19 to 27	7
9507	7099	-35 to -30	0
9531	5791	-35 to -9	17
9551	5206	21 to 30	5
9561	6258	-35 to -11	15
9575	5295	-35 to -19	7
9578	5264	19 to 30	7
9589	5266	-21 to -11	10
9605	5270	-30 to -19	7
9626	5351	-35 to -9	17
9658	5333	-35 to 0	26
9822	5432	17 to 27	9
9842	5507	-30 to -21	5
9856	5803	-35 to -25	1
9866	5509	-21 to -11	10
9872	5548	-35 to -23	3
9878	5526	11 to 23	12
9886	5570	-35 to -27	0
9888	5553	-35 only	1
9923	5575	25 to 30	1
9926	5561	-35 to -27	0
9999	5658	19 to 25	6
10003	5605	-35 to -13	13
10035	5620	-35 to -30	0
10097	5737	-35 to -27	0
10216	5667	-19 to -17	2
10217	5668	17 to 30	9
10233	5715	-35 to 0	26
10242	5696	-30 to -25	1

RIE Number	Bar code	Noisy angles (degrees)	Noisy range (degrees)
10298	5747	-35 only	1
10300	5749	-35 to -11	15
10316	5768	-17 to -11	6
10319	5811	15 to 30	11
10338	5769	9 to 30	17
10343	5826	-35 to 13	39
10349	5827	-35 to 0	26
10459	6022	-35 to -9	17
10471	5912	-35 to -13	13
10708	5921	25 to 30	1
10722	5925	11 to 27	15
10739	5937	-30 only	1
10772	6029	13 to 30	13
10795	6002	-35 to -17	9
10804	6003	-35 to -11	15
10818	6030	-35 to -11	15
10833	6008	19 to 21	2
10835	6156	-35 to -5	21
10882	6166	9 to 30	17
10910	7471	-35 to -19	7
10920	7039	-35 to -11	15
10933	7551	15 to 27	11
10952	6362	-35 to -23	3
10956	6106	11 to 21	10
11019	6209	13 to 27	13
11071	6701	23 to 30	3
11168	6586	-35 to -25	1
11231	6177	17 to 30	9
11302	6234	-35 to -15	11
11323	6247	-35 to -15	11
11324	6320	13 to 30	13
11356	6274	-19 to -7	12
11357	7717	-35 to -9	17
11367	7554	-35 to -30	0
11371	6385	23 to 30	3
11374	7101	-35 to -13	13
11387	6252	-35 to -25	1
11396	7121	-35 to -21	5
11398	6915	-35 to -30	0
11409	6286	-35 to -13	13
11414	7120	-35 to -30	0
11426	6290	-35 to -21	5
11428	6292	-35 to -27	0
11433	6533	-35 only	1
11449	6329	-35 to -13	13
11461	6263	13 to 30	13
11501	6353	-35 to -17	9
11510	6398	-35 to -15	11
11599	6578	-35 to -21	5
11609	6429	-35 to -9	17

RIE Number	Bar code	Noisy angles (degrees)	Noisy range (degrees)
11618	7104	-35 to -19	7
11619	6466	-35 to -21	5
11621	6444	-35 to -27	0
11638	6474	-35 to -17	9
11642	6475	19 to 30	7
11644	6488	17 to 32	9
11661	6537	9 to 30	17
11674	6481	9 to 30	17
11686	6580	19 to 30	7
11702	6519	-30 to -21	5
11711	6812	-35 to -15	11
11742	6567	-35 to -23	3
11770	6613	-35 to -5	21
11771	6623	15 to 25	10
11786	6813	-27 to -21	5
11816	6640	-30 to -11	15
11833	8364	15 to 30	11
11834	6826	-23 to -11	12
11872	6663	-35 to -7	19
11887	6696	15 only	1
11916	6711	-25 only	1
11928	6714	-35 to -30	0
11952	6717	-35 to -17	9
11955	6718	19 to 30	7
11957	6720	-35 to -17	9
12090	6795	-35 to -17	9
12225	8307	-30 to -23	3
12227	6786	-35 to -9	17
12229	6923	17 to 21	4
12295	6805	-30 to -15	11
12325	7112	-35 only	1
12345	6871	9 to 27	17
12359	6968	-35 to -27	0
12362	6900	7 to 21	14
12397	6969	-35 to -23	3
12457	7002	-35 to -15	11
12496	7004	-30 to -3	23
12536	7051	-30 to -11	15
12568	7078	-35 to -19	7
12636	8474	15 to 17	2
12681	7249	-35 to -13	13
12698	7310	-35 to -27	0
12712	7205	-35 to -30	0
12735	7086	-27 to -25	1
12755	7160	-35 to -30	0
12823	7333	-35 to -17	9
12848	7386	17 to 30	9
12953	7345	11 to 27	15
12973	8075	-35 to -15	11
12976	7350	-30 to -13	13

RIE Number	Bar code	Noisy angles (degrees)	Noisy range (degrees)
12993	7352	-35 to -7	19
13054	7521	11 to 17	6
13062	7402	11 to 25	14
13063	7480	21 to 30	5
13094	7423	25 to 30	1
13206	7629	17 to 25	8
13348	7566	21 to 30	5
13354	7430	-35 only	1
13359	7464	9 to 30	17
13371	7496	-35 to -11	15
13373	7510	7 to 21	14
13375	7568	9 to 17	8
13394	8379	-35 to -11	15
13396	7580	27 to 30	0
13441	7542	19 to 30	7
13459	7594	-30 to -7	19
13470	7586	-35 only	1
13492	7613	-35 to -30	0
13519	7637	-35 to -15	11
13546	7647	-35 to -30	0
13548	7621	-9 only	1
13608	7702	-35 to -27	0
13611	7756	19 to 21	2
13613	7741	-35 to -25	1
13655	7780	-27 only	1
13662	7742	-35 to -11	15
13695	7788	-30 to -11	15
13702	7798	-27 to -25	1
13712	7805	-35 to -13	13
13715	7862	-35 to -13	13
13718	7863	-35 to -25	1
13728	7807	27 to 30	0
13767	7841	-35 to -23	3
13768	7868	-35 to -27	0
13772	7842	-35 to 9	35
13780	7845	9 only	1
13782	7824	15 to 17	2
13791	7847	13 to 30	13
13792	7848	-35 to -11	15
13866	7944	-35 to -9	17
14214	8323	15 to 30	11
14222	8028	-17 to -9	8
14241	8055	19 to 30	7
14265	8059	17 to 30	9
14280	8109	23 to 30	3
14285	8086	-35 to -11	15
14288	8089	25 to 30	1
14300	8138	9 to 30	17
14303	8110	-35 to -25	1
14305	8139	-35 to -9	17

RIE Number	Bar code	Noisy angles (degrees)	Noisy range (degrees)
14322	8118	-27 to -7	19
14340	8152	-35 to -13	13
14347	8154	17 to 19	2
14364	8172	-35 to -30	0
14366	8196	-35 to -21	5
14370	8175	-35 to -11	15
14396	8431	-35 to 17	43
14403	8238	21 to 30	5
14444	8280	11 to 15	4
14461	8262	19 to 30	7
14475	8283	-35 to -25	1
14477	8255	-35 to -27	0
14503	8407	13 to 30	13
14534	8397	25 to 30	1
14583	8421	-17 to -11	6
14593	8493	-35 to -25	1
14613	8583	15 to 30	11
14629	8501	15 to 30	11
14704	8541	-25 to -17	8
14741	8567	-35 to -17	9
14750	8575	19 to 30	7

Table 2. Details of VPTs displaying discharges, ordered by RIE production number. The "Noisy range" gives the range of angles where the VPT was observed to be noisy, excluding angles greater than 26° from the VPT axis.

3. Summary and conclusions

This note has presented data on all VPTs with bar-codes in the range 1501-8600 which have displayed discharges when measured in the RAL 1.8T test rig. 5.9% of these VPTs appear to be noisy. Some of the VPTs have only been tested once in the test rig, and will be remeasured as soon as possible at RAL to confirm the observation of discharges.

The fraction of noisy VPTs shows significant variations as a function of the RIE production number. This information may be useful in understanding how the manufacturing conditions affect the behaviour of the VPTs.

4. References

[1] 'Observation of noise in production VPTs at 1.8T: VPTs with bar-codes 1501-8600', B W Kennedy, 14 October 2004

[2] 'Technical specification of vacuum phototriodes for the endcap electromagnetic calorimeters of the Compact Muon Solenoid (CMS) experiment', 11 May 2001.