



DRIVE BEAM QUADRUPOLE MEASUREMENTS

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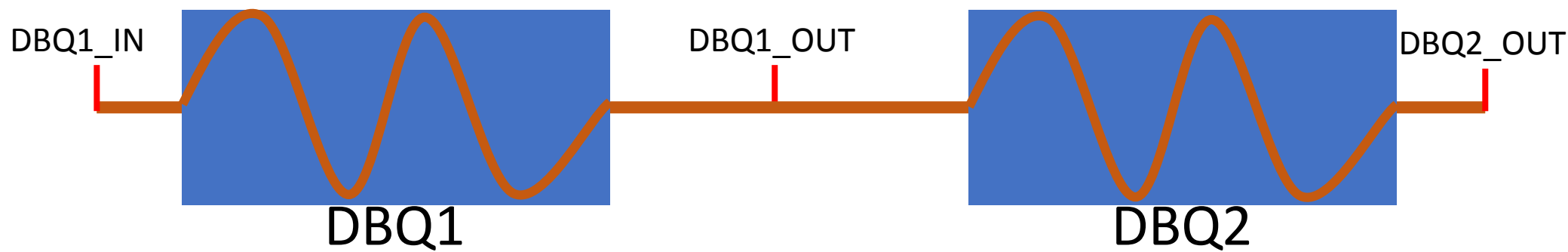
29/08/2018



MEASUREMENT PROCESS

- Measure the increase in temperature of 2 magnets for different scenarios.
- Compare the measurements with simulations done by Jakub.

TEMPERATURE SENSORS





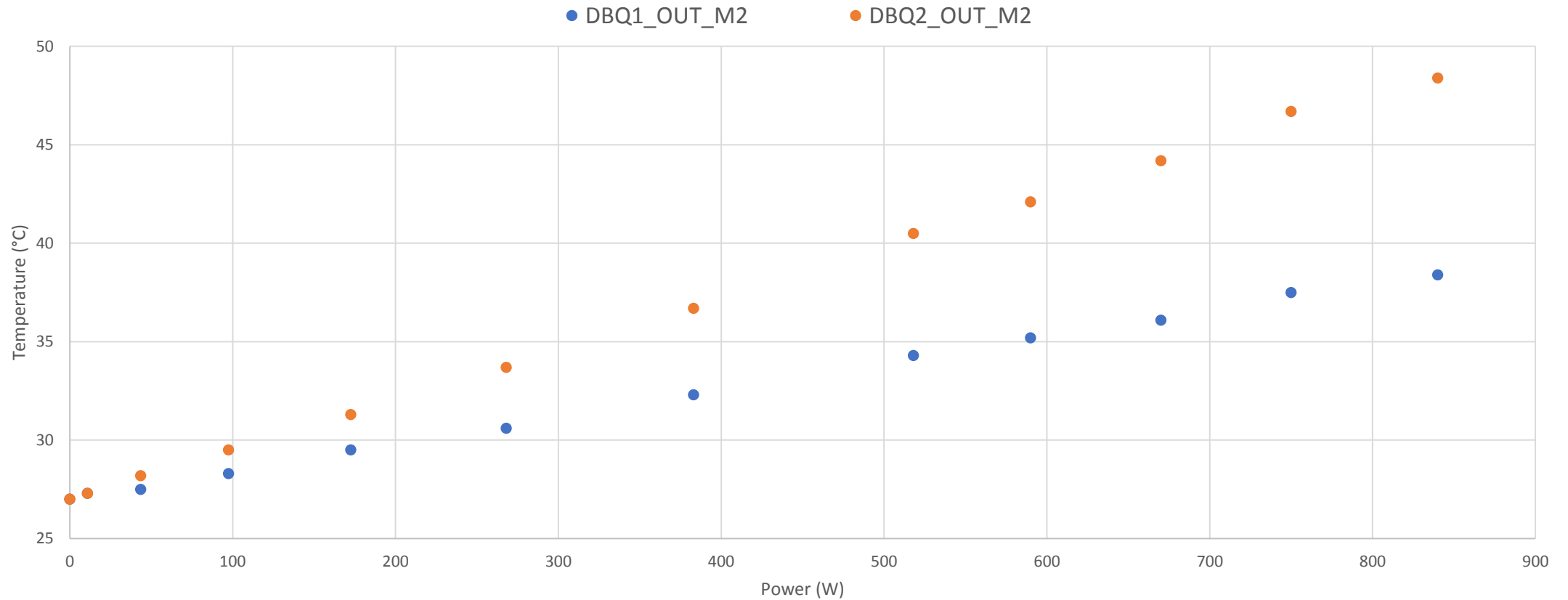
Measurement : 27°C Ambient – 1.0 L/min

Current (A)	Voltage (V)	total Power (W)	Power in each magnet (W)	DBQ1_IN	DBQ2_OUT	DBQ1_OUT	Flow (L/min)	dT dbq1	dT dbq2	
0,0		0	0	0	27,1	27	27	1,03	-0,1	0
10,9		2	21,8	10,9	27,2	27,3	27,3	1,02	0,1	0
21,8		4	87	43,5	27,1	28,2	27,5	1,02	0,4	0,7
32,5		6	195	97,5	27,2	29,5	28,3	1,02	1,1	1,2
43,1		8	345	172,5	27,2	31,3	29,5	1,04	2,3	1,8
53,6		10	536	268	27,2	33,7	30,6	1,03	3,4	3,1
63,8		12	766	383	27,5	36,7	32,3	1,03	4,8	4,4
74,0		14	1036	518	27,5	40,5	34,3	1,04	6,8	6,2
78,7		15	1180	590	27,4	42,1	35,2	1,06	7,8	6,9
83,8		16	1340	670	27,8	44,2	36,1	1,05	8,3	8,1
88,2		17	1500	750	28	46,7	37,5	1,04	9,5	9,2
93,3		18	1680	840	27,9	48,4	38,4	1,05	10,5	10



Measurement : 27°C Ambient – 1.0 L/min

27° ambient, 1.0 L/min flow : Power vs. Temperature outlet magnets





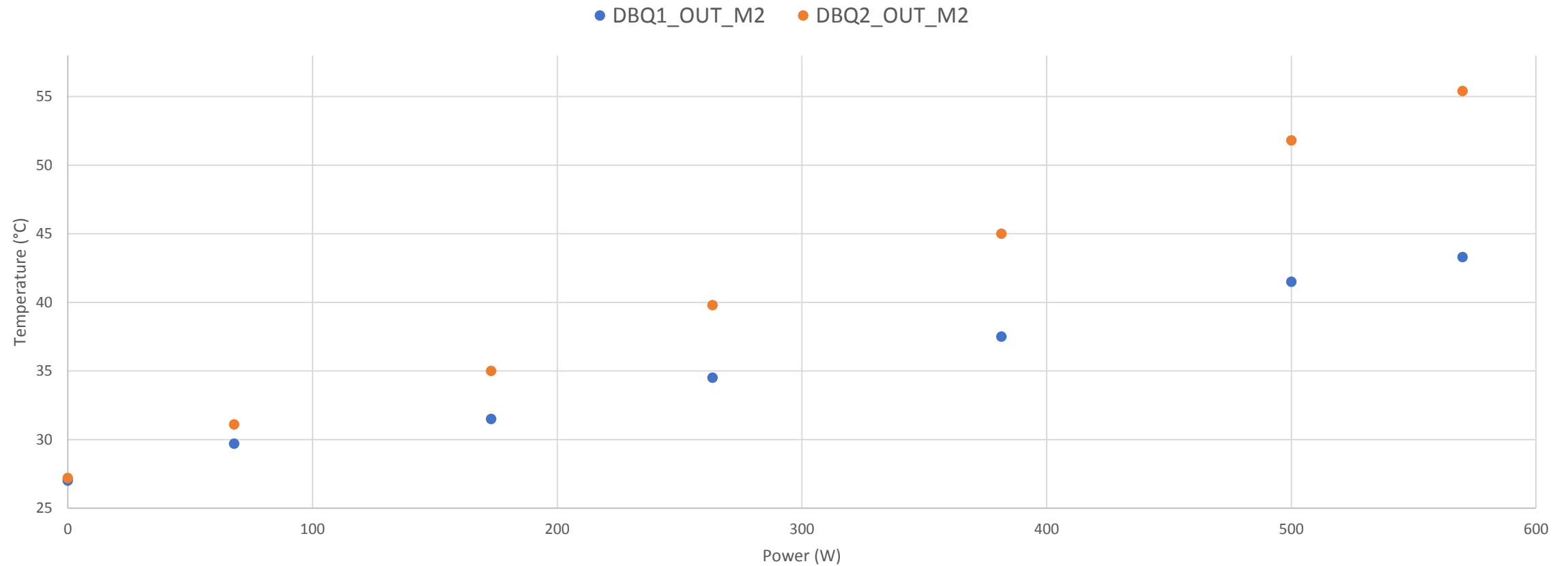
Measurement : 27°C Ambient – 0.5 L/min

Current (A)	Voltage (V)	total Power (W)	Power in each magnet	DBQ1_IN	DBQ2_OUT	DBQ1_OUT	Real flow (L/min)	dT dbq1	dT dbq2	
0,0		0	0	0	27,2	27,2	27	0,52	-0,2	0,2
27,2		5	136	68	27,3	31,1	29,7	0,53	2,4	1,4
43,3		8	346	173	27,5	35	31,5	0,53	4	3,5
52,7		10	527	263,5	27,6	39,8	34,5	0,54	6,9	5,3
63,6		12	763	381,5	27,7	45	37,5	0,52	9,8	7,5
71,4		14	1000	500	27,9	51,8	41,5	0,51	13,6	10,3
76,0		15	1140	570	28,5	55,4	43,3	0,5	14,8	12,1



Measurement : 27°C Ambient – 0.5 L/min

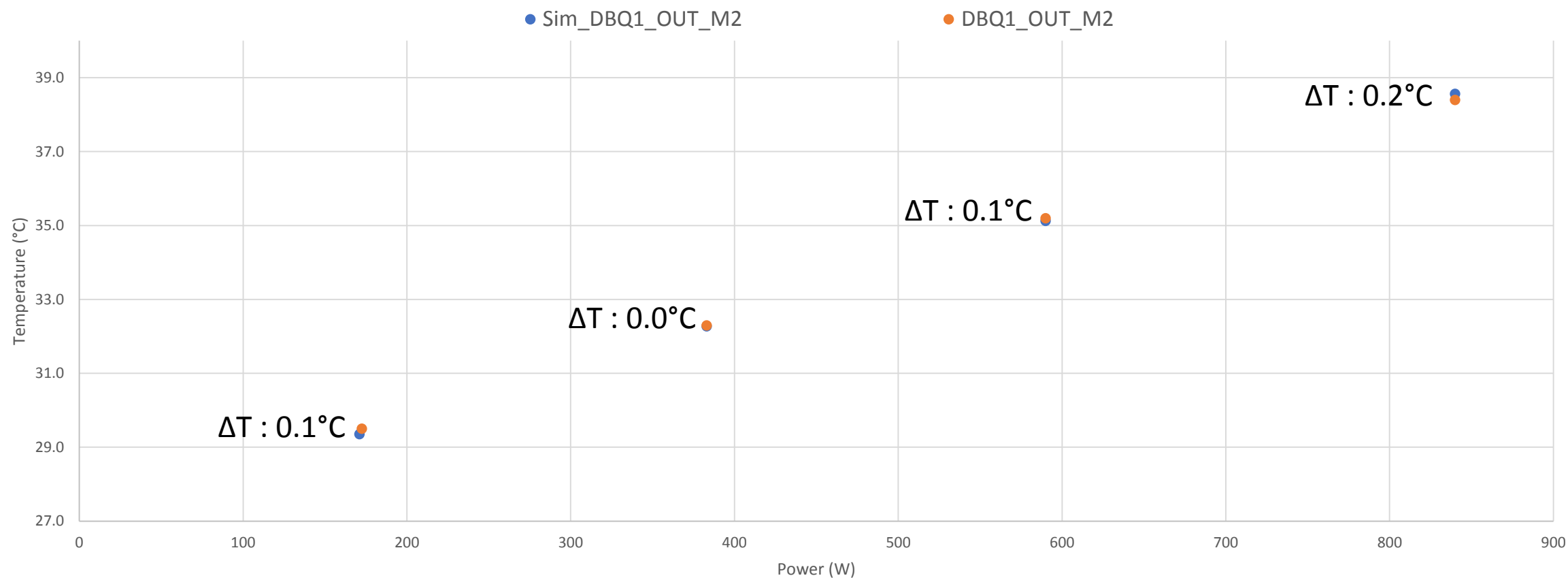
27° ambient, 0.5/min flow : Power vs. Temperature outlet magnets



Measurement vs. Simulation

27°C Ambient – 1.0 L/min

27° ambient - 1.0 L/min flow : Power vs. Temperature outlet first magnet

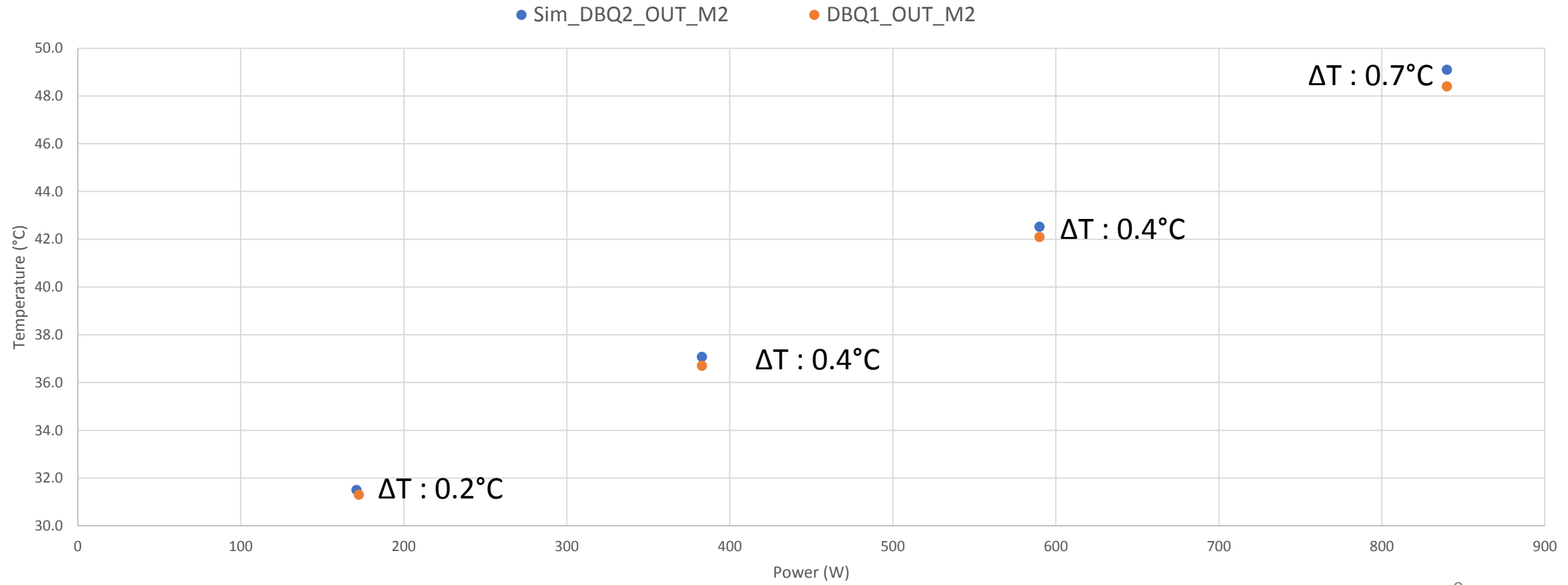




Measurement vs. Simulation

27°C Ambient – 1.0 L/min

27° ambient, 1.0 L/min flow : Power vs. Temperature outlet second magnet

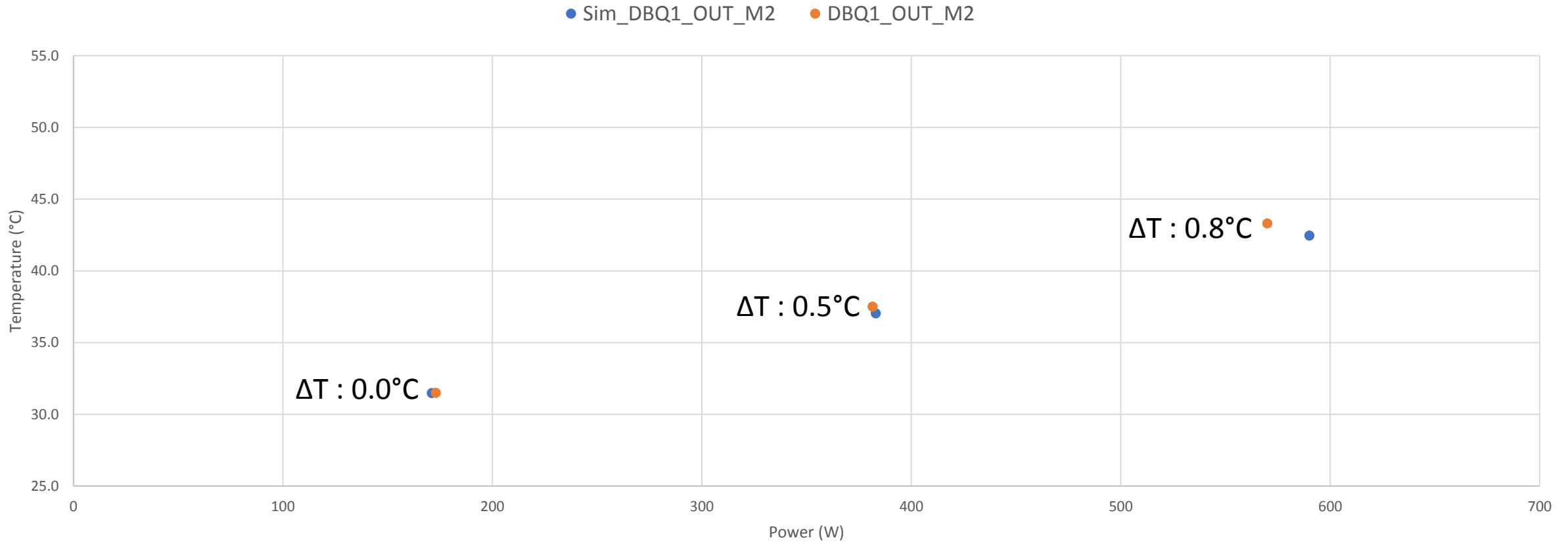




Measurement vs. Simulation

27°C Ambient – 0.5 L/min

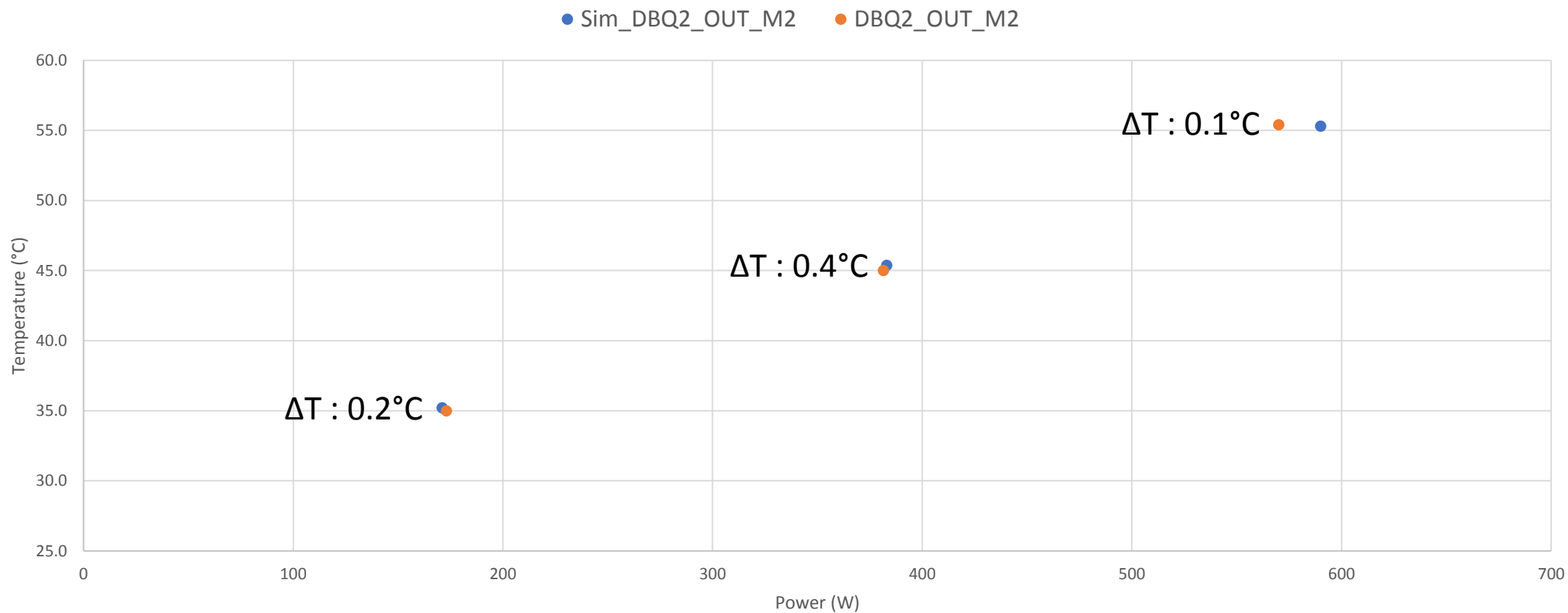
27° ambient, 0.5/min flow : Power vs. Temperature outlet first magnet



Measurement vs. Simulation

27°C Ambient – 0.5 L/min

27° ambient, 0.5/min flow : Power vs. Temperature outlet second magnet





MEASUREMENT : Heat to Air 27°C Ambient – 1.0 L/min

Current (A)	Voltage (V)	Power in each magnet (W)	Mes_HTA DBQ1	Mes_HTA DBQ2	
0,0		0	0	7,182533333	0
10,9		2	10,9	3,7872	10,9
21,8		4	43,5	15,0488	-6,2896
32,5		6	97,5	19,2592	12,1464
43,1		8	172,5	5,697866667	41,9592
53,6		10	268	23,79386667	45,34146667
63,8		12	383	38,2384	66,96853333
74,0		14	518	24,84586667	68,35946667
78,7		15	590	13,4448	79,9704
83,8		16	670	62,274	76,918
88,2		17	750	61,03466667	82,79146667
93,3		18	840	71,19	107,8



MEASUREMENT : Heat to Air 27°C Ambient – 0.5 L/min

Current (A)	Voltage (V)	Power in each magnet (W)	Mes_HTA DBQ1	Mes_HTA DBQ2
0,0	0	0	7,252266667	-7,252266667
27,2	5	68	-20,7008	16,25786667
43,3	8	173	25,16533333	43,64466667
52,7	10	263,5	3,6736	63,9232
63,6	12	381,5	26,13893333	109,54
71,4	14	500	16,3296	133,6908
76,0	15	570	53,97333333	148,1133333



MEASUREMENT : Heat to Air

Measurement errors

- Flowmeter error : $\pm (0,8 \% \text{ Measured Value} + 0,5 \% \text{ Maximum Value})$
- Temperature sensor error : $\pm (0,15 K + 0,002 \times |t|)$
- Power generator error :
 - Voltage : $6 \cdot 10^{-5} V$
 - Current : $9 \cdot 10^{-5} A$

—————→ Neglected

MEASUREMENT : Heat to Air

Measurement errors 27°C Amb – 1.0 L/min



Current (A)	Voltage (V)	total Power (W)	error heat to air dbq1	error heat to air dbq2	
0,0		0	0	20,73195268	20,72157755
10,9		2	21,8	20,57158719	25,45733626
21,8		4	87	20,5855686	25,40171298
32,5		6	195	20,69937007	25,48500382
43,1		8	345	21,31591724	26,11590775
53,6		10	536	21,35642723	26,2345633
63,8		12	766	21,79674277	26,46349674
74,0		14	1036	22,6778441	27,19911546
78,7		15	1180	23,47307009	28,04111462
83,8		16	1340	23,54657416	28,30441399
88,2		17	1500	23,89836822	28,40638
93,3		18	1680	24,57120836	28,91743886



MEASUREMENT : Heat to Air

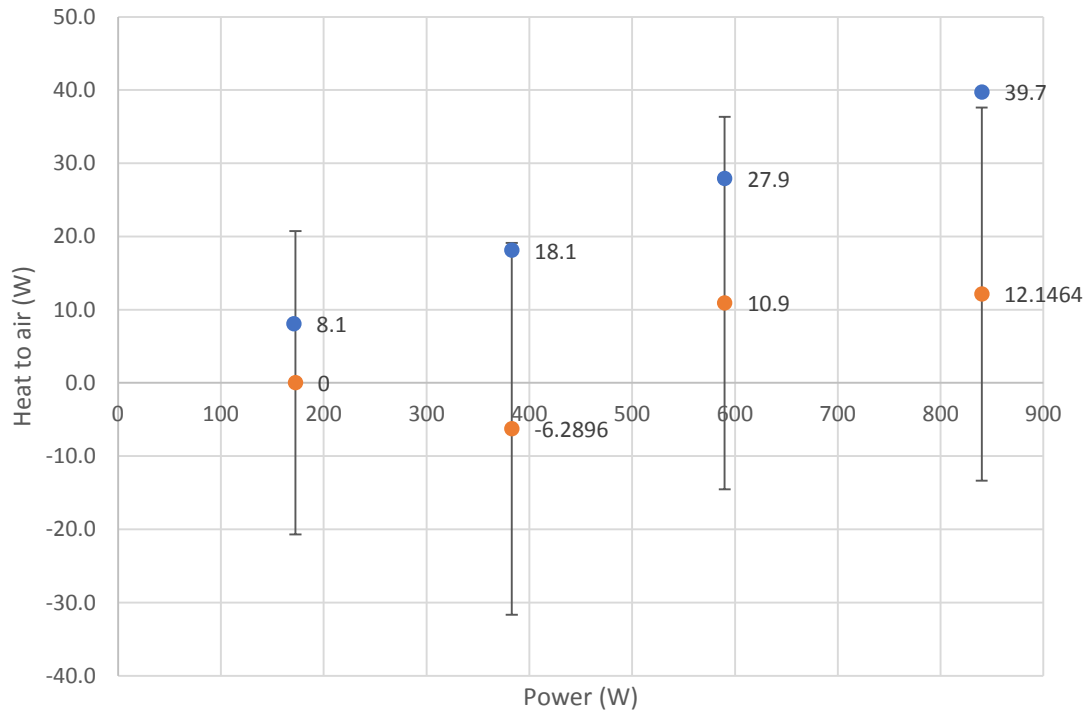
Measurement errors 27°C Amb – 0.5/min

Current (A)	Voltage (V)	total Power (W)	error heat to air dbq1	error heat to air dbq2
0,0		0	0	10,47207729
27,2		5	136	10,88394242
43,3		8	346	11,09875258
52,7		10	527	11,79834241
63,6		12	763	12,00469533
71,4		14	1000	12,79422693
76,0		15	1140	12,96462493

Measurement vs Simulation

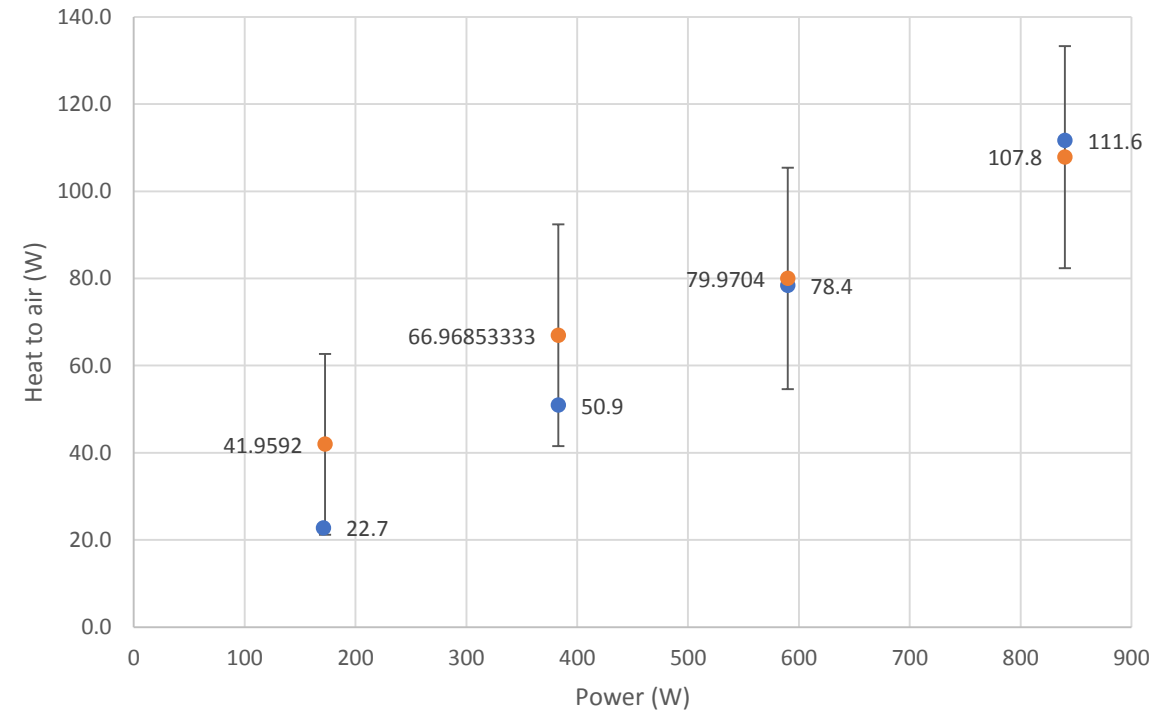
Heat to Air 27°C Ambient – 1.0 L/min

27 amb, 1 L/min : Heat to air generation magnet 1

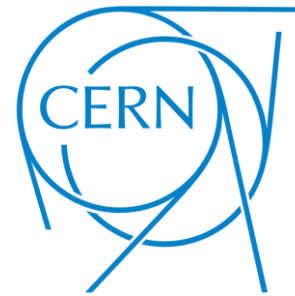


● Sim_HTA DBQ1 ● Mes_HTA DBQ1

27 amb, 1 L/min : Heat to air generation magnet 2



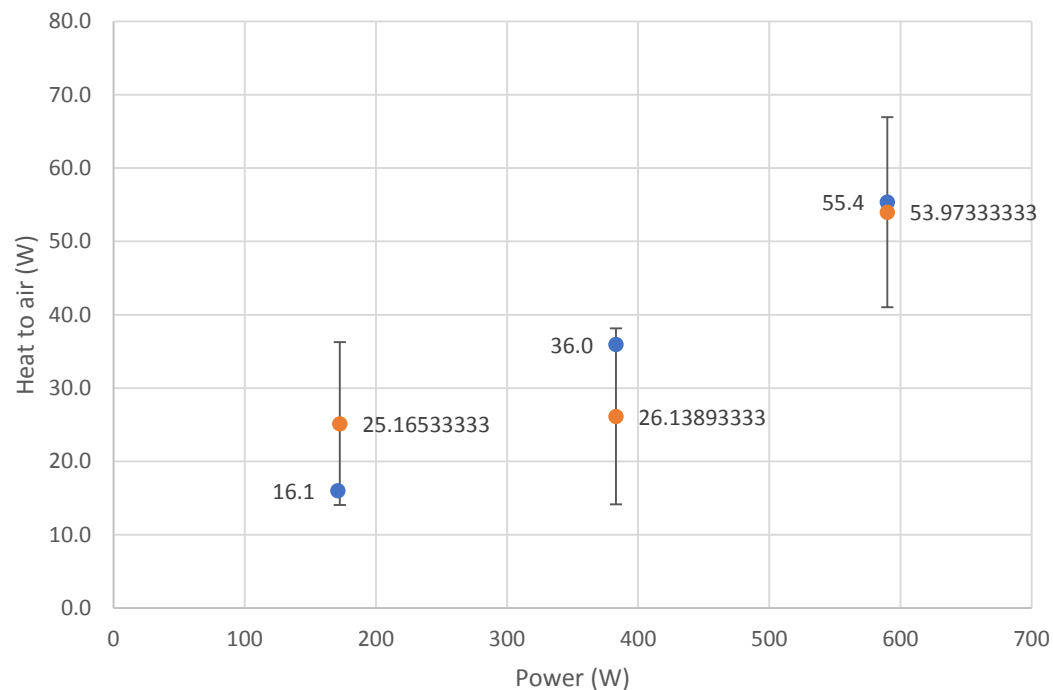
● Sim_HTA DBQ2 ● Mes_HTA DBQ2



Measurement vs Simulation

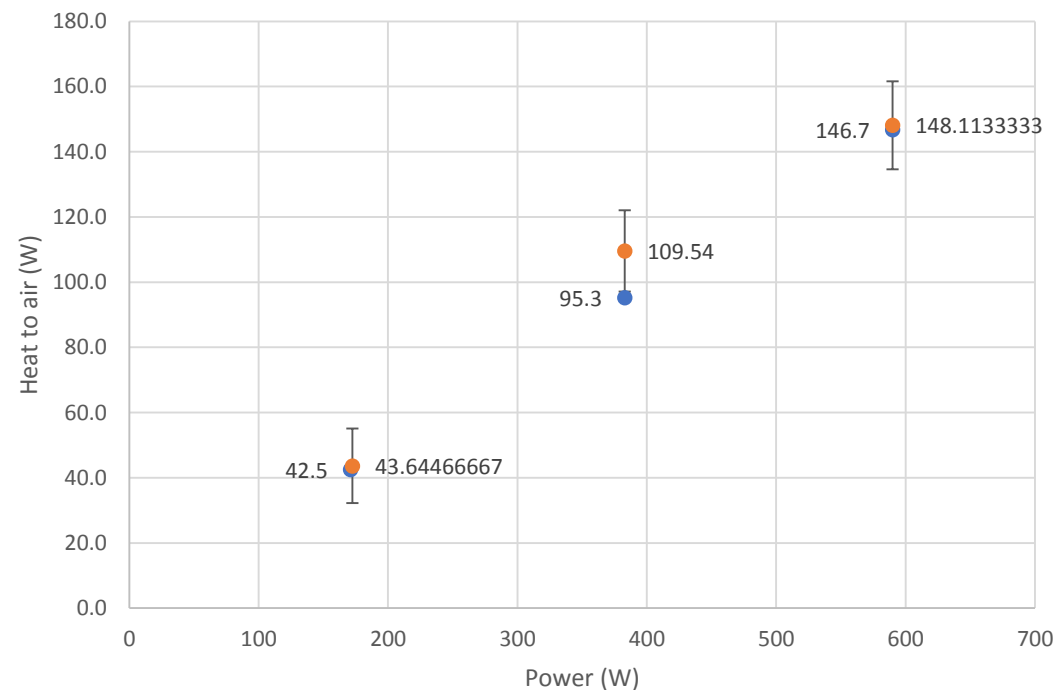
Heat to Air 27°C Ambient – 1.0 L/min

27 amb, 1 L/min : Heat to air generation magnet 1



● Sim_HTA DBQ1 ● Mes_HTA DBQ1

27 amb, 1 L/min : Heat to air generation magnet 2



● Sim_HTA DBQ2 ● Mes_HTA DBQ2



Thanks for listening