MUST Trial Notes for UVICs and UK Sonics

Release 1.1

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1 Introduction and Scope

This document gives a brief description of the configuration and operation of the UVIC and Sonic detectors deployed by Dstl during the MUST experiments, held September 2001 at Dugway Proving Ground, Utah. The details are given to assist in the processing and analysis of the data collected by these instruments. Queries should be addressed to any of the authors.

2 Times

All data collected is time referenced in Greenwich Mean Time (GMT) , which was 6 hours ahead of local Mountain Daylight Time (MDT). UVIC data file names followed the MUST standard trial naming convention with some minor changes (see section 4.4). The Sonic data filenames are automatically generated and an explanation can be found in section 5.1.

3 General Configuration

The UVICs and Sonics were mainly located on four 6m towers. Figure 1 shows roughly the position of the towers within the grid and the naming convention used throughout the trial programme for both the UVICs and Sonics.

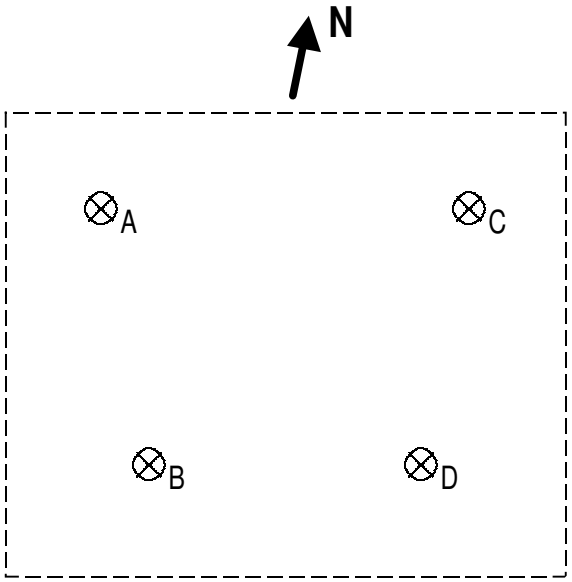

Figure 1: Naming convention of UVIC and Sonic Towers

This information is also tabulated in Table 1.

Tower Name	Quadrant
A	Northwest
B	Southwest
C	Northeast
D	Southeast

Table 1: Naming convention of UVIC and Sonic Towers

Details on the positions of these towers can be found in the experimental description compiled by Chris Biltoft.

4 UVIC Notes

4.1 Calibrations

Two sets of calibrations were carried out. The calibration and configuration data files can be found in the relevant subdirectory of the directory `Uvic data\Cal`.

a) Calibration 1

Carried out on 30 August and 6 September, prior to any trial runs. The measured calibration values can be found in the Excel spreadsheet `Cal\Cal1\Cal1readings.xls` and the UVIC configuration files used for the calibration is `Cal\Cal1\Cfg_c1_x.cfg`, where `x` is the configuration set number.

Filters were used in series between the UVICs and the acquisition (attached to the output connectors of the calibration rig). The resistance ratings of these filters were all 16,000 Ohms with a 1 micro farad capacitor to ground. The output impedance of the UVIC is not exactly known although it is thought to be fairly low, probably less than 1,000 Ohms. No other significant resistances were involved. The calibration values will need to be adjusted to match the residences involved in the configuration used when acquiring the data (see section 4.3).

b) Calibration 2

Carried out on 27 September, after all trial runs were complete. The measured calibration values can be found in `Cal\Cal2\Cal2readings.xls` and the UVIC configuration file used for the calibration is `Cal\Cal2\Cfg_c2_x.cfg`, where `x` is the configuration set number.

UVICs 46 and 47 were calibrated together with two TIPS to provide instrument output for known concentrations. The results can be found in `Cal2readings.xls`.

Two sets of resistance sources were present between the UVICs and the acquisition. The first were the filters applied in series between the UVICs and the acquisition connector boxes, as they were attached to the output connectors of the calibration rig, all of which had a resistance rating of 16,000 ohms with a 1 micro farad capacitor to ground. The second set of resisters were in the acquisition connector boxes (added to reduce signal problems – see section 4.3) and all had resistance rating 10,000 Ohms. As discussed above, the output impedance of the UVIC is estimated to be less than 1,000 Ohms. No other significant resistances were involved. The calibration values will need to be adjusted to match the residences involved in the configuration used when acquiring the data (see section 4.3). In particular, the measured values for the second calibration were significantly lower than they would have been if they were configured in the same way as in the trials, because the combined resistances were higher.

4.2 Set Up and Configuration

Up to 24 UVICs were deployed on the four towers (see section 3) and additionally one UVIC was collocated with a TIPS at ~2 m height on the central tower and another UVIC to the north of the container H4 at a height of 2.0 m (and position shown in Figure 2).

The UVICs on the towers were at height 1.0 m, 2.0 m, 3.0 m, 4.0 m, 5.0 m and 5.9 m. These positions were named X1, X2, X3, X4, X5 and X6 respectively, where X was the name of the tower A, B, C or D as defined in section 3.

Table 2 through to Table 7 show the positions of the UVICs throughout the trials. It should be noted that the positions given in the UVIC data header files should be ignored. Positional data should be derived from these tables and the height information given above.

The UVIC data header files do contain the correct channel / UVIC number / Gain setting information, which is also reproduced in the tables.

Data set	Channel	Position	UVIC	Gain (nA)
A	1	A1	11	10
	2	A2	12	3
	3	A3	13	3
	4	A4	14	3
	5	A5	15	10
	6	A6	16	3
	7	B1	18	1
	8	B2	19	10
	9	B3	20	3
	10	B4	21	10
	11	B5	22	3
	12	B6	23	3
B	1	C1	24	3
	2	C2	25	10
	3	C3	26	3
	4	C4	28	3
	5	C5	29	3
	6	C6	30	10
	7	D1	31	3
	8	D2	33	10

	10	D3	34	3
	11	D4	41	1
	12	D5	42	3
	13	D6	43	3

Table 2: UVIC configuration for trials 2562042 to 2562235

Data set	Channel	Position	UVIC	Gain (nA)
A	1	A1	45	3
	2	A2	12	3
	3	A3	13	3
	4	A4	14	3
	5	A5	15	10
	6	A6	16	3
	7	B1	18	1
	8	B2	19	10
	9	B3	20	3
	10	B4	21	10
	11	B5	22	3
	12	B6	23	3
B	1	C1	24	3
	3	C2	25	10
	4	C3	26	3
	5	C4	28	3
	6	C5	29	3
	7	C6	30	10
	8	D1	31	3
	10	D2	33	10
	11	D3	34	3
	12	D4	41	1
	13	D5	42	3
	14	D6	43	3

Table 3: UVIC configuration for trials 2562257 to 2610220

Data set	Channel	Position	UVIC	Gain (nA)
A	1	A1	45	3
	2	A2	12	3
	3	A3	13	3
	4	A4	14	3
	5	A5	15	10
	6	A6	16	3
	7	B1	18	1
	8	B2	19	10
	9	B3	20	3
	10	B4	21	10
	11	B5	22	3
	12	B6	23	3
	13	Wake	47	3
B	1	C1	24	3
	3	C2	25	10
	4	C3	26	3
	5	C4	28	3
	6	C5	29	3
	7	C6	30	10
	8	D1	31	3
	10	D2	33	10
	11	D3	34	3
	12	D4	41	1
	13	D5	42	3
	14	D6	43	3
	15	TIPS	46	3

Table 4: UVIC configuration for trials 2610458 to 2610758

Data set	Channel	Position	UVIC	Gain (nA)
A	1	A1	45	3
	2	A2	12	3
	3	A3	13	3

	4	A4	14	3
	5	A5	15	3
	6	A6	16	3
	7	B1	18	1
	8	B2	19	3
	9	B3	20	3
	10	B4	21	3
	11	B5	22	3
	12	B6	23	3
	13	Wake	47	3
B	1	C1	24	3
	3	C2	25	3
	4	C3	26	3
	5	C4	28	3
	6	C5	29	3
	7	C6	30	3
	8	D1	31	3
	10	D2	33	3
	11	D3	34	3
	12	D4	41	1
	13	D5	42	3
	14	D6	43	3
	15	TIPS	46	3

Table 5: UVIC configuration for trials 2620224 to 2630701

Data set	Channel	Position	UVIC	Gain (nA)
A	1	A1	45	3
	2	A2	12	3
	3	A3	13	3
	4	A4	14	3
	5	A5	15	3
	6	A6	16	3
	7	B1	18	1

	8	B2	19	3
	9	B3	20	3
	10	B4	21	3
	11	B5	22	3
	12	B6	23	3
	13	Wake	47	3
B	1	C1	24	3
	3	C2	25	3
	4	C3	26	3
	5	C4	28	3
	6	C5	29	3
	7	C6	30	3
	8	D1	31	3
	10	D2	33	3
	11	D3	34	3
	12	D4	41	1
	13	—	—	—
	14	D5	42	3
	15	D6	43	3

Table 6: UVIC configuration for trial 2630636

Data set	Channel	Position	UVIC	Gain (nA)
A	1	A1	45	3
	2	A2	12	3
	3	A3	13	3
	4	A4	14	3
	5	A5	15	3
	6	A6	16	3
	7	B1	18	1
	8	B2	19	3
	9	B3	20	3
	10	B4	21	3
	11	B5	22	3

	12	B6	23	3
	13	Wake	47	3
B	1	C1	24	3
	3	C2	25	3
	4	C3	26	3
	5	C4	28	3
	6	C5	29	3
	7	C6	30	3
	8	D1	31	3
	10	D2	33	3
	11	D3	34	3
	12	D4	41	1
	13	D5	42	3
	14	D6	43	3
	15	TIPS	46	3

Table 7: UVIC configuration for trials 2640246 to 2692314

Notes

The UVIC at position “TIPS” was collocated with the TIPS at height ~2 m on the central tower.

The UVIC at position “Wake” was on the North side of Container H4 as shown in Figure 2. It was at a height of 2.0 m.

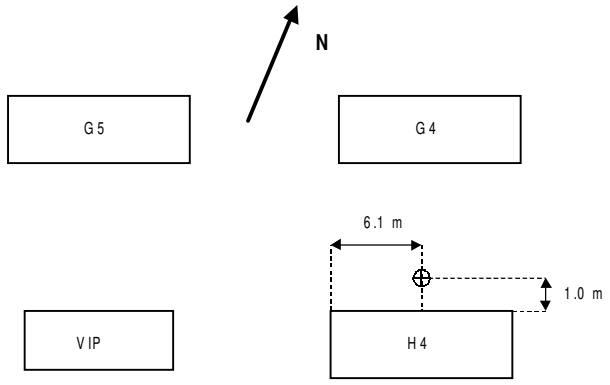

Figure 2: Position of ‘Wake’ UVIC

4.3 Resistances

Grounding problems were experienced which we attempted to overcome by adding resistors to the connections within the junction boxes.

On Day 1 (10/11 Sep) no resistances were applied at all, as not even low-pass filters were used. However, as discussed in section 4.1 the UVICs have a small output impedance, which is estimated to be less than 1,000 Ohms. In addition, long coaxial cables were used to connect the UVICs on the towers to the acquisition system. The resistance of these approximately 100 metre long cables is estimated to be 10-20 Ohms.

Prior to Day 2 (13/14 Sep), 10,000 Ohm resistors were added to the acquisition connector boxes to each signal connection. As mentioned above, the UVICs have a small output impedance, estimated to be less than 1,000 Ohms, and the approximately 100 metre long cables connecting the UVICs on the towers had an estimated resistance of 10-20 Ohms. Filters were not used for any of the tria days because with the additional resistances of these, the UVIC's output signa could overcome the combined resistances of the wiring and those in the connector boxes.

4.4 UVIC Directories and Filenames

The UVIC data was acquired on two separate computers, A and B. Computer A logged data from the UVICs on Towers A (Northwest) and B (Southwest) as well as the UVIC in the wake of Container H4; the data files can be found in directory `Uvic data\Data_a`. Computer B logged data from the UVICs on Towers (Northeast) and D (Southeast) as well as the UVIC collocated with the TIPS at 2m on the Central Tower; the data files can be found in directory `Uvic data\Data_b`.

Within both the `Data_a` and `Data_b` subdirectories, the data files have been subdivided into directories named after the trial day and date, e.g. `DAY01 - 11 Sep`. The binary files `.bin` and associated header files `.hdr` have filenames with root `DDDhhmmX`, where `DDD` is the Julian date, `hh` is the hour of the trial in Mountain Daylight Time, `mm` is the minute and `X` is the computer `A` or `B`.

4.5 Trial Notes for the UVICs

The notes taken during the trial are given below.

General

PC Clocks were synchronised before the start of every trial day and, when possible, between individual trials.

Continuous release unless otherwise stated.

Day 01 – 10/11 Sep 2001 (Julian Day 254 for trial names)

Severe grounding problems. However, it may be possibly to extract concentration data as on each computer A and B, one tower was not hit but showed the same sinusoidal baselines.

Day 02 – 13/14 Sep 2001 (Julian Days 256 and 257)

Grounding problems generally resolved.

Run 2562042a/b started logging at 02:45:00 GMT, 20:42:00 MDT. Detected on Tower A (NW).

Run 2562209a/b started logging at 04:10:00 GMT, 22:09:00 MDT. Detected on Tower B (SW).

Clocks Synchronised.

Run 2562235a/b started logging at 04:35:00 GMT, 22:35:00 MDT. Detected on Tower B (SW).

UVIC 11 changed with UVIC 45 at position A1 (Channel 1 on Tower A).

Run 2562257a/b started at 04:56:00 GMT, 22:56:00 MDT. Problems experienced from 05:04:49 GMT to 05:13:30 as tried to investigate grounding problems. UVIC 29 at position C5 (Channel 6 on Computer B) was disconnected owing to grounding problem.

Clocks Synchronised.

Run 2562325a/b started at 05:25:00 GMT, 23:25:00 MDT. Detected on Tower B (SW).

Run 2562350a/b started at 05:50:00 GMT, 23:50:00 MDT. Wind dropped below $1ms^{-1}$ resulting in the tracer pooling and dispersed very gradually. Detected on all four Towers. UVIC 14 at position A4 (computer A channel 4) not operating properly. Were concerned that other UVICs were not operating properly so tested UVIC 24 at position C1 (computer B channel 1) from 06:06:02 GMT until 06:06:05 GMT and UVIC 25 at Position C2 (computer B channel 2) from 06:06:10 GMT to 06:06:15 GMT, which was unfortunately approximately the time that the cloud passed the sensors.

Clocks Synchronised.

Run 2570548a/b started at 11:48:00 GMT, 05:48:00 MDT. Released in 10 seconds puffs. Detected on Tower A (NW) and C (NE). On Computer A, Channels 7 and 8 (UVIC 18 position B1 and UVIC 19 position B2) became noisy (11:50:00 GMT), Channel 3 (UVIC 13 position A3) had a wobbly baseline, and Channel 8 (UVIC 19 position B2) became noisy (12:10:00 GMT). On Computer B, Channel 5 (UVIC 28 position C4) did not appear to detect anything so possibly it was not working.

Day 03 – 15 Sep 2001 (Julian Day 258)

UVIC 29 at position C5 (Channel 6 on Computer B) remained disconnected owing to grounding problem.

Run 2580637a/b started at 12:45:00 GMT, 06:37:00 MDT. Detected on Towers B (SW) at 12:47:00 GMT, C (NE) at 12:50:00 GMT and D (SE) at 12:52:00 GMT.

Run 2580720a/b started at 13:22:20 GMT, 07:20:00 MDT. Trial aborted at 13:27:00 GMT, 07:27:00 MDT.

Clocks Synchronised.

Run 2580741a/b started at 13:42:00 GMT, 07:42:00 MDT. Other groups had continued logging so maybe part of previous run (2580720) Detected on Towers B (SW) at 13:48:30 GMT, C (NE) at 13:42:30 GMT and D (SE) at 13:43:00 GMT.

Run 2580806a/b started at 14:06:00 GMT, 08:06:00 MDT. Detected on Towers B (SW), C (NE) and D (SE).

Run 2580855a/b started at 14:55:00 GMT, 08:55:00 MDT.

Day 04 – 18 Sep 2001 (Julian Day 261)

Grounding problem for UVIC 29 at position C5 (Channel 6 on Computer B) sorted out so UVIC reconnected.

UVIC 42 at position D5 had a grounding problem so disconnected Channel 13 on Computer B.

Run 2610220a/b started at 08:20:00 GMT, 02:20:00 MDT. Detected on Tower (SE). Southerly wind.

UVIC 47 has been set-up as a Mobile UVIC positioned on the north side of Container H4 at a height of 2m and connected to computer A channel 13.

UVIC 46 was collocated with a TIPS on the central tower at a height of ~2 m (approximately 2 cm below TIPS inlet) and connected to computer B channel 15.

Run 2610458a/b started at 10:58:00 GMT, 04:58:00 MDT. Detected on Tower B (SW) at 11:04:00.

Clocks synchronised on UVIC acquisition computers.

Run 2610532a/b started at 11:32:00 GMT, 05:32:00 MDT. Detected on Tower (NE) and D (SE). Trial aborted due to a change in the wind.

Clocks Synchronised.

Run 2610543a/b started at 11:46:00 GMT, 05:43:00 MDT. Logging started late because the clocks were being synchronised but no tracer was detected until recording started although baselines recording time was short. Tracer detected

on Towers C (NE) at 11:48:00 GMT, D (SE) at 11:46:30 GMT, on the Wake UVIC 11:46:15 GMT and the TIPS UVIC at 11:54:30 GMT.

UVIC 33 at position D2 (Channel 10 on computer B) was not responding.

Run 2610622a/b started at 12:22:00 GMT, 06:22:00 MDT.

Run 2610708a/b started at 13:08:00 GMT, 07:08:00 MDT. Detected on Towers A (NW) and B (SW). UVIC 33 at position D2 (Channel 10 on computer B) was still not responding. Disseminator problem stopped trial.

Run 2610731a/b started at13: 31:00 GMT, 07:31:00 MDT. Detected on Towers A (NW) and B (SW). UVIC 14 at position A4 (channel 4 on computer A) has baseline problem.

Run 2610758a/b started at 13:56:49 GMT, 07:58:00 MDT. Detected on Tower B (SW). UVIC 45 at position A1 (channel 1 on computer A) had a piece of ribbon obstructing the inlet, so measurement may be unreliable.

Day 05 – 19 Sep 2001 (Julian Day 262)

All UVIC's that had gains that were previously set to 10nA were changed to 3nA. Configuration file were updated accordingly.

UVIC 42 at position D5 remained disconnected from Channel 13 on Computer B.

Run 2620224a/b started at 08:24:00 GMT, 02:24:00 MDT. Detected on Towers A (NW) at 08:27:00 GMT, B (SW) 08:27:30 GMT and D (SE) at 08:25:15 GMT, Wake UVIC at 08:25:45 GMT and TIPS UVIC 08:26:00 GMT.

UVIC 33 at position D2 (Channel 10 on computer B) was still unresponsive.

Run 2620246a/b started at 08:46:00 GMT, 02:46:00 MDT. Detected on Towers A (NW), B (SW) and D (SE), Wake UVIC and TIPS UVIC.

UVIC 14 at position A4 (Channel 4 on computer A) had a 'noisy' baseline.

TIPS UVIC repositioned for improved alignment for better comparison. No collocated pretty much exactly.

Run 2620307a/b started at 09:07:00 GMT, 03:07:00 MDT. Detected on Towers A (NW) and B (SW), Wake UVIC and TIPS UVIC.

Run 2620332a/b started at 09:32:00 GMT, 03:32:00 MDT. Detected on Towers A (NW) and D (SE), Wake UVIC and TIPS UVIC.

Run 2620356a/b started at 09:56:00 GMT, 03:56:00 MDT. Detected on Towers A (NW), B (SW) and D (SE) and Wake UVIC.

Run 2620433a/b started at 10:33:00 GMT, 04:33:00 MDT. Detected on Tower B (SW).

Run 2620502a/b started at 11:02:00 GMT, 05:02:00 MDT. Detected on Towers A (NW) and B (SW), Wake UVIC and TIPS UVIC

Day 06 – 20 Sep 2001 (Julian Day 263)

UVIC 42 at position D5 remained disconnected from Channel 13 on Computer B.

UVIC 33 at position D2 (Channel 10 on computer B) was still unresponsive.

UVIC 14 at position A4 (Channel 4 on computer A) was not responsive.

Run 2630415a/b started at 10:15:00 GMT, 04:15:00 MDT. Detected on Towers A (NW), B (SW) and C (NE), Wake UVIC and TIPS UVIC. UVIC 18 at position B1 (channel 7 on computer A) overloaded or at around 10:29:30 GMT.

Run 2630446a/b started at 10:47:00 GMT, 04:47:00 MDT. Detected on Towers C (NE) and D (SE) and Wake UVIC.

Run 2630636a/b started at 12:36:00 GMT, 06:36:00 MDT. Detected on Towers C (NE) and D (SE), Wake UVIC and TIPS UVIC.

Day 07 – 21 Sep 2001 (Julian Day 264)

Connections to computer B were wrong: UVIC 42 at Position D5 was connected to channel 14 instead of channel 13, UVIC 43 at Position D5 was connected to channel 15 instead of channel 14, and UVIC 46 collocated with the TIPS was not connected at all. Header file edited to match actual configuration.

UVIC 33 at position D2 (Channel 10 on computer B) was still unresponsive.

UVIC 14 at position A4 (Channel 4 on computer A) was still not responsive.

Run 2640138a/b started at 07:38:00 GMT, 01:38:00 MDT. Detected on all four Towers.

All relevant connections on computer B were corrected with the UVIC 42 at Position D5 connected to channel 13, UVIC 43 at Position D5 connected to channel 14, and UVIC 46 collocated with the TIPS connected to channel 15. Header file match actual configuration.

Run 2640246a/b started at 08:46:30 GMT, 02:46:30 MDT. Detected on Towers A (NW) and D (SE), Wake UVIC and TIPS UVIC.

Run 2640314a/b started at 09:14:00 GMT, 03:14:00 MDT. Detected on all four Towers, Wake UVIC and TIPS UVIC. No baseline s recorded for this run.

Battery changed on Disseminator.

Run 2640425a/b started at 10:25:00 GMT, 04:25:00 MDT. Detected on Towers B (SW) and D (SE).

Run 2640533a/b started at 11:37:00 GMT, 05:33:00 MDT. Release not detected.

Run 2640638a/b started at 12:38:00 GMT, 06:38:00 MDT. Detected on Towers A (NW) and B (SW).

Run 2640701a/b started at 13:01:00 GMT, 07:01:00 MDT. Detected on Towers A (NW) and B (SW), Wake UVIC and TIPS UVIC.

Day 08 – 22 Sep 2001 (Julian Day 265)

UVIC 29 at position C5 (Channel 6 on computer B) had a noisy baseline.

Run 2650315a/b started at 09:15:30 GMT, 03:15:30 MDT. Detected on Tower (SE) and Wake UVIC.

Run 2650548a/b started at 11:48:00 GMT, 05:48:00 MDT. Puff releases. Detected on Tower C (NE).

Run 2650728a/b started at 13:28:00 GMT, 07:28:00 MDT. Detected on Tower (SE).

Day 09 – 24 Sep 2001 (Julian Day 267)

UVIC 29 at position C5 had a grounding problem. It was disconnected fro Channel 6 on computer B.

Run 2671852a/b started at 00:52:00 GMT, 18:52:00 MDT. Detected on Towers B (SW), C (NE) and D (SE), Wake UVIC and TIPS UVIC.

Run 2671934a/b started at 01:35:00 GMT, 19:34:00 MDT. Detected on Towers B (SW), C (NE) and D (SE), Wake UVIC and TIPS UVIC.

Run 2672003a/b started at 02:03:00 GMT, 20:03:00 MDT. Detected on Towers B (SW), C (NE) and D (SE), Wake UVIC and TIPS UVIC.

Run 2672033a/b started at 02:33:00 GMT, 20:33:00 MDT. Detected on Towers B (SW) and C (NE), Wake UVIC and TIPS UVIC.

Run 2672101a/b started at 03:01:00 GMT, 21:01:00 MDT. Detected on all four Towers, Wake UVIC and TIPS UVIC.

Run 2672150a/b started at 03:50:00 GMT, 21:50:00 MDT. Detected on Towers A (NW) and D (SE), Wake UVIC and TIPS UVIC.

Run 2672213a/b started at 04:13:00 GMT, 22:13:00 MDT. Detected on Towers A (NW) and D (SE), Wake UVIC and TIPS UVIC.

Run 2672235a/b started at 04:35:00 GMT, 22:35:00 MDT. Detected on Towers A (NW) and D (SE), Wake UVIC and TIPS UVIC.

Run 2672303a/b started at 05:03:00 GMT, 23:03:00 MDT. Detected on all four Towers, Wake UVIC and TIPS UVIC.

UVIC 34 at position D3 (channel 11 on computer B) was a little ‘noisy’.

Run 2672338a/b 05:38:00 GMT, 23:38:00 MDT. Detected on Towers C (NE) and D (SE), Wake UVIC and TIPS UVIC.

Day 10 – 25 Sep 2001 (Julian Day 268)

Grounding problems with UVIC 29 at position C5, UVIC 30 at position C6 and UVIC 42 at position D5. Disconnected UVIC 42 (D5) from channel 13 of computer B. Logged UVIC 29 (C5) on channel 6 of computer B and UVIC 30 (C6) on channel 7 of computer B.

UVIC 45 at position A1 (channel 1 on computer A) was not responding, possibly lamp had failed.

Run 2681829a/b started at 00:29:00 GMT, 18:29:00 MDT. Detected on Towers B (SW), C (NE) and D (SE), Wake UVIC and TIPS UVIC.

Run 2681849a/b started at 00:49:00 GMT, 18:29:00 MDT. Detected on TIPS UVIC.

Run 2681921a/b started at 01:21:00 GMT, 19:21:00 MDT. Release of 5-second puffs every 60 seconds (55 seconds separation). Detected on Towers B (SW) and C (NE), Wake UVIC and TIPS UVIC. UVIC 30 at position C6 (channel 7 of computer B) working correctly. UVIC 23 at position B6 (channel 12 of computer A) was noisy. After 30 minutes release frequency changed to every 85 seconds.

Run 2682150a/b started at 03:51:00 GMT, 21:50:00 MDT. Detected on Towers B (SW), C (NE) and D (SE), Wake UVIC and TIPS UVIC.

Run 2682211a/b started at 04:11:00 GMT, 22:11:00 MDT. Detected on Towers B (SW), C (NE) and D (SE), Wake UVIC and TIPS UVIC.

Run 2682234a/b started at 04:34:00 GMT, 22:34:00 MDT. Release of 5-second puffs released every 2 minutes (115 seconds separation). Detected on Towers B (SW) and C (NE), Wake UVIC and TIPS UVIC.

Run 2682256a/b started at 04:56:00 GMT, 22:56:00 MDT. Detected on Towers B (SW) and C (NE).

Run 2682320a/b started at 05:20:00 GMT, 23:20:00 MDT. Detected on Towers B (SW) and C (NE), Wake UVIC and TIPS UVIC.

Run 2682353a/b started at 05:54:00 GMT, 23:54:00 MDT. Detected on Towers B (SW) and C (NE), Wake UVIC and TIPS UVIC.

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Run 2692054a/b started at 02:54:00 GMT, 20:54:00 MDT. Detected on Towers A (NW), B (SW) and D (SE) and TIPS UVIC.

Run 2692131a/b started at 03:31:00 GMT, 21:31:00 MDT. Detected on Towers A (NW) and D (SE) and Wake UVIC.

Run 2692157a/b started at 03:57:00 GMT, 21:57:00 MDT. Detected on Towers A (NW) and D (SE), Wake UVIC and TIPS UVIC.

Run 2692223a/b started at 04:23:00 GMT, 22:23:00 MDT. Detected on Towers A (NW), B (SW) and D (SE), Wake UVIC and TIPS UVIC.

Run 2692250a/b started at 04:50:00 GMT, 22:50:00 MDT. Detected on Towers A (NW), B (SW) and D (SE), Wake UVIC and TIPS UVIC.

Run 2692314a/b started at 05:14:00 GMT, 23:14:00 MDT. Detected on Towers A (NW), B (SW) and D (SE) and TIPS UVIC. Release of 5-second puffs every 2 minutes (115 seconds separation). After third puff, puffs released every 90 seconds (85 seconds separation). From 05:45:00 GMT puffs released every 2 minutes (115 seconds separation).

5 Sonic Notes

5.1 Set Up

The Sonic acquisition system is designed to telemeter and record signals from up to 8 remote ultrasonic anemometers. Severe damage to some of the transmitters reduced the number of available channels to 6: channels 1, 2, 3, 4, 7 and 8. Of these channel 3 failed after a short period of use (data available only on Day 03, 15 Sep, trial day 258).

Two Sonics were deployed on each of the four masts as defined in section 3, in each case the lower instrument being at a height of 2.0 m and the upper instrument being at 6.0 m. The Sonics were placed on booms that extended approximately 1.5 m south of the Tower structure. The bearings of the booms were measured as given in Table 8.

Tower	Quadrant of trial grid	Bearing of boom
A	NW	177°
B	SW	184°
C	NE	178°
D	SE	185°

Table 8: Bearing of Sonic booms on Met Towers

Each Sonic has a serial number and the position of the Sonics were fixed throughout the trials. Table 9 shows the position of the Sonics on the towers.

Tower	2 m Sonic Serial	6 m Sonic Serial
A	7	3
B	2	9
C	8	4

D	6	1

Table 9: Position of Sonics on Met Towers

It was not possible to position the Sonics so that they were exactly vertical. Instead measurements were taken of the pitch, roll and yaw of the individual Sonics, defined as:

Pitch of Sonic
The angle between the upright shaft of the Sonic and the vertical in the North-South plane. A positive angle means that the Sonic's top is tilting towards the South (away from the Tower), and a negative angle means that the Sonic's top is tilting towards the North (towards the Tower). Figure 3 shows this diagrammatically.

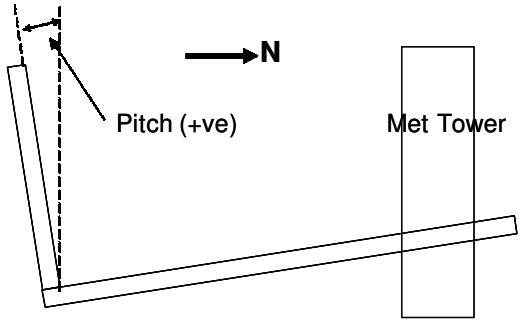

Figure 3: Definition of Sonic Pitch

Roll of Sonic
The angle between the upright shaft of the Sonic and the vertical in the East-Weat plane. A positive angle means that the Sonic's top is tilting towards the West (rotated clockwise looking from North to South), and a negative angle means that the Sonic's top is tilting towards the East (rotated anticlockwise looking from North to South). Figure 4 shows this diagrammatically.

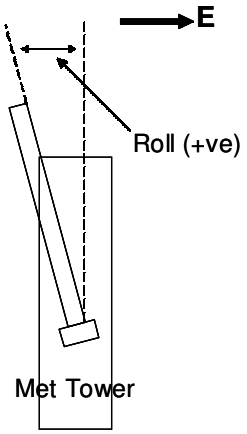

Figure 4: Definition of Sonic Roll. Observer standing South of Met Tower looking towards North

Yaw of Sonic

The angle between the boom and South in the horizontal plane. A positive angle means that the boom is rotated clockwise looking from above. A negative angle means that the boom is rotated anticlockwise looking from above. Figure 5 shows this diagrammatically.

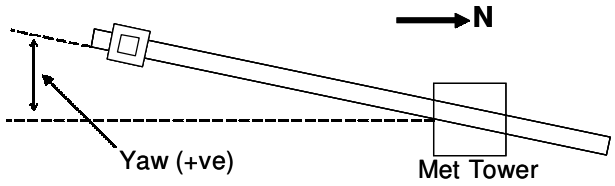

Figure 5: Definition of Sonic Yaw. Plan View.

Each Sonic was aligned so that the specified north direction for the instrument was actually rotated by 180° so that it pointed towards the South, as this was closer to the expected predominant South-easterly wind direction than North. (This reduces the disturbance effects caused by the design of the Sonics.) The tables of Sonic orientation below include the effects of both the instrument offset from the booms (its yaw) and the bearings of the booms themselves (Table 8). As mentioned, in all positions, the Sonics were generally oriented to the South. Table 10 shows the orientation of the Sonics. The Sonic data acquisition system records the fields given in section 5.4b) with the assumption that the Sonic was level and pointing to the North. It will be necessary to apply rotations based on this table to obtain correct values.

Position	**Sonic serial**	**Pitch**	**Roll**	**Yaw**		
				Boom	Offset	Final
A 2m	7	0.2°	-0.3°	177°	+1.1°	178.1°
A 6m	3	-0.09°	0.9°	177°	—	177°
B 2m	2	0.15°	-0.9°	184°	+0.7°	184.7°
B 6 m	9	-0.21°	-0.1°	184°	—	184°
C 2m	8	0.14°	0.5°	178°	+1.5°	179.5°
C 6m	4	-1.03°	-0.43°	178°	—	178°

D 2m	6	0.43°	0.2°	185°	+1.3°	186.3°
D 6m	1	0.4°	2.8°	185°	—	185°

Table 10: Orientation of Sonics on Met Towers

The offset yaw for the lower Sonics was measured accurately using tape measures. The offsets for the upper Sonics were more difficult to measure: using binoculars, an observer placed himself facing the Sonic and aligned with its horizontal orientation and took the bearing using a compass. The observer attempted to stand sufficiently far away from the trials grid that the compass would not be affected by the metal containers. Table 11 contains the offsets measured this way. They appear to be so large (around 10°) compared with the offsets for the lower Sonic (around 1°) that their reliability is doubted, as the attachments for both all the instruments were of the same design. (Additionally, the orientations for the Sonics measured by the compass all tend to the same bearing irrespective of the known offset of the Met Tower to True North, suggesting that the compass was influenced by steel within the experimental grid.)

Position	**Sonic serial**	**Yaw**		
		Boom	Offset	Final
A 6m	3	177°	-8°	169°
B 6 m	9	184°	-10°	174°
C 6m	4	178°	-9°	169°
D 6m	1	185°	-17°	168°

Table 11: Possibly Required Amendment to Horizontal Orientation of Upper Sonics on Met Towers

It is recommended that initially the offsets for the upper Sonics are taken as 0° as in Table 10. Comparison should be made with other meteorological measurements taken on the trial to see if these values are roughly similar. If the comparison suggests that the measured offsets o Table 11 would significantly improve the agreement between the compared measurements, then they should be taken.

5.2 Configuration of Sonic Telemetry Channels

Although the Sonic positions were fixed as described in section 5.1, the telemetry channels were occasionally changed during the trial period in an attempt to

maximise the usefulness of the data collected owing to having only between 4 and 6 channels available.

Three configurations were deployed. These are given in Table 12 to Table 14.

Sonic channel	Position	Sonic serial	Pitch	Roll	Yaw
1	A 2m	7	0.2°	-0.3°	178.1°
2	A 6m	3	-0.09°	0.9°	177°
4	B 6m	9	-0.21°	-0.1°	184°
7	D 2m	6	0.43°	0.2°	186.3°
8	D 6m	1	0.4°	2.8°	185°

Table 12: Configuration 1 of Sonic telemetry channels – Day 1 (Julian day 254) 07:10 11 Sep GMT (01:00 11 Sep MDT) to Day 2 (Julian day 257) 13:37 14 Sep GMT (07:13 14 Sep MDT)

Sonic channel	Position	Sonic serial	Pitch	Roll	Yaw
1	A 2m	7	0.2°	-0.3°	178.1°
2	A 6m	3	-0.09°	0.9°	177°
3	C 6m	4	-1.03°	-0.43°	178°
4	B 6m	9	-0.21°	-0.1°	184°
7	D 2m	6	0.43°	0.2°	186.3°
8	D 6m	1	0.4°	2.8°	185°

Table 13: Configuration 2 of Sonic telemetry channels – Day 3 (Julian day 258) 14:09 15 Sep GMT (03:09 15 Sep MDT) to Day 10 (Julian day 268) 02:07 26 Sep GMT (20:07 25 Sep MDT)

Sonic channel	Position	Sonic serial	Pitch	Roll	Yaw
1	A 2m	7	0.2°	-0.3°	178.1°
2	B 2m	2	0.15°	-0.9°	184.7°

4	B 6m	9	-0.21°	-0.1°	184°
7	C 2m	8	0.14°	0.5°	179.5°
8	C 6m	4	-1.03°	-0.43°	178°

Table 14: Configuration 2 of Sonic telemetry channels – Day 10 (Julian day 258) 02:26 26 Sep GMT (20:26 25 Sep MDT) to Day 11 (Julian day 269) 05:57 27 Sep GMT (23:57 26 Sep MDT)

5.3 Sonic Directories and Filenames

The Sonic data is of two types: the raw binary `.chX` files and ASCII `.asX` files, where `X` is the telemetry channel number. The raw files can be found in directory `\Sonic data\Raw` and the ASCII files can be found in directory `\Sonic data\Ascii`. In both cases the data is separated into subdirectories named after the Sonic telemetry configuration number as given in Table 12 to Table 14 and further separated into trial days to match the UVIC data file structure.

The Sonic data filename root is formatted as `DDhhmmss` where `DD` is the day of the month, `hh` the hour, `mm` the minute past the hour and `ss` the seconds.

5.4 Sonic Data File Formats and Notes

a) Raw Binary `.chX` Files

In order to help handle the binary data, code samples used for reading raw sonic data are given in file `Code for raw sonic data.txt` in directory `Sonic data\Raw`.

No adjustment for the true Sonic alignment has been made to the data fields in these raw binary files. Rotations based on the information given in Table 10 will be required.

There is a Year 2000 issue with the Sonic logging program, which will be addressed in the near future. For the MUST trial it was necessary to set the date on the Sonic acquisition computer to 1990, which gave the same day of the week as 2001 for any specific day of the year. When processing the raw files, it is thus necessary to add 11 years to the date field. This correction has been made to the time stamped ASCII files (see section 5.4b) below).

b) ASCII `.chX` Files

The contents of the binary `.chX` files were simply converted to ASCII `.asX` files. In addition, an algorithm was applied to add a time stamp to the data fields, which should be accurate to within approximately 0.05 seconds. The date field was also corrected to be 2001 (see section 5.4a) above).

The data in the ASCII files are arranged in the following columns:

1. Day of week.

2. Month.

3. Day of month.

4. Time (hour:min:sec).

5. Year.

6. Milliseconds past last second.

7. U in cm/s.

8. V in cm/s.

9. W in cm/s.

10. Speed of sound in cm/s^2.

No adjustment for the true Sonic alignment has been made to the data fields in these ASCII files. Rotations based on the information given in Table 10 will be required.

5.5 Trial Notes for the Sonics

The notes taken during the trial are given below.

General

PC Clocks were synchronised before the start of every trial day.

Day 01 – 10/11 Sep 2001 (Julian Day 254 for trial names)

Sonics channels 1, 4, 7 and 8 logged. Sonic configuration 1.

Day 02 – 13/14 Sep 2001 (Julian Days 256 and 257)

Sonics channels 1, 2, 4, 7 and 8 logged. Sonic configuration 1.

Day 03 – 15 Sep 2001 (Julian Day 258)

Added Sonic telemetry channel 3 for Sonic at position C 6m, giving Sonic configuration 2.

Sonics channels 1, 2, 3, 4, 7 and 8 logged.

Sonic telemetry channel 3 stopped working after a short period.

Day 04 – 18 Sep 2001 (Julian Day 261)

Sonics channels 1, 2, 4, 7 and 8 logged. Sonic configuration 2.

Day 05 – 19 Sep 2001 (Julian Day 262)

Sonics channels 1, 2, 4, 7 and 8 logged. Sonic configuration 2.

Day 06 – 20 Sep 2001 (Julian Day 263)

Sonics channels 1, 2, 3, 4, 7 and 8 logged. Sonic configuration 2.

Sonic telemetry channel 3 only worked for a short period.

Day 07 – 21 Sep 2001 (Julian Day 264)

Sonics channels 1, 2, 4, 7 and 8 logged. Sonic configuration 2.

Day 08 – 22 Sep 2001 (Julian Day 265)

Sonics channels 1, 2, 4, 7 and 8 logged. Sonic configuration 2.

Day 09 – 24 Sep 2001 (Julian Day 267)

Sonics channels 1, 2, 4, 7 and 8 logged. Sonic configuration 2.

Loss of signal on Sonic channel 1 during trial 2671934. Changed aerial.

Day 10 – 25 Sep 2001 (Julian Day 268)

Sonics channels 1, 2, 4, 7 and 8 logged. Sonic configuration 2. Stopped logging at 02:07:44 GMT (20:07:44 MDT).

Telemetry boxes where changed around due to the flow of wind was mainly flowing though towers B and C

Restarted logging at 02:26:36 GMT (20:26:36 MDT) with new configuration. Sonics channels 1, 2, 4, 7 and 8 logged. Sonic configuration 3.

Day 11 – 26 Sep 2001 (Julian Day 269)

Sonics channels 1, 2, 4, 7 and 8 logged. Sonic configuration 3.