MB5 *Multibeam Activity Monitor*

The MB5 *Multibeam Activity Monitor* measures the complete locomotor activity of 16 individual flies, each in a separate tube. 17 independent infrared beams bisect each tube from top to bottom, allowing the unit to record any movement at any location within the 51mm of active length of each tube.

As a fly walks back and forth within its tube, it interrupts these 17 beams in sequence, providing a high-fidelity record of where and when it moved within the tube.

In a typical experiment, an agar/sucrose food mixture is placed into one end of each tube, followed by the fly, and followed by a cotton plug in the open end. The 16 tubes are inserted into holes in the monitor case, and centered.

Over the course of the experiment, which may last for days or weeks, the counting circuits continuously monitor the activity in each tube, and at periodic intervals, upload their movement record to the host computer for storage and analysis. This daily record provides a good measure of both the intensity of locomotor activity, its location within the tube, and the relative periods of sleep or rest.

The multiple beams for each tube allow the unit to record not only beam crossings (counts), but also beam-to-beam transitions (moves), position, beam occupancy (dwell), and length of inactivity (rest.) These detailed measurements may be recorded every second for maximum resolution, and because the fly is always in one of the 17 beams, all movement is captured precisely.

Applications for this unit include assays of position preference, climbing ability, and low-mobility, where multiple beams insure accurate movement capture at any location within the tube.

The MB5 uses the PSIU24 Power Supply Unit and the DAMSystemMB data collection software, to which up to 32 units may be simultaneously connected (each recording at 1-second if so selected.)

MB5

Features

- 16 tubes of 5, 7, or 10mm diameter, 80mm length

- 17 independent beams cover each tube completely, recording all activity along 51mm of active tube length

- Output data types include Counts, Moves, Dwell, Position, and Rest

- 1-second reading interval for up to 32 monitors per system

- Consistent operation in bright room light or darkness

- Tubes may be horizontal or vertical

Specifications

- Dimensions: 18.5" x 2.5" x 2.5" (470 x 64 x 64 mm LWH), tube spacing 1" (25mm)

- Mass: 0.8 kg without tubes

- Requires PSIU24 Power Supply Unit, 32 monitors per system max

- Data collection via DAMSystemMB software (not PSIU9/DAMSystem3)

- Interconnect: 6-wire, 6 position, RJ-11 modular telephone line jack, SPLT8 splitter

- Operating environment: normal laboratory, non-condensing

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Notes

1. The multibeam monitor requires use of the PSIU24 Power Supply Interface Unit, PS24 Power Supply, and CAB6 cables. It is *not* compatible with the PSIU9 Power Supply Interface or its cables and monitors, and should not be connected to them.

2. The DAMSystemMB collection software should be used to acquire data from multibeam monitors, up to 32 simultaneously. Single-beam monitors such as the DAM2 or LAM25 are *not* compatible with this software, and will not work with it.

3. The 16 tubes of the MB5 monitor are numbered 1-16 as shown on the white mask plate. The 17 IR beams for each tube are numbered 1-17 from left to right, and are separated by 3mm. Thus the entire 51mm of exposed tube between the side plates is covered by the multiple beams, and fly movement anywhere along this length will be detected and registered.

4. Activity 'counts' are registered independently at each beam position for each tube, and thus multiple flies in a tube will generate counts at separate beam positions simultaneously. If only a single fly is loaded into each tube, then activity counts will occur in only a single beam channel, and the fly position will be registered as the last beam to count.

5. To compare results with those from single-beam monitors such as the DAM2, extract channel 9, the center of the 17 beams, from the counts tube file. The results should be identical.

6. Counts are registered by each beam as the fly enters the beam. If the fly moves into the beam and sits, only a single count will be accumulated, but if the fly moves around in the beam, multiple counts may be recorded in succession.

7. Moves are registered only when the fly repositions from one beam to the next. Activity which occurs within a beam will be ignored until the fly moves to an adjacent beam.

8. Dwell data builds a simple histogram for each tube of the fly position at each second over the course of a reading. Such data reveals the position preference over time within the tube.

9. The Rest column increments each second for each tube, and is reset to 0 when a move occurs. Thus Rest indicates the number of seconds since the last detected move.

Tubes

We supply 5mm tubes in Corning Pyrex glass and polycarbonate plastic. While the 65mm tube length will work, the 80mm length is recommended for this unit. Both materials are transparent, and may be washed and autoclaved for cleanliness and sterility.

Fly Food

A food mixture must be placed into one end of each tube to sustain the fly over the course of a multi-day experiment. Many recipes are reported in the literature, but a simple one which works is as follows:

100 ml water

5g sucrose crystals

2g agar powder

Combine the ingredients in a glass beaker, and bring carefully to a boil using a hot plate or microwave oven. When the solids are completely dissolved, pour the solution slowly down the side of another glass beaker containing the tubes standing on end, to a level of about 15mm deep. Allow the mixture to cool and solidify. Carefully remove the tubes from the agar matrix,

sealing the tops with a finger to retain the food, and wipe them clean. Then seal the food end of each tube with either a quick dip in melted paraffin wax or a plastic cap to prevent desiccation. The flies may now be loaded, one into the open end of each tube, and the tubes then plugged with cotton.

System Setup

1. Download and install the USB driver from the TriKinetics web site.

2. Connect the PSIU24 to its PS24 power supply, and connect the USB cable from the PSIU24 to a port on the data collection computer (Macintosh or Windows PC.) Verify that the PSIU green led is on.

3. Download the DAMSystemMB data collection software application from the TriKinetics web site, and place it into a separate folder on the hard drive.

4. Launch the application, and click on Preferences.

5. Select the Serial Port corresponding to the PSIU USB connection, most likely the last one. Verify that the monitor status boxes are red and not black.

6. Select the reading interval, monitor range, and output file options.

7. Connect the multibeam monitor(s) to the PSIU24 using the 6-conductor phone cables provided. Verify that the status box for each monitor turns from red to green.

8. Load 5x65 or 5x80mm tubes containing flies into the 16 positions of each monitor by inserting the tubes from one side, through the monitor, and out the other side. Beams 1 and 17 graze the 2 sides of the monitor case at each tube position, so cotton or food in the tube ends should just barely, if at all, extend into the tube interior beyond the monitor sides. No harm will come from blocking one or more of the 17 beams, just no counts will be recorded at that position.

9. If flies are allowed to roam beyond the monitor sides, they clearly will be out of the detection range of the IR beams, and will not be counted. The current position will remain accurate.

Data file management

Monitor data is saved in the individual Monitor text files in the DAMSystem4Data folder. This folder resides in the same directory with the DAMSystem4 application, as does the DAMSystem4Settings file and the DAMSystem4Log file. All of these files are automatically generated by the program when necessary.

At the conclusion of an experiment, the relevant Monitor files (perhaps only a few of the total) should be moved (drag or cut/paste) out of the DAMSystem4Data folder and into another folder on the computer. This will effectively terminate the data collection, for at the next reading the program will create new Monitor files for these monitors, and begin writing new data into them. Thus the files just moved will contain the activity records for the experiment just ended, and a new set of files will begin for the next one.

The moved monitor files, now disconnected from the data collection process by being out of the DAMSystem4Data folder, may be transferred to another computer for archival storage, FileScan, and analysis or plotting.

MultiBeam Data Output Format

Multibeam data is saved into 42-column tab-delimited Monitor text files, similar in layout to those of the DAMSystem3 monitors. Each selected output data type in the Preferences window will cause one or more lines of text to be written to the monitor file at each reading.

Selections in the Monitor column generate only a single row at each reading, and contain summary data for each tube (count totals, move totals, position.)

Selections in the Tube column generate one 42-column output row per tube, and therefore contain the full-fidelity data for each tube (counts, moves, dwell at each beam position.)

All data rows for each monitor are written to a single Monitor file at each reading. The FileScan application can be used at the conclusion of an experiment to separate the individual data types within the monitor file into distinct files for analysis (counts, moves, dwell, position.)

Monitor File: Header Columns - common to all data types

Index	Column 1	Incremented with each reading, 1 at program launch
Date at reading	Column 2	DD MMM YY
Time at reading	Column 3	HH:MM:SS
Monitor Status	Column 4	1 Valid data status green 51 no monitor data received status red 50 no connection to PSIU status black
Extras	Column 5	Number of extra readings, if any, consolidated by Filescan
Monitor number	Column 6	1-255
Tube number	Column 7	1-32 or 0 if monitor row
Data type	Column 8	Mv = moves, Ct = Counts, Pn = Positions, Dw = Dwell
	Column 9	unused
Light Sensor	Column 10	1 = On, 0 = Off (not present in all units)

Monitor File: Data columns - specific to each output data type

Monitor rows contain summary data for all tubes in a single row

Monitor Counts	Columns 11-42	Total counts for each tube
Monitor Moves	Columns 11-42	Total moves for each tube
Monitor Positions	Columns 11-42	Position for each tube

Tube rows contain complete data for each tube in a separate row

Tube Counts	Column 11	Position
	Column 12	Total counts for tube
	Column 13-42	Counts in each beam
Tube Moves	Column 11	Position
	Column 12	Total moves for tube
	Column 13-29	Moves in each beam
	Column 30	Rest for tube (seconds since move)
	Column 31-42	unused
Tube Dwell	Column 11	Position
	Column 12	Total dwell (seconds)
	Column 13-42	Dwell in each beam (seconds)

Columns will contain 0 if unused.

MultiBeam FileScan

The FileScan program will properly manage multibeam data files, and may be used to scan for errors, consolidate bins, select start and stop bins, etc. There are output file options for each monitor and tube data type, as well as the legacy channel format for monitor counts.

Monitor Files	1 output file per monitor, 42 columns, Monitor rows only
Tube Files	Multiple output files per monitor, 1 for each tube, 42 columns each
Channel Files	32 output files per monitor, 1 column each from columns 11-42 of monitor counts rows

Precautions

Beware of operation in proximity to incandescent light, where stray infrared illumination can easily interfere with the exposed detectors. Perform an empty-tube run to verify zero counts prior to operation with live specimens.

Beware of liquid spills onto the green circuit boards. Unplug the unit immediately if water or any liquid drips inside, and dry thoroughly in a warm (40C) oven prior to reuse.

Data Collection Software

This sample output shows all 16 flies quiescent for the number of seconds in the rest column, with their current position shown in red. The fly in tube 16 moved 30 seconds ago into beam 13, after transiting from beam 1 to beam 17 and then back to beam 13 where it now sits.

DAMSystem MB

Display Select			Next Reading in: 30 seconds		Monitor Status
Monitor 4	Counts		Date: 18 Oct 18		■ 1
Current	Moves		Time: 19:26:00		■ 2
Previous	Dwell	Preferences	Index: 28		■ 3
					■ 4

Tube	Posn	Total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Rest
1	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	608
2	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	607
3	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	618
4	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	618
5	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	618
6	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	562
7	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	562
8	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	373
9	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	373
10	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	373
11	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	373
12	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	373
13	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	373
14	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	557
15	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	372
16	13	20	0	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	1	30

v1.06   TriKinetics Inc   Quit

DAMSystemMB Data Collection Software