FOOD-WATER-LIQUID INTAKE MONITOR FOR GROUP-HOUSED RODENTS [HM-2]

The HM-2 system is the only online food-water intake and activity monitor on the market that continuously monitors feeding and drinking activity in two independent channels in group-housed rodents. The channels have been designed for low spillage, for high standards of hygiene, and for ease of operation and cleaning. The feeding and drinking data is collected without human intervention - the system records events with millisecond precision, including meal start time, amount of food consumed, meal duration, and meal end-time. Activity is monitored at the cage-level and reports a circadian rhythm of the social group. Configurations allow the researcher to establish the parameters for the experiment, study and session in advance. The system can operate with or without refilling the feed hopper and water bottle, due to the event-based nature of the system. Most importantly, it allows feed intake data to be collected automatically without disturbing the animal's normal eating behavior.

Subject Identification [RFID]

Individual animals housed together in the same cage are identified using ISO FDXB RFID tags, e.g. DataMars®, Pet-ID®, e-Vet®. Tagging is a safe way of identifying individual animals, and when integrated with MBRose weigh stations and scanners provides fully automated subject tracking through the entire experiment.

RESEARCH APPLICATIONS

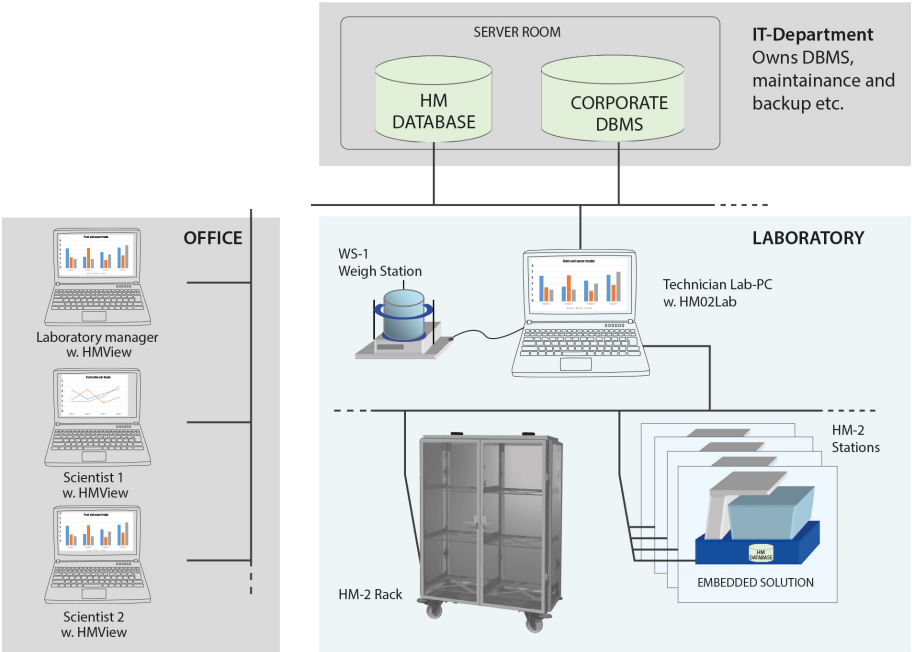
- Obesity & Diabetes
- Metabolic process
- Impact of treatment on health and behaviour
- Feed and liquid preference
- Eating behaviour
- Activity behaviour

MBRose

Software

The software that are delivered with the HM-2 system include HM02Lab, HMBase and HMView. The experiments, studies and sessions are centrally controlled by HM02Lab, which runs on a designated PC in the animal facility. The data collection software ensures robust storage of raw data in the HMBase SQL database. Data review is available in HMView which provides an easy 5 step process for the research to move raw data through to completed graphs. In addition, data can be extracted via predefined and custom filters to your preferred data analysis and visualization software, such as SigmaPlot®, Graphpad Prism® or Excel®.

HM-2 Client Server Solution



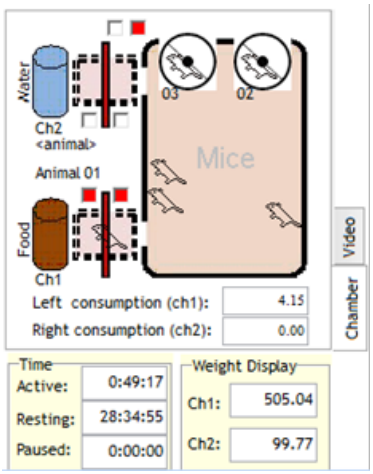
The client server solution provides secure, remote access to experimental parameters and raw data. The system spans at least 3 environments, including the animal facility, office and server room. With the HM-2 system placed inside the animal facility, researchers design their experiment and submit the protocol to the HM database, located on the corporate server. With experimental parameters now in place, the researcher can send an e-mail to the animal facility manager or technician permitting them to move forward with animal registration, experiment initiation, husbandry, body weighing, dosing procedures and completion of the protocol. Conveniently, the researcher can follow experiment progress from their office, make changes if necessary and even begin analyzing data in realtime. Simultaneously, other team members can use the system as well - they can submit their own project or analyze older data. This efficient multi-stream data collection and analysis process is possible because raw data is saved on a local database on each HM-2, and is also synchronized with the HM-database located on the corporate server.

EXERCISE WHEEL [EW-2]

The EW-2 Exercise Wheel is an accessory designed for mouse configurations of the HM-2 Food-Water-Liquid Monitoring System. The EW-2 is a modular device that is placed directly inside the cage. RFID sensors are located within the wheel housing, which serve to identify which animal is in the wheel at any given time.

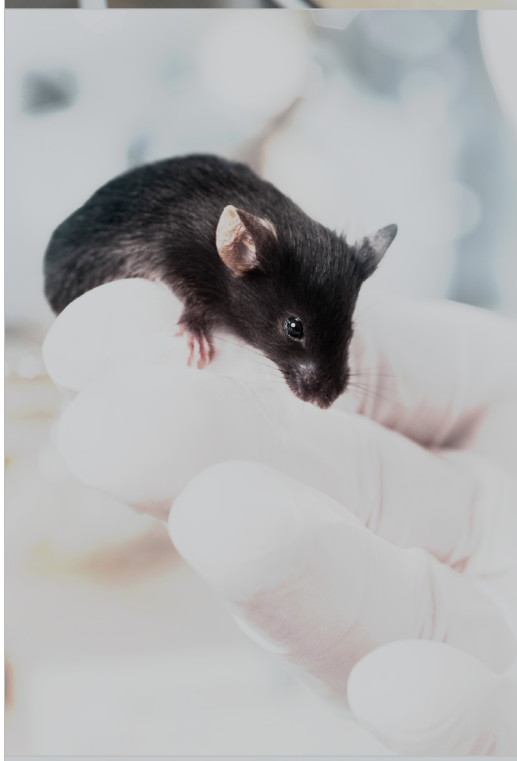
Setup, Data Processing and Analysis

Whether connected to the HM-2 network, or a stand-alone embedded controller [EMB-19i], experiments, studies and sessions involving the EW-2 are centrally controlled by the HM02Lab application running at the central Lab-PC. Running wheels appear in the HM02Lab application as two wheel icons in the detailed cage view (see image to right). Wheel turns are saved as time stamped events in milliseconds and raw data can be extracted via predefined and custom filters to your preferred data analysis and visualization software, such as SigmaPlot®, Graphpad Prism® or Excel®. Built in reports calculate distance, duration and speed for selected bins down to 10 seconds.



Subject Identification [RFID]

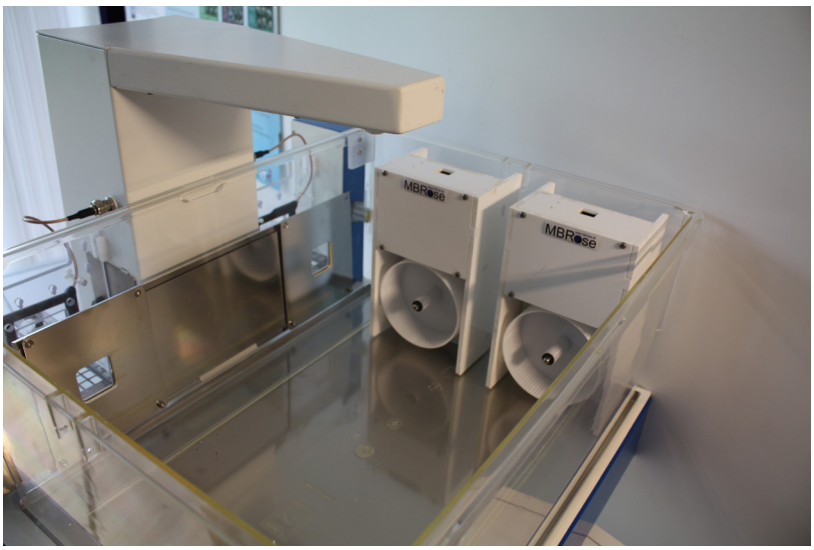
Radio-frequency identification (RFID) uses electromagnetic fields to automatically identify and track tags/transponders attached to an object. The tag contains an electronic stored identification code. RFID in our field of work is a passive identification system, which means that the tag will only reveal its identity when asked from a reader. The reader supplies the energy for the tag to go active and picks up the identification code. Animals are identified using ISO FDXB RFID tags, e.g. DataMars®, Pet-ID®, e-Vet®. Tagging is a safe way of identifying individual animals, and when integrated with MBRose weigh stations and scanners provides fully automated subject tracking through the entire experiment.



MBRose

Specifications

Parameter	Abbreviation	Value	Unit	Note
Height	H	195	mm	
Width	W	115	mm	
Depth	D	95	mm	
Wheel Diameter	DIA	96	mm	
Sensor 1	SEN1	Digital	0/1	Hall Effect
Sensor 2	SEN2	Digital	0/1	Hall Effect
Magnet size	M	2x10x10	mm	Power magnet
RFID reader frequency	F_{RFID}	134.2	kHz	ISO FDXB
Cable connection	Con-Phys	UTP/RJ45		3
Network	Con-Sig	COM 232, prop.		RS 232, Dig. I/O, PWR
Weight of unit	WHEW-2	670	gram	Without optional metal shield



THE STATIONARY WEIGH STATION [WS-1]

The WS-1 is all about efficiency and the elimination of human error. The weigh station automatically scans RFID tagged animals when weighed and reports the scan ID to the HM02Lab software together with the weight data. Through this process, accurate bodyweight is entered into the HMBase database and directly associated to the animal in question. A dose calculation feature is also included, which streamlines experiments where subject dosage is calculated from the animals' bodyweight.

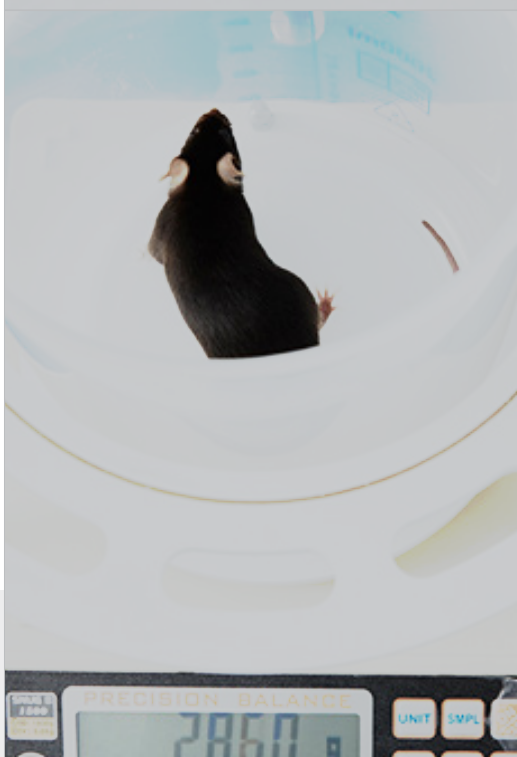
Bodyweight Entry

The WS-1 automatically weighs and scan RFID tagged animals and sends information to the HM02Lab application that directly associates the received data with the specific animal being weighed. This way human error is eliminated and the weighing process made efficient and fast.

Subject Identification [RFID]

Radio-frequency identification (RFID) uses electromagnetic fields to automatically identify and track tags/transponders attached to an object. The tag contains an electronic stored identification code. RFID in our field of work is a passive identification system, which means that the tag will only reveal its identity when asked from a reader. The reader supplies the energy for the tag to go active and picks up the identification code.

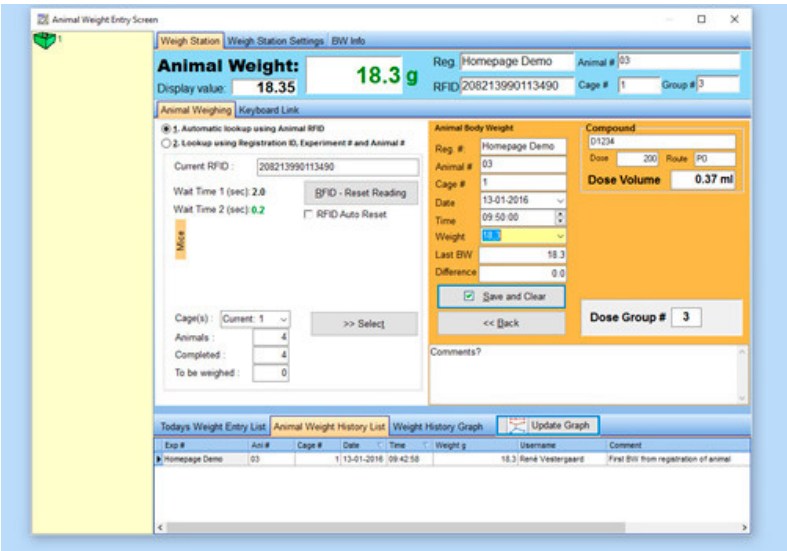
Animals are identified using ISO FDXB RFID tags, e.g. DataMars®, Pet-ID®, e-Vet®. Tagging is a safe way of identifying individual animals, and when integrated with MBRose weigh stations and scanners provides fully automated subject tracking through the entire experiment.



MBRose

Other Features

From the computer, the scientist can see the animals' bodyweight history and determine if there has been a change since the previous recording. This process serves as a confirmation of accurate recording - if the researcher has any doubt about the validity of the bodyweight measurement, the data can be overwritten and the subject can be simply weighed again.



Specifications

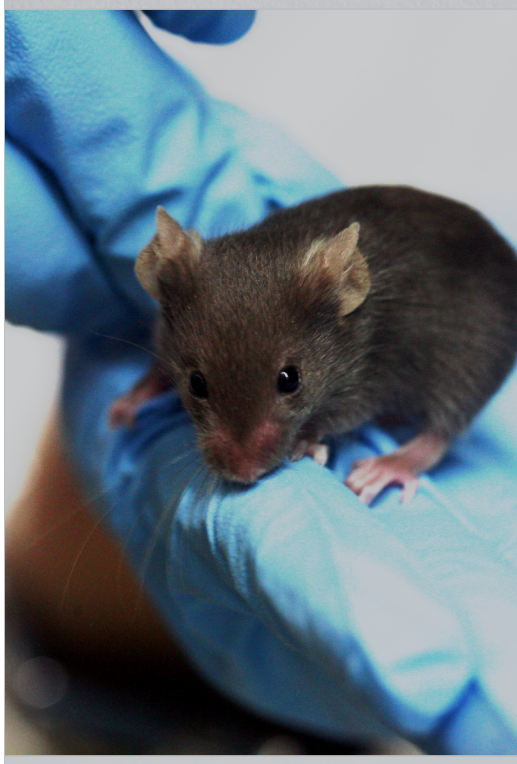
Parameter	Abbreviation	Value	Unit	Note
Load capacity	Lmax	1000	g	
Load resolution	Lres	10	mg	
Load accuracy	Lacc	50	mg	
RFID reader frequency	F_{RFID}	134.2	kHz	ISO FDXB
Cable connection	Con-Phys	USB		USB 1.0
Weight of station	WWS-1	5	kg	

THE STATIONARY FLEXIBLE WEIGH STATION [WS-2]

Much like the WS-1, the WS-2 offers an effecient, flexible process for animal bodyweight recording that eliminates human error.
A functional system includes a portable RFID antenna and controller from MBRose, paired with a weigh scale and computer provided by the user. Integration requires that the weigh scale includes a RS232 data output port. A single USB cable and input is required to connect the RFID antenna and scale to the Lab-PC.

Bodyweight Entry

The process for collecting bodyweight data is fast and simple. As an animal (research subject) is passed in front of the antenna and placed on the weigh scale, RFID information is gathered and reported to the HM02Lab software together with the weight data. Through this process, accurate bodyweight is entered into the HMBase database and directly associated to the animal in question. A dose calculation feature is also included, which streamlines experiments where subject dosage is calculated from the animals' bodyweight.



Subject Identification [RFID]

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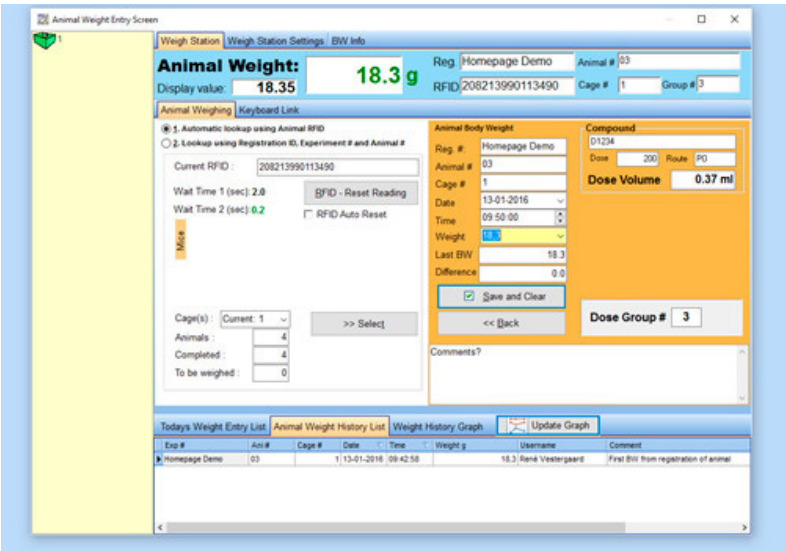
MBRose

Other features

From the computer, the scientist can see the animals' bodyweight history and determine if there has been a change since the previous recording. This process serves as a confirmation of accurate recording - if the researcher has any doubt about the validity of the bodyweight measurement, the data can be overwritten and the subject can be simply weighed again.



AUTOMATED MOTION AND BODY WEIGHT TRACKING FOR OBJECTIVE MONITORING OF RATS IN COLONY HOUSING [HM-3]

The HM-3 is a tracking system specifically designed for enriched large group housing environments where body weight and voluntary activity measurements are desired. It houses up to 48 animals in one cage, providing opportunity to jump, go uphill, speed up, climb, hide or segregate from the group. It presents automated individual tracking and body-weight data, 24/7, for each subject.

Subject Identification [RFID]

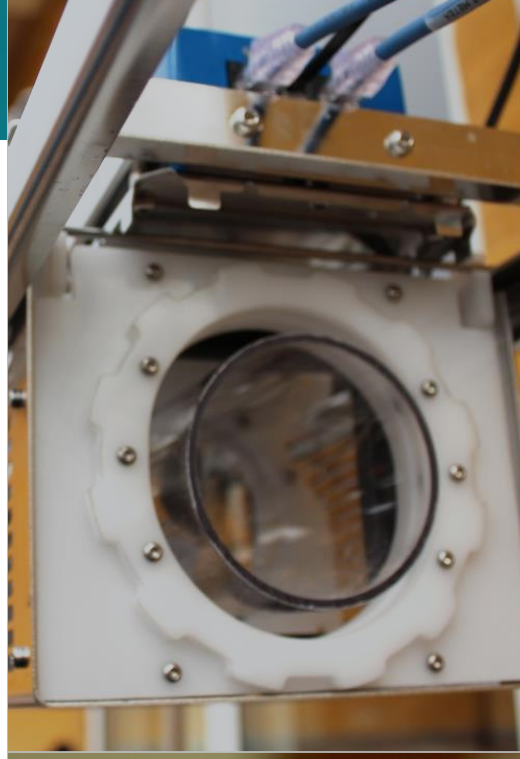
Individual animals housed together in the same cage are identified using ISO FDXB RFID tags, e.g. DataMars®, Pet-ID®, e-Vet®. Tagging is a safe way of identifying individual animals, and when integrated with MBRose weigh stations and scanners provides fully automated subject tracking through the entire experiment.

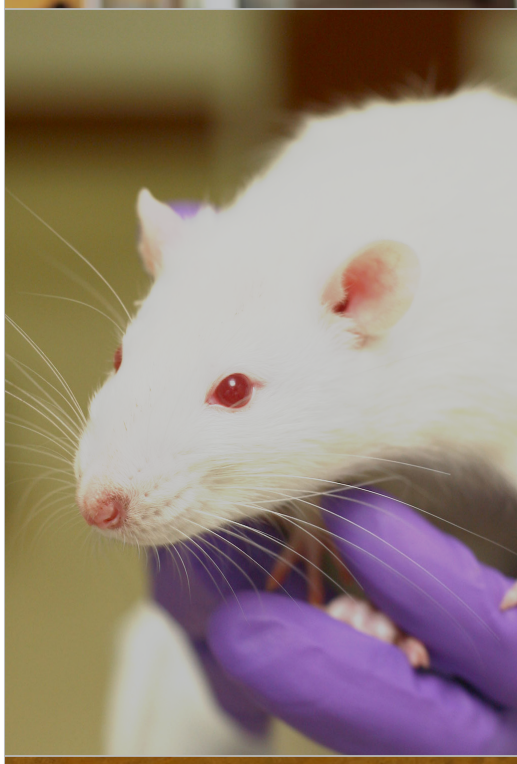
Body Weight Monitoring

The integration of the water access in the BW-1 supports regular weighing of all animals several times per day - bodyweight data is collected without human intervention. The system records the start time of each entry into the BW-1 weighing tube, the duration of the stay and the finishing time. Setup configurations allow the researcher to establish the parameters for the experiment, study and session in advance.

Jump Hole and Tracking Point Activity Monitors

Jump Hole [JP-2] and Track Point [TP-1-700] detectors are optimized for fast reading and is immune to interference with other RFID readers. Jump height is a simple variable of the experiment, set individually for each jump hole -- lining tubes are available in various lengths and are positioned by the press flanges in the jump hole. Tracking is registered by IR beam break when passing the loop for zero radiation (134.2 kHz excitation). First read latency is 250 ms.





MBRose

Embedded Controller & Data Processing

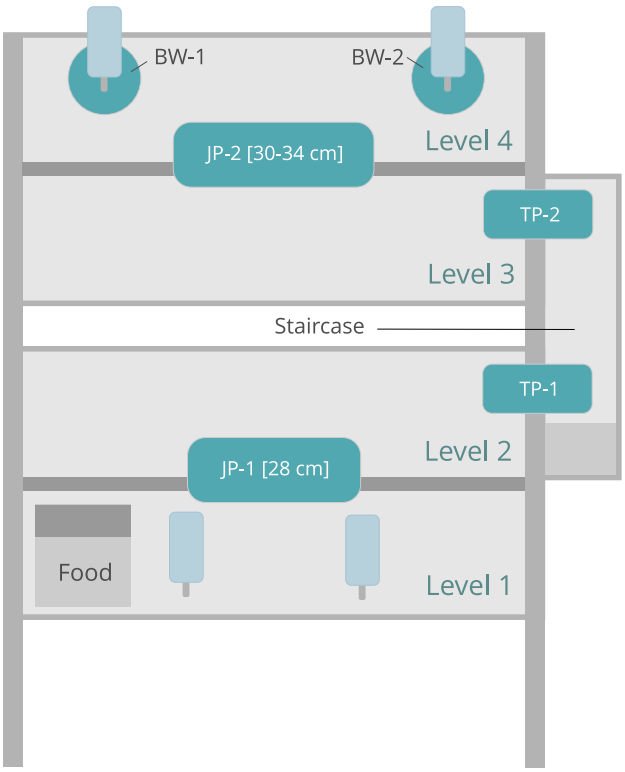
An embedded controller [EMB-19i] controls the individual rack and monitoring sensors, and communicates with the LabPc. Effectively, this makes the HM-3 rack self-contained, storing data locally until synchronised. In addition, the EMB-19i includes a health alarm function keeping track of animal activity.
The experiments, studies and sessions are centrally controlled by the HM03Lab application running at the central Lab-PC. Data collection software ensures robust storage of raw data in the HMBase SQL database and data view is available in HMView presenting the data quickly at the researcher's desk for check of experiment results. Data may be extracted via filters to SigmaPlot®, Graphpad Prism® and Excel®, for in-depth correlation with other research.

RESEARCH APPLICATIONS

- Measure Pain
- Reduced Movement
- Animal Health

Mechanical Outline

The HM-3 system is mounted in a Rat Colony Cage, based on a Techniplast F-Suite. The HM-3´s mechanical outline separates the system into seven parts.



1. Body weight stations on level 4 [BW-1+2]
2. Jump holes from level 1-2 and 3-4 [JP 1+2]
3. Tracking Point from level 2-3 [TP 1+2]
4. Water source on level 1 and 4
5. Food source on level 1
6. Embedded controller unit – EMB-RDMBS
7. Laboratory PC with the HM03Lab software installed – Lab-PC

THE ONLINE FEEDING MONITOR FOR SINGLE-HOUSED PIGS [MP-1]

The MP-1 Feed Intake Monitor (FIM) automatically measures and records the undisturbed, real-time food intake and the feeding behaviour of single-housed pigs in their home pen around the clock, and meal by meal.

Food Consumption Monitored Online

The FIM continuously monitors feeding activity at the trough, which has been designed for low spillage, for high standards of hygiene, and for ease of operation and cleaning. The feeding data is measured without human intervention. The system records the start time of each meal, the amount of food consumed, the duration of the meal, and the finishing time. Setup configurations allow the researcher to set parameters for the data collection prior to each experiment.

MP02 Database

The data collection software ensures robust storage of raw data and viewers are available to present the data quickly in order to check experiment results. Data may be extracted via filters to SigmaPlot®, Graphpad Prism® and Excel®, for in-depth correlation with other research. Export procedures to corporate database structures are also available on request.

RESEARCH APPLICATIONS

- Obesity
- General metabolic process
- Food preference
- Impact of treatment on health/behaviour
- Eating behaviour

MBRose

Features & Benefits

- Mounts quickly and easily to the pen enclosure with adjustable brackets for correct feeding height.
- Trough designed for high standards of hygiene, minimum food spillage, and ease of feed filling and cleaning.
- Full operational control at the FIM allows individual experiments to be started and stopped directly from the pen.
- A single cable connects both power and data network to the central data collection unit.
- Up to 48 FIMs may be connected through the network to the central unit.
- Data collection using the HM-Win database allows robust collection of information, which is then made available by the data viewer or via interface filters to Excel®, SigmaPlot® and Graphpad Prism®. It also allows export facilities to other lab databases.
- For remote site monitoring, the FIM may collect data using a stand alone operation mode without a central unit.
- Simple tare function of the entire system or of individuals.
- The FIM emits no light, no heat and no noise.
- A built in calibration function allows simple calibration to meet company quality standards.

Specifications

Parameter	Abbreviation	Value	Unit	Note
Volume capacity	Vmax	12	l	
Load capacity	Lmax	15	kg	
Load resolution	Lres	1	g	
Load accuracy	Lacc	5	g	
Meal start detection	$T_{Det\ start}$	5	s	1
Meal end detection	$T_{Det\ end}$	5	s	2
Cable connection	Con-Phys	UTP/RJ45		3
Bus Type	Con-Sig	CAN		ISO 11898/11519
Weight of FIM	Wfim	20	kg	

Note 1: The period in which the load cell readings are unstable before a meal session is started.
Note 2: The period in which the load cell readings are stable before a meal session is ended
Note 3: Standard UTP Cat 5 or better may be used to wire the FIMs to the central unit

MBROSE ONLINE FOOD-WATER-LIQUID INTAKE MONITORING: SUGGESTED READINGS

Publications

HM-2: Water intake disorder in a DEND syndrome afflicted patient with R50P mutation

HM-2: Cell Metabolism – FGF21 Mediates Endocrine Control of Simple Sugar Intake And Sweet Taste Preference By The Liver

HM-2: Alcohol & Alcoholism – SY15-2SUBCHRONIC LOW DOSE EXENDIN-4 PRETREATMENT INHIBITS RELAPSE TO ALCOHOL DRINKING IN HIGH ALCOHOL PREFERING C57BL6 MICE

HM-2: Physiological and Pathological Impact of Blood Sampling by Retro-Bulbar Sinus Puncture and Facial Vein Phlebotomy in Laboratory Mice

MP-1: Obesity – Liraglutide, a Once-daily Human Glucagon-like Peptide-1 Analog, Minimizes Food Intake in Severely Obese Minipigs

HM-2: Cerebral Markers of the Serotonergic System in Rat Models of Obesity and After Roux-en-Y Gastric Bypass

HM-2: Tesofensine, a Novel Triple Monoamine Reuptake Inhibitor, Induces Appetite Suppression by Indirect Stimulation of α_1 Adrenoceptor and Dopamine D_1Receptor Pathways in the Diet-Induced Obese Rats

The glucagon-like peptide 1 receptor agonist Exendin-4 decreases relapse-like drinking in socially housed mice
https://www.ncbi.nlm.nih.gov/pubmed/28778739

The histamine H3 receptor antagonist thioperamide rescues circadian rhythm and memory function in experimental parkinsonism
https://www.ncbi.nlm.nih.gov/pubmed/28398338

Posters

HM-2: Monitoring food intake in mice with the HM-2 system

HM-2: TESOFENSINE, A NOVEL TRIPLE MONOAMINE REUPTAKE INHIBITOR, INDUCES APPETITE SUPPRESSION BY COMBINED STIMULATION OF α1 ADRENOCEPTOR AND D1 DOPAMINERGIC RECEPTORPATHWAYSINTHEDIET-INDUCEDOBESERAT

Tutorials

Measuring Behavior 2012, Enhancing animal welfare in high throughput systems
www.measuringbehavior.org/files/tutorials/MB2012_MBRose.pdf