QUALITY INSPECTION SUMMARY

We have made every effort to manufacture this instrument to the highest quality standards. All assemblies have been thoroughly tested and inspected at the factory as follows:

Initial Assembly Inspection	_____	☐
Initial QC Inspection/Calibration	_____	☐
2 Hour Burn-In	_____	☐
Final Performance Inspection	_____	☐

Packaging Inspection Initials: _____ Date: _____

Items included with any catalog number may be labeled and packaged separately in shipping carton.

	Description	**Quantity**	**Checked**
55-50-3	MSU – Monitor Sync Unit	_____	☐
55-50-3-02	MSU Power Adapter	_____	☐

FHC, Inc. maintains a system of traceability to allow for product notifications in the event that issues arise pertaining to the recall or failure of critical components contained in this instrument. In order that we may properly notify you, we ask you to complete the following information and return to:

Quality Assurance Department
FHC, Inc.
1201 Main Street
Bowdoin ME 04287 USA
Serial Number(s) _____ _____ _____
Installation and Functional Checkout Complete per section 2.2 and 2.4 of this manual:

Accepted by: _____

Institution: _____

Date: _____

0.1 EC Declaration of Conformity

We: **FHC Europe – Termobit Prod s.r.l.**

of: **42A Barbu Vacarescu Str. 3rd Fl**

Bucharest 020281 Sector 2

Romania

declare that:

Equipment: **MSU – Monitor Sync Unit**

Model: **Catalog No 55-50-3**

Serial Number: _____

in accordance with the following Directives:

73/23/EEC	Low Voltage Directive
	and its amending directives
89/336/EEC	Electromagnetic Compatibility Directive
	and its amending directives

I hereby declare that the equipment named above has been designed to comply with the relevant sections of the above referenced specifications. The unit complies with all essential requirements of the Directives.

Signed by: Keri S. Seitz Digitally signed by Keri S. Seitz DN: c=US, st=ME, l=Bowdoin, o=FHC, Inc., ou=Admin, cn=Keri S. Seitz, email=kseitz@fh-co.com Date: 2012.08.30 16:47:16 -04'00'

Name: Keri Seitz

Position: President, FHC

Done at: *FHC Inc., 1201 Main Street, Bowdoin, ME 04287 USA*
Phone: 1207-666-8190, Fax: 207-666-8292
E-mail: fhcinc@fh-co.com, Website: http://www.fh-co.com

CE

"Innovation through collaboration"

FHC

Providing Instrumentation and Apparatus for Cellular Research, Intraoperative Recording; and Microneurography; Microelectrodes, Micropipettes, and Needles to the Neuroscience Community for 40+ years.

MSU – Monitor Sync Unit

55-50-3 MSU – Monitor Sync Unit

A1009 (REV. A0, AUGUST 2012)

microTargeting™

neurocraft™

FHC Headquarters
1201 Main Street,
Bowdoin, ME, 04287 USA
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24 hour technical service
+1-207-666-8190
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(TERMOBIT PROD srl)
42A Barbu Vacarescu Str, 3rd Fl
Bucharest 020281 Sector 2
Romania

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Manual A1009: 55-50-3 MSU

0.2 ***CONDITIONS FOR USE***

Intended Use
Monitor Sync Unit main intended functionality is to provide a digital synchronization signal to recording equipment and experiment control units from displays on which visual stimuli are presented. It is not approved for use on human patients.

Warnings
The Monitor Sync Unit components should not be disassembled beyond their major assemblies. Any disassembly beyond this may affect function and calibration. If repair is required please contact FHC at (207) 666-8190 for evaluation and to secure a return authorization number if necessary.

Storage Precautions
Store at normal room temperatures between -34°C (-29°F) and 57°C (135°F). Do not expose to temperatures below -39°C (-29°F) or greater than 70°C (158°F), or a relative humidity of less than 10% or more than 100%, including condensation, or an atmospheric pressure less than 500hPa or greater than 1060hPa for long-term storage.

Sterilization
None of the Monitor Sync Unit components are designed for sterilization. Any attempt to sterilize them may result in malfunction or component failure.

Handling
While a high degree of durability has been designed into the Monitor Sync Unit components, care should be taken not to drop them. Do not force any of the connections. Place all cables and leads where they will not be inadvertently pulled or tangled.

1 *OPERATIONAL MANUAL*

1.1 *FEATURES*

- Sends real-time triggers of visual stimuli to recording instruments (APM) or experiment control modules (ECM), for synchronizing electrophysiological recording and visual stimulation.
- Hardware triggering based on actual on-screen presentation rather than from other hardware or software, minimizes delay and jitter.
- Photodiode attaches to upper left corner of screen with supplied tape.
- Compact circuit box easily mounts to side or rear of monitor.

1.2 *DESCRIPTION*

The MSU Monitor Sync Unit provides a real-time TTL triggering pulse to an electrophysiological recording system or experiment control units for synchronization of the recordings with visual stimuli.

1.3 *OPERATING ENVIRONMENT*

The MSU is designed to be used within the subject box on a visual stimulus monitor.

1.4 *INVENTORY*

1.4.1 *ITEMS DESCRIBED IN THIS MANUAL*

The following Items are included under the following catalog numbers:

1 ea. 55-50-3 MSU – Monitor Sync Unit

Includes: Monitor Sync Unit

A1009 Manual

1.4.2 *ADDITIONAL ITEMS REQUIRED FOR OPERATION*

The following additional items are ORDERED SEPERATELY:

1 ea. 55-50-3-02 5V MSU Power Adapter

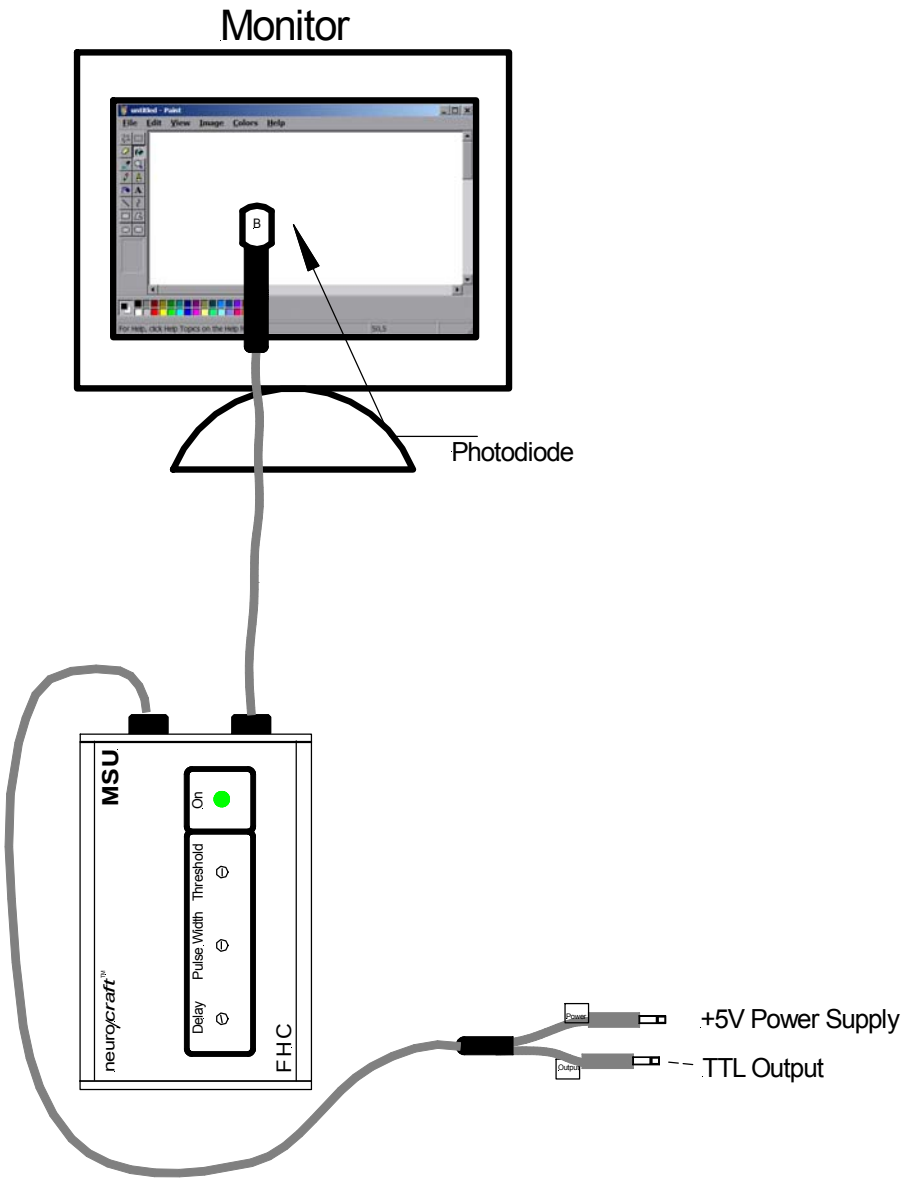
1.4.3 *REPLACEMENT ITEMS*

None

1.4.4 *OPTIONAL ACCESSORIES*

None

1.4.5 ***SYSTEM CONFIGURATIONS***



List and description of system configurations including any additional items from sec. 1.4.2

1.5 *CONCEPTS*

1.5.1 *TERMINOLOGY*

TTL – stands for **Transistor–Transistor Logic** which is a class of digital circuits built from bipolar junction transistors (BJT) and resistors. It is called transistor–transistor logic because both the logic gating function (e.g., AND) and the output buffering/amplifying functions are performed by transistors. The designation TTL is in this used in this manual as a reference to TTL-compatible logic levels, even when not associated directly with TTL integrated circuits. The TTL logic levels are: low voltage: 0V to 0.8V, high voltage: 2V to V_{CC} where VCC is 4.75 V to 5.25 V.

1.5.2 *DESIGN DESCRIPTION*

The MSU consists of a photodiode connected to a circuit board by 4” of shielded cabling. The photo diode attaches to a convenient screen region (with provided opaque tape). On progressive scan monitors (like CRT monitors) there will be a variable delay of the trigger pulse depending on the position of the photodiode on the monitor.

The circuit board is enclosed in a box that fits with the neurocraft packaging. The photodiode cable will be captured within the packaging. The box will attach to the monitor with provided material (Velcro)

The circuit board connects to an ECM Simulus through a 3.5mm mono jack labeled “ECM”. A 20’ cable (3.5mm mono male/male) will be provided for interfacing with the ECM.

1.6 *TECHNICAL SUMMARY*

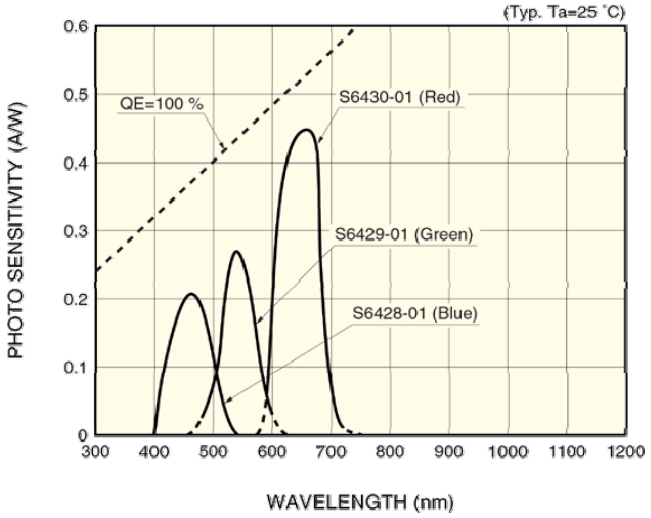
1.6.1 *SPECIFICATIONS*

MSU:

Optical Sensor: Hamamatsu S6429-01 photodiode

Peak Sensitivity: 0.27 A/W (photodiode), 0.27 V/µW (MSU)

Spectral Response: (from Hamamatsu photodiode data sheet)



Dark Current: 0.02nA

Input Capacitance: 250 pF total (200 pF photodiode + 50 pF MSU)

Detection Threshold Voltage Range: 0 to 2.38V or 0 to 8.8 µW

Delay Range : 0.1 ms to 21 ms

Output Pulse Width Range : 0.1 ms to 21 ms

Output Voltage: 5V TTL, normal/inverted – jumper selectable.

Weight: 265g (without any cables)

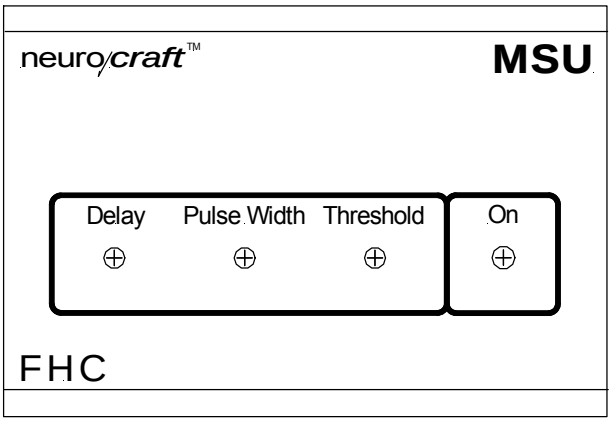
Dimensions:

Height: 1.69” (4.3cm)
Width: 3.07” (7.8cm)
Length: 4.84” (12.3cm)

Case: Anodized Aluminum, (analog common), 4 rubber feet.

Output Cable: Shielded, DB37M-M, 1.0cm dia. 3m (10’) (other lengths available).

1.6.2 ***CONTROLS/CONNECTORS***



Control – MSU Front Panel

Delay: multitrim potentiometer for adjusting the delay between the detection of a light pulse and the output pulse.

Pulse Width: multitrim potentiometer for adjusting the output pulse width.

Threshold: multitrim potentiometer for adjusting the light pulse detection threshold.

Connections– MSU Side Panel

Power: 3.5mm mono jack

Output: 3.5mm mono jack for interfacing with other systems (APM, ECM etc).

1.6.3 ***COMPATIBILITIES***

Compatible with all existing FHC and NeuroCraft™ products.

1.7 ***ILLUSTRATIVE PROCEDURE***

1. Attach the photodiode of the MSU the monitor.
2. Install the MSU and power it up. Check the functionality by connecting its output through a MONO-to-BNC adapter to an oscilloscope input. Set the oscilloscope to 2V/div vertical scale and 1 ms/div horizontal scale (typically).
3. Display a flashing stimulus in the monitor display area where the photodiode is attached.
4. Adjust the threshold such that the stimulus is reliably detected, as indicated by the signal displayed on the oscilloscope. If the threshold is too low, no pulses will be detected, since even when the stimulus is off, the background illumination may cause the photodiode signal to be above the detection threshold. If the thresold is too high, the signal when the stimulus is on will always be below the detection threshold, and no output pulses will be visible.
5. Adjust the delay of the output pulse. In most cases, the delay will be set to a minimum (0.1 ms)
6. Adjust the width of the output pulse.
7. Check the re-triggerable functionality of MSU by flashing the stimulus at an interval smaller than the pulse width. With a CRT monitor, this it easy to test by displaying a continuous stimulus and setting the pulse width to a value greater than the vertical refresh interval. In this case, the MSU

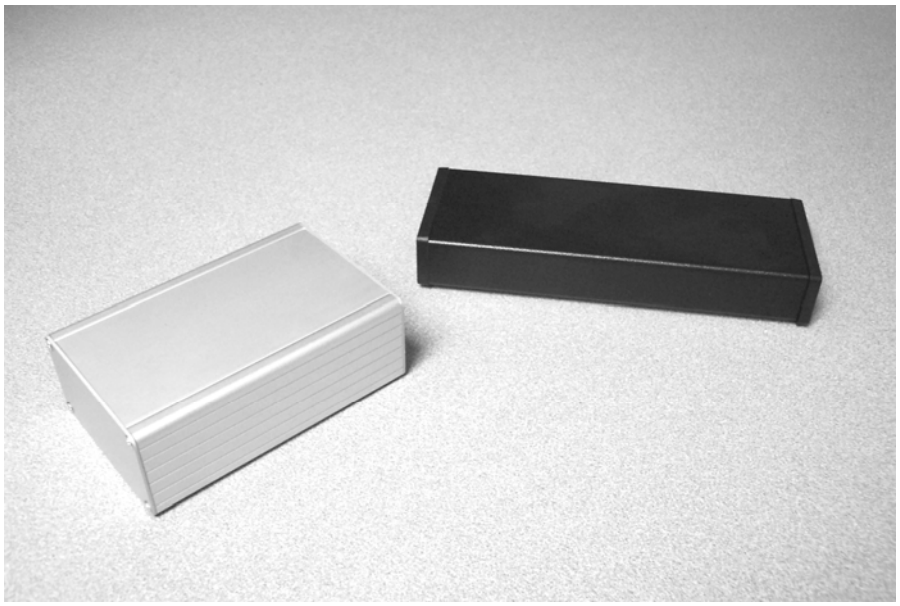
output should be continuosly on while the stimulus is presented. Setting the pulse width to a value less than the vertical refresh interval should result in a sequence of pulses spaced with the vertical refresh interval (16.67 ms @ 60 Hz), as long as the stimulus is on.

8. Once the settings are the desired ones, disconnect the output from the oscilloscope and connect it to the recording system or the experiment control module. Test its functionality within your experimental setup and refine adjustments, whenever required (change of monitor, adjustments in the brightness/contrast, repositioning the photodiode etc).

2 *REFERENCE MANUAL*

2.1 *REFERENCE INFORMATION*

2.1.1 *PACKAGING*



The neuro/craft™ series instruments designated as Unit (as in MSU Monitor Sync Unit) are designed to be modular in nature. Generally located close to the subject, they are tethered through either captive or detachable cabling to the stand-alone or channel type instruments. Shown above are two examples of this type of packaging (a MSU type box to the left and an MCU type box on the right.). If the packaging will require opening in order to set or calibrate, that will be described in the relevant instruction sections of the manual.

2.1.2 *MOUNTING*

All stand-alone modules are completely encased and can be used without further mounting or hardware. Provided rubber feet may be used to protect surfaces from scratching. However, it may be suitable to group modules, and we have made provision for several configurations. The SAF-08 Rack Frame for Stand-Alone Modules (cat #55-11-0) will hold up to eight Type 2 modules, four Type 4 modules, or two Type 6 modules and 2 ea. Type 2 Dress Panels (cat #55-11-1 use optional), while occupying only 3 rack units (5.25") vertically on a standard 19” instrument rack. Several combinations are available for all of the neuroCraft series stand-alone modules. For example an SAF frame could accommodate 3-Type 2, 1-Type 4, and 1-Type 6 within its 16" of horizontal rack space.

2.1.3 *INSPECTION*

FHC Modules are factory checked and calibrated but should be carefully inspected upon receipt, before using, or activating power. If any exterior damage to the shipping carton is noted, the instrument(s) should be inspected for obvious physical damage. The contents of each package

should be physically checked against the inventory list (sec. 1.3) to determine shortages or errors in inventory.

2.1.4 ***POWER CONNECTIONS***


The stand-alone modules in the NeuroCraft series are powered by a desktop 12V power supply (input:100-240VAC, 50-60Hz, 1.7A; output: +12VDC,5000mA) (Cat. # 55-00-1) or by a 5V power supply (input:100-240VAC, 50-60Hz, 1A; output: +5VDC,5000mA) (Cat. # 55-50-3-02). An international pattern Line Cord (not shown) is ordered separately, and is specified by country per the catalog number. (See table below for catalog numbers.) Additionally, the power transfer cord (not shown) supplied with the NeuroCraft stand-alone modules can be used to "daisy-chain" the power between other instruments in the series from one power supply. The MSU uses the 5V version of the power supply, and can be also powered through custom cables from other devices, like ECM (Cat. #55-50-0). As the connectors for the 5V and 12V power supplies are different, there is no risk for accidentally using the wrong power supply. The amount of modules powered from one supply is determined by the amount of current drawn by each module. Contact Technical Services at (207) 666-8190 for assistance.

55-AUS	Australia
55-CH	China
55-DAN	Denmark
55-EURO	Europe
55-ISR	Israel
55-ITA	Italy
55-JA	Japan
55-SAF	South Africa
55-SWI	Switzerland
55-UK	United Kingdom
55-USA	North America

2.1.5 ***WARRANTY***

All FHC products are unconditionally guaranteed against defects in workmanship for one year from date of shipment as long as they have been exposed to normal and proper use. Although the one-year warranty may have expired, please contact our Service Department before attempting any repairs or alterations. Many of these repairs will still be performed at the factory at no charge to the customer.

2.1.6 ***POLICIES***

1.TECHNICAL SUPPORT: It is our policy to provide our customers with the most comprehensive technical support in the industry. If any questions arise or problems occur, we encourage you to call

or write and we promise to promptly and comprehensively respond to your requirements.

2.TRADE-UP POLICY: It is our policy to offer customers trade-up ability as new and/or expanded capabilities for their instruments are announced. In many cases, full credit will be given. In general, we will allow 100% credit for two years and depreciate 20% per year thereafter. Please contact our Marketing Department for information relating to your particular situation.

2.1.7 ***SERVICE***

Should service be required, please contact our Service Department for a return authorization number and instructions (207-666-8190). Please have the model and serial number on hand (Both are located on the back panel). Carefully pack the instrument before returning.

Please include a note indicating:

1. The model number and purchase date of the instrument
2. The person to contact if questions arise
3. The "symptoms" indicating that repair is necessary

If the instrument is not covered by the warranty, a quotation will be forwarded to the sender detailing the repairs necessary and charges, before repair is begun.

2.2 *INSTALLATION*

1. Ensure that the MSU is placed in a convenient out of the way spot.
2. Attach the photodiode to the display (using adhesive tape, for instance), by placing it over the desired active region of the display.
3. Connect the output to your recording or experiment control unit.
4. Connect the power to the unit using either the stand-alone power adapter or a custom power cable that connects to the experiment control unit (for instance to ECM feature connector pins 60 and 55). When using custom cables, maximum attention has to be paid to prevent polarity reversal, which results in permanent damage of the unit.

2.3 *FUNCTIONAL CHECKOUT*

Please use the steps described in the ***Illustrative Procedure*** section 1.7 of this manual to perform a functional checkout.

2.4 *OPERATIONAL INFORMATION*

1. The photodiode detects changes in the luminance of the screen area over which it is placed, generating a weak current that is converted to a voltage and amplified by the MSU circuitry. The sensitivity of the photodiode and MSU analog circuitry is 0.27 V per µW of light power falling onto the photodiode.
2. A digital pulse is generated by an analog comparator circuitry whenever this voltage exceeds a threshold that is set by adjusting the ***Threshold*** potentiometer located on the MSU front panel.
3. For insuring a convenient timing of the output pulse, the digital pulse at the output of the comparator can be further delayed using an adjustable monostable circuit. The ***Delay*** potentiometer on the front panel can be used to adjust the delay in the range 0.1 ms to 21 ms.
4. The MSU outputs a single pulse of a limited duration, regardless of how much time the input exceeds the threshold, if no further crossings of the threshold level occur. The width of the output pulse can be controlled from the ***Pulse Width*** potentiometer on the front panel in the range 0.1 ms to 21 ms.
5. Further crossings of the threshold level that occur while the output is active, will result in extending the duration of the pulse with the same time interval as the pulse width setting, from the point the threshold is exceeded. This is the retriggerable monostable feature of the MSU that can be used for generating steady output levels even when using displays (like CRT's) that that display information in frames that are refreshed at a particular rate. A steady pulse can be obtained whenever the pulse width is set to a value larger than the frame refresh rate (e.g. 16.67 ms @ 60 Hz).

2.5 *SCHEDULED MAINTENANCE*

The Monitor Sync Unit components are not user repairable or serviceable. The functional checkout in section 2.3 of this manual should be performed on a yearly basis. If any discrepancies are found, please contact Technical Services at (207) 666-8190 to discuss.