



MyoSystem 1400L

Operation and Technical Manual



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MyoSystem 1400L Installation and Setup

The Noraxon MyoSystem 1400L is a state-of-the-art modular EMG data collection system. The MyoSystem 1400L offers outputs for each EMG input channel with the capability of expanding up to 16 EMG or sensor input channels in addition to 4 accessory analog input channels.

The setup and installation are actually quite simple. Check to see that you have all the proper parts and components.

Step #1 - Unpack All Items and Check Inventory

The following items should be included with the MyoSystem 1400L. *(See figure on next page)*

1. MyoSystem 1400L Instrument: White case that contains EMG input connectors on the front.
2. Detachable power cord: The cord plug is matched to your country's specific wall receptacle configuration.
3. Active Cable: One cable provided per 8 EMG channel. Cables provided according to the number of channels ordered.
4. Preamplified EMG leads: One lead per channel. The reference lead has 3 snaps, all others have 2 snaps.
5. USB cable: For communication between the MyoSystem 1400L and a computer.

Step #2 – Connecting the System

1. Place the MyoSystem 1400L instrument on a level tabletop or a stand adjacent to your computer and testing area.
2. The MyoSystem 1400L was supplied with a detachable power cord. Plug the mating end of the power cord into the receptacle on the rear of the instrument. Note that the opposite end of the power cord has a safety or ground terminal on its plug. It is essential only to plug the power cord into a wall outlet that has a properly grounded receptacle.
3. Plug the Active cable set into the input connector on the front of the MyoSystem. Please note that each Active cable has 8 plug-in lead terminations. There are two-snap preamplified electrode leads for each EMG channel plus one three-snap preamplified electrode lead (usually lead #1). The longer third snap is to provide an electrical reference to the subject. The electrode connected to this extra snap should be placed on a non-muscular area or bony prominence, such as the back of the wrist. This connection must be used regardless of how many EMG channels are being monitored. Only one reference is required for any number of channels.
4. The unit may now be connected to any USB compatible computer system by use of the USB connector on the back of the instrument.



MyoSystem 1400L Components



1. MyoSystem 1400L Instrument



2. Power Cord
(Country Specific)



3. EMG Active Cable



4. Pre-amplified electrode lead
(One per channel)
3 snap version shown



5. USB Cable



Controls and Displays

Front Panel



- 1. Active Cable Connector (Channel 1-8)
- 2. Power Indicator

Back Panel



- 1. Fuse Holder
- 2. Power ON/OFF Switch
- 3. Power Cord Inlet

- 4. USB Connector
- 5. Analog Output Connector



Explanation of Symbols



Symbol for type BF patient connection. This identifies that the patient electrode connections are electrically isolated from the mains (AC) power source.



Symbol identifying approval to market this product in the European Community as certified by Notified Body #0344, KEMA.



MyoSystem 1400L Cable and Accessory Connection/Disconnection

1. Active Cables (General)

Noraxon uses the term 'Active Cable' to mean that isolated low voltage, low current power is present in the cable. The active cable carries 8 sEMG (or sensor) lead pairs and terminates in a 20-pin connector. The 20-pin connector on the MyoSystem 1400L front panel (see item 1 in CONTROLS and DISPLAYS) carries SEMG leads 1-8 (or leads 1-4 on a four channel system).

The active cable should be secured to the front panel with the locking clips to preserve the integrity of the cable shielding as well as to avoid unintended disconnection. Gently tug on the cable to confirm that the clips are locked into position.

2. Preamplified Leads

The preamplified EMG leads have built in electronics powered from the MyoSystem 1400L active cable. In addition, any of the eight EMG leads can be separately removed or replaced with other leads or sensors. The preamplifier electronics are contained in the removable lead and can be a single (standard) or a double differential configuration.



It is advisable to turn off the MyoSystem 1400L power before connecting or disconnecting any active cable or individual lead. Failing to do so could damage the lead electronics.

The MyoSystem 1400L is designed to accept any battery powered analog signals that are limited to +/- 5 volts. These signals can be substituted for any of the SEMG preamplified leads. Noraxon supplies an extensive line of direct plug-in sensors that can be safely attached. Users planning to apply their own battery powered sensors should contact Noraxon to insure compatibility and safety. If the sensor has its own power source (battery) then the +5 volt and -5 volt power connections on the cable connector should not be made.

The +/- 5 Volt power supplied through the active cable is electrically isolated from the main (50/60 Hz wall power) supply. This power is protected by re-settable fuses, so that if the power lines are accidentally 'shorted' the circuit will open and power is removed. Once the 'short' circuit (i.e. faulty preamplified lead or sensor) is removed the fuse will reset and power will be restored. Re-settable fuses are present on inputs sets 1-4, 5-8. If a short develops in any one input of a set, the other 3 inputs in the set will lose power and fail to operate. Less likely, but also possible is a fault inside the active cable itself.



If a set of 4 inputs simultaneously become non-operational, a fault has occurred. To locate the fault, disconnect all non-operational inputs and then one-by-one reinsert them into the active cable.

3. Analog Output Cable

All EMG signals are available at the back of the MyoSystem 1400L on a 25 pin analog output connector (see item 7 in CONTROLS and DISPLAYS) and are scaled to +/- 5 volts. An output cable with an overall shield is required to assure electromagnetic compatibility.



It is important to turn off the MyoSystem 1400L power before connecting or disconnecting the analog output cable. Failing to do so could damage the output electronics.

4. USB port

There are both high and low speed versions of USB cables. The MyoSystem 1400L requires a high speed USB cable for attachment to the back panel USB connector (see item 4 in CONTROLS and DISPLAYS). The USB cable may be freely connected or disconnected at any time without damage to the instrument or PC. However, software problems can arise if the USB cable is disconnected when active communication is taking place between the MyoSystem 1400L and the computer.



Beware that loss of all data acquired in a recording is possible if the USB cable is inadvertently disconnected before an active data recording is completed.



Use of Disposables

While the MyoSystem 1400L can operate with reusable electrodes, it is most commonly used with disposable surface electrodes. Any good quality silver/silver chloride electrode is acceptable. Noraxon provides several types of quality disposable electrodes for a wide variety of SEMG applications. It is recommended that any electrodes used with the MyoSystem 1400L satisfy the requirements for standard ANSI/AAMI EC12-1991 Disposable ECG electrodes.



Advisory on Use of Disposables

Because disposable electrodes have a shelf life, it is important not to use expired electrodes. Bulk disposable electrodes come packaged in a sealed container or bag. The expiration date can be found printed on the package container. After the sealed bulk container is opened, the remaining electrodes should be used before their gel begins to dry out. Always keep the remaining electrodes in their bulk package until they are used. Avoid using electrodes that are randomly found lying outside of their bulk packaging as their expiration date is uncertain and their gel has been exposed to accelerated drying.

Noraxon discourages any attempt to reuse a disposable electrode, even if it simply is to peel it off and slightly reposition the electrode's muscle placement. Noraxon strongly recommends against the use of dried out electrodes that are re-wetted with electrode gel.

Electrode Application Guidelines and Facts

1. If the subject has a fair amount of hair at the electrode application site, the hair should be clipped. Shaving is not necessary and may irritate the skin.
2. The electrode application site should be clean and dry. The preferred method of cleaning is with soap and water plus drying the skin with a dry cloth. Dry skin contributes to good electrode adhesion and good trace quality.
3. Cleaning with isopropyl alcohol should be avoided or limited to situations where electrode adhesion is an issue (diaphoresis, excessively oily or lotion covered skin), since it may dehydrate the skin thereby causing skin impedance to increase. If alcohol is used, allow it to dry prior to electrode application. A 'skin prepping gel' is a much better way to lower the skin impedance if a reliable electrode connection can not be made.
4. Attach the lead wire to the electrode prior to placing the electrode on the skin. This will eliminate the potential for discomfort if snap lead wires are pressed onto the electrode after the electrode has been applied.
5. Electrode application sites should be abraded to lower the skin impedance. Abrasion patches can be found on most electrodes. Simply draw the abrasion patch several times over the skin of the intended application site.
6. Electrodes are the weak link in the EMG measurement chain. Lack of proper attention to electrode quality or site preparation is by far the most common cause of inferior recordings.
7. It may take up to 5 minutes for disposable electrodes to fully stabilize electrically once applied to the skin. If extremely critical or precise measurements are intended the electrodes should be applied several minutes in advance of the recording.



- 8. Cable motion artifact, if present, can be minimized by immobilizing the electrode lead wires near the snap end of the cable. Taping or wrapping the wires to the subject may prove helpful when very dynamic movements are being measured.
- 9. When attaching the cable set to the electrodes always connect the Reference lead first. This permits any difference in static electricity between the subject and the instrument to be safely discharged.

Maintenance and Cleaning

The MyoSystem 1400L is designed to be maintenance free. For interested users, Noraxon offers a MultiTester device that can inject standard test signals to confirm proper operation.

Care should be exercised not to place or stack objects (especially liquids) on top of the MyoSystem 1400L case. Not only does this avoid the possibility of accidental liquid spillage into the instrument but allows air to freely circulate through the enclosure ventilation slots.

The instrument case and cables can be wiped down with a damp cloth using a mild soap or detergent and water. Isopropyl alcohol can be safely used to remove tape or other adhesive residues from the cables. Before cleaning any portion of the system, the instrument should be unplugged from the wall power outlet.

Troubleshooting Common Problems

The source of any problem can be quickly determined by an awareness of causes according to their likelihood of occurrence. For EMG measurements, problem sources from most to least likely suggest examination in this order:

- 1) electrode site preparation
- 2) electrode
- 3) improper instrument setting
- 4) subject or muscle site variability
- 5) electrode cable fault
- 6) instrument fault

Keep this sequence in mind whenever troubleshooting EMG problems. As can be noted the highest frequency problems involve electrodes. In recognition of this fact, Noraxon offers a low cost Electrode Impedance Checker device to quickly and efficiently identify electrode fault conditions. Noraxon encourages all users to include electrode impedance testing as part of routine practice. In addition, Noraxon offers a MultiTester device that can be used to verify proper operation of the instrument itself.

Isolating Single Channel Problems

SYMPTOM	CAUSE	DIAGNOSTIC
Noise or artifact	Electrode	Impedance Check fails on that channel
	Intermittent cable lead	Exchange cable lead with another set of electrodes on a working lead, problem will remain with original lead
	Instrument	MultiTester check fails on that channel
Weak/Strong signal	Improper gain	Verify SET GAIN value
	Subject variability	Exchange EMG leads with another set of electrodes on a working lead, problem will now appear on substitute lead



Isolating Multiple Channel Problems

SYMPTOM	CAUSE	DIAGNOSTIC
Noise or artifact	Electrodes	Impedance Checker fails on several channels
	Reference electrode	Impedance Checker fails on Reference electrode
	Intermittent cable	Problem resolves with replacement of cable
	Ground loop	Problem resolves after disconnecting all other equipment attached to the MyoSystem 1400L
	AC power source	Problem is alleviated by placing an isolation transformer between the MyoSystem 1400L and the AC outlet
	Instrument	MultiTester check fails on several channels
Weak/strong signals	Improper gain	Verify SET GAIN values
	Subject variability	Exchange cable leads with other sets of electrodes on working leads, problems will now appear on substitute leads

Isolating USB Communication Problems

SYMPTOM	CAUSE	DIAGNOSTIC
PC doesn't recognize the MyoSystem 1400L	Missing USB driver or INF file	Check Windows Device Manager's USB settings
Communication frozen	USB driver lockup	Problem resolves when MyoSystem USB cable is unplugged/re-plugged and or Windows is restarted
	Non-compliant USB device	Problem resolves when other USB devices are removed from the USB bus

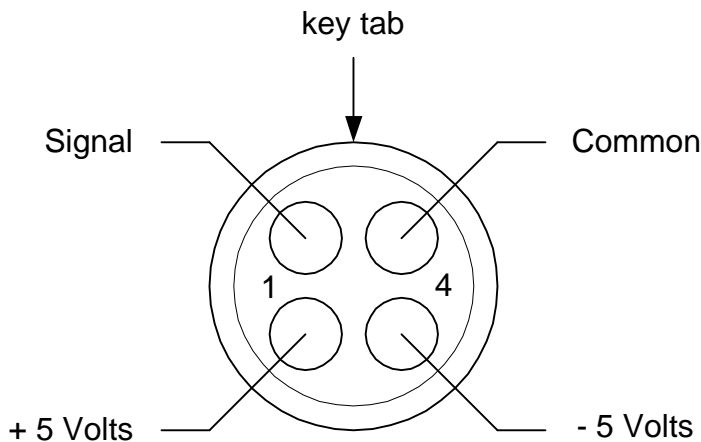


Signal Inputs and Outputs

Preamplified Lead / Sensor Connectors

These connectors are intended for Noraxon supplied lead sets or sensors. Use of other cable sets may reduce signal quality or compromise safety features.

Active Lead / Sensor Wiring Diagram



Binder Connector
p/n 09-9764-70-04
Solder Side Shown

Analog Output Connector

This connector is available for general use with cables supplied by Noraxon, the user or other manufacturers. Use of a shielded cable is required to preserve electromagnetic compatibility. All outputs vary between +/- 5 volts. The DB-25 connector pin assignments are as follows:

pin	upper row signals	pin	lower row signals
1	n/c	14	EMG lead 6
2	n/c	15	EMG lead 3
3	n/c	16	EMG lead 7
4	n/c	17	EMG lead 4
5	n/c	18	EMG lead 8
6	n/c	19	signal common
7	n/c	20	signal common
8	n/c	21	signal common
9	signal common	22	n/c
10	signal common	23	n/c
11	EMG lead 1	24	n/c
12	EMG lead 5	25	n/c
13	EMG lead 2	shell	MyoSystem 1400L enclosure/earth ground



Cleaning, Disinfecting & Sterilization of Electrode Cables

The electrodes, whether disposable or reusable, surface, fine wire or needle make the only intimate contact with the patient or subject. However, the electrode cables can and do make physical contact with the individual. For sanitary purposes it is advisable to clean the cables on a regular basis. Electrode cables can be cleaned with a solution of mild soap or detergent and water. Isopropyl alcohol can be used to remove adhesive residue from electrodes or tape.

The electrode cables are not constructed to withstand repeated application of any disinfectant solution. Likewise the cables are not warranted against exposure to any of the conventional forms of sterilization. Users wishing to utilize this equipment in a sterile environment, such as an operating theater, should consult Noraxon for other options. In certain cases cable extenders can be provided to accommodate the attachment of sterile terminal leads to the patient.

Sterilizing Electrodes

Noraxon provides high quality disposable surface electrodes for single use applications. Different types of electrodes: fine wire, needle, vaginal, rectal or esophageal probes are available from other reputable manufacturers. Consult the product documentation for each specific manufacturer on the advisability and proper means to sterilize reusable electrodes.



Technical Specifications

Outputs

- Analog +/- 5 volts all SEMG channels
- Digital 12 bit resolution per channel from USB port

Inputs

- 4-8 SEMG channels @ +/- 10 mV max
- 4-8 sensor channels @ +/- 5 Volts max
- Power 100-240 VAC @ 50/60 Hz (0.9 A max)

SEMG Amplifier Performance

- 1 uV sensitivity
- < 1 uV RMS baseline noise

Data Acquisition

- 12 bit resolution 8 channels
- USB update to PC every millisecond

High Pass Cutoff

- 10 Hz first order on SEMG channels

Low Pass Cutoff

- Selectable 500 or 1000 Hz on SEMG channels
- 8th order Butterworth (maximally flat)

Input Impedance

- > 100 MOhm on SEMG channels (isolated to > 3000 Volts)

Common Mode Rejection

- Min 100 dB @ 50-60 Hz

Physical

- Width: 11"
- Height: 4"
- Weight: 3 lbs
- Depth: 7.75"



Technical Description

General

The MyoSystem 1400L is an electromyographic (EMG) instrument available as a 4 or 8 channel unit. It is designed in compliance with international standard IEC60601-2-40, Particular *requirements for the safety of electromyographs and evoked response equipment*. All EMG inputs are provided with type BF isolation. The instrument contains an integral 12 bit analog to digital conversion system for all input channels. Communication with a computer system is provided by means of a Universal Serial Bus (USB) port.

Equipment Installation and Restricted Use

The instrument is equipped to operate from all conventional alternating current power sources (i.e. 90-240VAC 50/60Hz) without modification. A power cord matched to the local service configuration is needed and comes supplied with the unit. The power cord requires an IEC320 style connector for the instrument end. The opposite end of the power cord must terminate with a grounded AC plug. Electrically the MyoSystem 1400L possesses a Class I type BF equipment rating. Therefore, the protective earth ground connection must be in place at all times to ensure safe operation and full compliance with the relevant standards. The instrument is not protected against the ingress of water and carries no IPX rating (i.e. is Ordinary equipment)

Restricted Usage

The MyoSystem 1400L is **not** intended for use in the following situations:

1. In the presence of flammable anesthetizing agents or substances.
2. In the presence of strong magnetic fields such as occurs in the vicinity of MRI (magnetic resonance imaging) equipment.
3. In the presence of heavy electrical machinery such as near large motors, elevators, compressors and the like.

Fuses and Fuse Replacement

The MyoSystem 1400L has two externally accessible fuses. Ratings for both fuses are identical, 2A 250VAC slow acting. The fuse holder is accessed by prying open a small door on the power inlet module. (Be sure to unplug the power cord first!) Opening the door can be accomplished by inserting a standard screwdriver into the small slot at the top of the power inlet module just above the red rectangle. Using the screwdriver gently pry open the door to expose the red fuse holder. Slide out the fuse holder, remove the spent fuse(s) and replace them as needed.

The fuse holder is designed to accept both English and metric style fuses. Note the position of the old fuse upon its removal and ensure that the replacement fuse is installed in the same position.

Transport and Storage

The MyoSystem 1400L is capable of transport and storage in environmental conditions within the following ranges:

Ambient temperature	-40 degrees C to + 70 degrees C
Relative humidity	10% to 100%
Atmospheric pressure	500 HPa to 1060 HPa

Disposal

The MyoSystem 1400L printed circuit boards contain hazardous materials. Follow your local governing ordinances for the disposal or recycling of equipment and electrodes.



Guidance and manufacturer's declaration – electromagnetic emissions

The MyoSystem 1400A/L is intended for use in the electromagnetic environment specified below. The customer or the user of the MyoSystem 1400A/L should assure that it is used in such an environment.

Emissions Test	Compliance	Electromagnetic environment - guidance
RF emissions CISPR 11	Group 1	The MyoSystem 1400A/L uses RF energy only for its internal function. Therefore, its RF emissions are very low and not likely to cause any interference in nearby electronic equipment.
RF emissions CISPR 11	Class A	The MyoSystem 1400A/L is suitable for use in all establishments other than domestic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic Emissions IEC 61000-3-2	Class A	
Voltage fluctuations/ flicker emissions IEC 61000-3-3	complies	

Guidance and manufacturer's declaration – electromagnetic immunity

The MyoSystem 1400A/L is intended for use in the electromagnetic environment specified below. The customer or the user of the MyoSystem 1400A/L should assure that it is used in such an environment.


Immunity Test	IEC 60601 test level	Compliance level	Electromagnetic environment - guidance
Electrostatic discharge (ESD) IEC 64000-4-2	±6 kV contact ± 8 kV air	±4 kV contact ± 8 kV air	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30 %. Contact discharges > ± 4kV can cause display dimming but no loss of performance.
Electrical fast transient/burst IEC 61000-4-4	±2kV for power supply lines ±1kV for input/output lines	±2kV for power supply lines ±1kV for input/output lines	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	±1kV differential mode ±2kV common mode	±1kV differential mode ±2kV common mode	Mains power quality should be that of a typical commercial or hospital environment.
Voltage dips, short interruptions and voltage variations on power supply input lines IEC 61000-4-11	<5 % U_T (>95 % dip in U_T) for 0,5 cycle 40 % U_T (60 % dip in U_T) for 5 cycles 70 % U_T (30 % dip in U_T) For 25 cycles <5 % U_T (>95 % dip in U_T) For 5 sec	<5 % U_T (>95 % dip in U_T) for 0,5 cycle 40 % U_T (60 % dip in U_T) for 5 cycles 70 % U_T (30 % dip in U_T) For 25 cycles <5 % U_T (>95 % dip in U_T) For 5 sec	Mains power quality should be that of a typical commercial or hospital environment. If the user of the MyoSystem 1400A/L requires continuous operation during power mains interruptions, it is recommended that the MyoSystem 1400A/L be powered from an uninterruptible power supply.
Power frequency (50/60 Hz) magnetic field IEC 61000-4-8	3 A/m	Not Applicable	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.

NOTE U_T is the a.c. mains voltage prior to application of the test level.



Guidance and manufacturer’s declaration – electromagnetic immunity

The MyoSystem 1400A/L is intended for use in the electromagnetic environment specified below. The customer or the user of the MyoSystem 1400A/L should assure that it is used in such an environment.

Immunity Test	IEC 60601 test level	Compliance level	Electromagnetic environment - guidance
Conducted RF IEC 61000-4-6	3 Vrms 150 kHz to 80 MHz	3 V	<p>Portable and mobile RF communications equipment should be used no closer to any part of the MyoSystem 1400A/L, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter.</p> <p>Recommended separation distance</p> $d = 1.2\sqrt{P}$
Radiated RF IEC 61000-4-3	3 V/m 80 MHz to 2,5 GHz	3 V/m	<p>$d = 1.2\sqrt{P}$ 80 MHz to 800 MHz</p> <p>$d = 2.3\sqrt{P}$ 800 MHz to 2,5 GHz</p> <p>where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in metres (m).</p> <p>Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey,^a should be less than the compliance level in each frequency range.^b</p> <p>Interference may occur in the vicinity of equipment marked with the following symbol:</p> 

NOTE 1 At 80 MHz and 800 MHz, the higher frequency range applies.

NOTE 2 These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

^a Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the MyoSystem 1400A/L is used exceeds the applicable RF compliance level above, the MyoSystem 1400A/L should be observed to verify normal operation. If abnormal operation is observed, additional measures may be necessary, such as reorienting or relocating the MyoSystem 1400A/L.

^b Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3 V/m.



Recommended separation distances between portable and mobile RF communications equipment and the MyoSystem 1400A/L

The MyoSystem 1400A/L is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the MyoSystem 1400A/L can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the MyoSystem 1400A/L as recommended below, according to the maximum output power of the communications equipment.

Rated maximum output power of transmitter W	Separation distance according to frequency of transmitter m		
	150 kHz to 80 MHz	80 MHz to 800 MHz	800 MHz to 2,5 GHz
	$d = 1.2\sqrt{P}$	$d = 1.2\sqrt{P}$	$d = 2.3\sqrt{P}$
0,01	0.12	0.12	0.23
0,1	0.38	0.38	0.73
1	1.2	1.2	2.3
10	3.8	3.8	7.3
100	12	12	23

For transmitters rated at a maximum output power not listed above, the recommended separation distance d in metres (m) can be estimated using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.

NOTE 1 At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.

NOTE 2 These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

Noraxon will make available on request circuit schematics, component parts lists and calibration instructions to assist qualified technical personnel in the service and maintenance of the MyoSystem 1400L. Please contact Noraxon USA at:

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