Davis Vantage Pro & Vantage Pro 2 Wind Sensor

Contents

1 Davis Anemometer and Direction Vane

An anemometer is a wind speed measuring device. It usually uses cups mounted on a vertical shaft that rotates as the wind flows past. Davis has included a wind direction vane but still refers to the entire instrument as an anemometer.

Illustration 1: A complete anemometer before installation.

The various parts of the wind measuring device are; the base which mounts to the user supplied mast, the aluminum arm (tube), the head assembly, the wind cups, the direction vane, and a pre-wired cable.

The anemometer and vane is a passive analog device. It is not powered. It responds to a brief direction excitation pulse from the sensor interface module (SIM). Speed pulses are created by a sealed mechanical reed switch. The head is a sealed unit and not intended to be serviced or repaired. The head contains the magnetic reed switch on a circuit board, the direction potentiometer and wires connecting these to a 4 conductor flat cable. The supplied 40 foot cable has a 6 position, 4 conductor RJ-14 male plug on the end that connects to the Davis Integrated Sensor Suite (ISS).

B Wind Speed

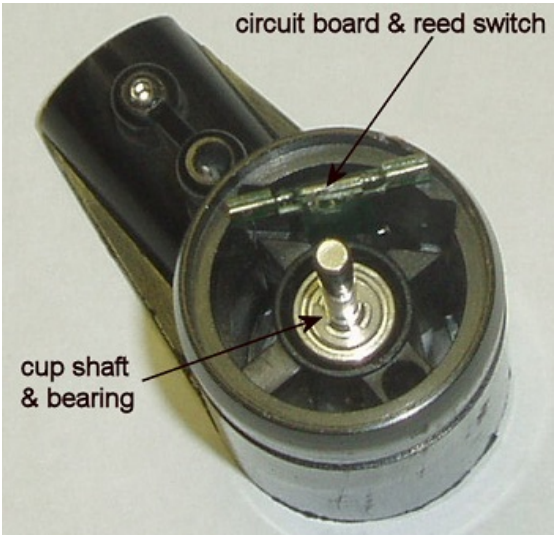
Illustration 2: Anemometer cups can be disassembled for repair.

This anemometer uses three cups with their shafts pressed into a plastic hub. Each cup is replaceable if it is damaged. The three cups are held in place by a plastic plug pressed on the end of the hub. The wind cups come assembled, not as shown above.

The wind cups are held on to the vertical shaft of the head assembly by a single 0.050 inch hex drive set screw. The internal vertical shaft is 1/8 inch diameter and 1.6 inch long. The shaft uses one bearing and one brass bushing. Each are held in place by two spring clips that fit into channels milled into the steel shaft. The bearing and bushing measurements are .125 inch bore and .375 inch diameter. The plastic head assembly is molded for mounting of the bearing/bushing and also the potentiometer and switch assembly circuit board.

The wind cups has a magnet fitted into the plastic hub. Wind causes the cups to rotate which rotates the magnet across but not touching the magnetic reed switch. During each pass of the magnet over the reed switch, the switch closes. The reed switch is normally open but closes briefly only as the magnet is near the switch. Each revolution of the wind cups cause one switch closure cycle.

Link to more information about anemometer/wind cups.



B Wind Direction

Wind direction is sensed by the vane that is mounted above the head assembly. The vane is fastened on the ¼" shaft of the potentiometer by a 0.050 inch hex drive set screw. As the wind direction changes, the vane follows and changes the resistance at the slider terminal of the potentiometer. The potentiometer is a linear resistance type that is free to rotate 360º with no mechanical stop. It is normal that the vane movement has more resistance to rotation than the wind cups. The reason is that the potentiometer has a mechanical slider that is in contact with the inner surface of the potentiometer body. The direction vane needs some drag/dampening to prevent the vane from excessively overshooting when rotating.

Notice that there is an area of roughness near the north or 0º position. This happens when the slider crosses between the two ends of the pot resistance strip. The roughness is normal.

The manufacturer attaches the vane to the shaft and it will accurately report direction if the arm is pointed toward true north. If the arm cannot be pointed to true north due to installation limitations, then the vane can be re-oriented or aligned. If the vane is removed from the shaft, then the realigning will have to be done. The Davis ISS manual has vane adjustment procedures. The direction can also be aligned by a console adjustment instead of the hardware method.

Other than realigning, no other service is needed. The head assembly is permanently sealed and is not to be opened. Troubleshooting procedures are in the manual.

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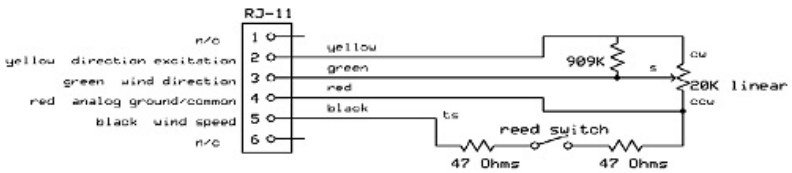
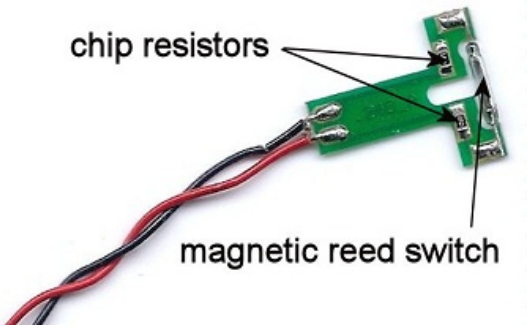
2 Anemometer and Direction Vane Circuit Description

Refer to the schematic diagram for the description. The flat (not twisted) cable has 4 conductors.
yellow = direction excitation This is an excitation pulse sent from the SIM to the anemometer and is applied to the cw terminal of the potentiometer.
green = direction This is the direction signal from the anemometer to the SIM. This wire is connected to the potentiometer slider s terminal of the potentiometer. The slider returns a portion of the excitation pulse depending on the angular position of the vane.
red = common or analog ground This wire is connected to the wind speed and the wind direction circuits.
black = wind speed signal This wire provides the wind speed pulses from the magnetic reed switch to the SIM. This wire connects to the ts terminal on the potentiometer then to the switch circuit board.

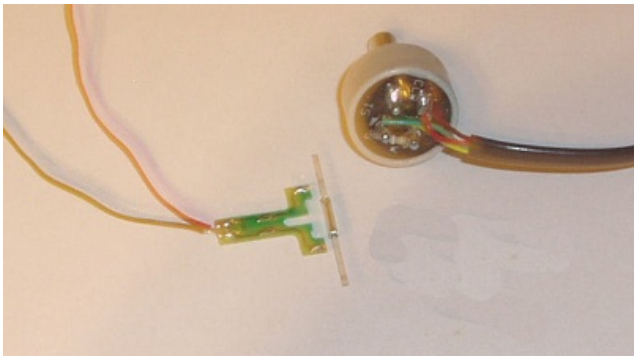


The wind speed and wind direction functions has separate circuits but the red wire is common to both. If you measure the voltage on the black wire at the anemometer if it is connected to the SIM, it will probably indicate +3 volts unless the reed switch is closed. This is because this wire is 'pulled up' to that voltage internally in the SIM. The magnetic reed switch is connected from the red wire to the black wire. Hence, when the reed switch closes, the black wire voltage will go from +3 volts to zero while the switch is closed. This + to – pulse lasts only while the magnet is in the vicinity of the reed switch. This pulse occurs once per revolution of the anemometer cups as the device is operating in the

wind. Notice in the schematic there are two 47 Ohm resistors in series with the reed switch. These resistors protect the reed switch only if someone foolishly connects power from the red wire to the black wire.



The wind direction circuit uses a linear 20K Ohm potentiometer to sense the position of the vane. A voltage pulse is sent from the SIM to the pot through the yellow wire. This voltage is applied to one end of the pot. The mechanical slider in the pot picks a portion of that voltage depending on the angular position of the vane/slider. The voltage level of this pulse is determined by the vane/pot slider position. The pot has 3 contacts, red=common (ccw), yellow=excitation (cw), green=direction signal (s). One additional terminal on the potentiometer (ts) is used as a termination point for the black wire. A 909K Ohm fixed resistor is mounted across the pot from the yellow to the green wires. This resistor prevents the slider voltage from 'floating' while it is crossing the open end points of the pot. This resistor causes the indicated direction to remain at north while the circuit is briefly open. If not for this resistor, the direction indication may briefly go to a false direction.



3 Troubleshooting the wind speed and direction sensor.

The cable may be the most common failure item. Unplug the RJ-14 plug from the SIM, inspect the plug and socket for debris or moisture. Plug the connector in, pushing until it snaps in place.

Moisture on the plug, socket or on the SIM circuit board may cause failure of the speed and direction indications. The best way to remove moisture from inside the plug/socket or board is with a can of compressed air. Caution: using a mechanical air compessor with a hose and nozzle can be dangerous to people and equipment.

When installing the anemometer and vane, the cable must be securely fastened to the mast or placed inside the mast pipe. If the cable is not anchored to the mast, the wind may blow the cable and cause fraying. The insulation may become worn and wires short or open. A common symptom is the direction always indicates a few degrees within north.

Wiring errors:
yellow wire open causes a north indication
green wire open causes a north indication

red wire open causes a north indication and prevents wind speed from being indicated
black wire open prevents wind speed to be indicated
yellow to green shorted causes a north indication
yellow to red shorted causes a north indication
green to red shorted causes a north indication
black to yellow shorted, wind speed zero
black to green shorted, wind speed zero and direction erratic
black to red shorted, wind speed zero, intermittent short causes wind speed error

The anemometer cable must have 'straight through' connections. Telephone extension cables have connections that reverse the wiring. Sometimes an owner will connect a telephone extension cable to extend the anemometer cable length. This causes failure of the anemometer. The wind speed will be zero and the direction will indicate north.
A 'straight through' extension must be used. The same wire color pattern must be on both ends of the cable.
If telephone extension cables must be used, use two. Using two telephone extension cables will cause two reversals which nulls out the reversals.

It is difficult to repair the head assembly. The halves of the unit are glued together and can't be opened. Removal of the reed switch or potentiometer is difficult because the red and black wires from the potentiometer to the circuit board don't have slack. If you are replacing the reed switch, buy 2 or more. You'll break one.

Symptom: Wind cups turning slow. After a few years operation, the wind cups may turn slow or stop when the wind is still blowing. The likely cause is a dirty or lack of lubrication of the anemometer shaft and bearings.
The head assembly is sealed and not easily repaired. Oiling is not recommended. However some have extended the life of the anemometer by oiling. Oil in the bearings may attract bugs and accumulate grit.

Link to extensive wind sensor troubleshooting information.

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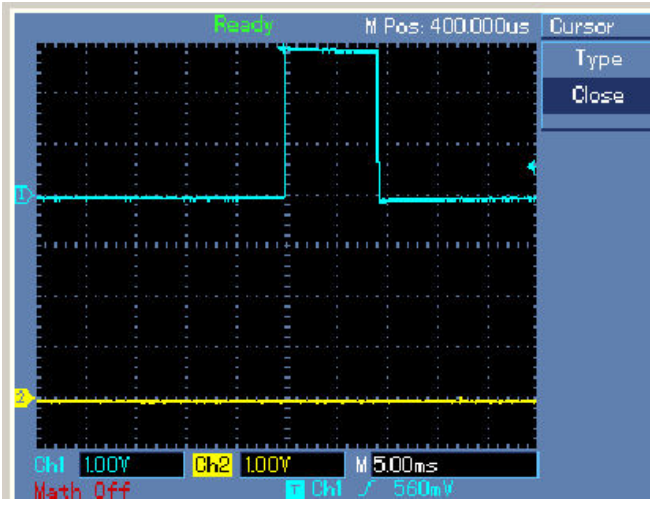
4 Replacement Parts

Mouser stock #	
652-6639S-1-203	Bourns 6639 20K potentiometer 360º turn no stop
876-KSK-1A35-1015	Meder magnetic reed switch
	47 Ohm chip resistor 2 required
Got Bearings #	
R2ZZ	.125" bore, .375" diameter bearing (replace bearing & bushing with 2 bearings)

5 Waveshapes

A Wind Vane Direction

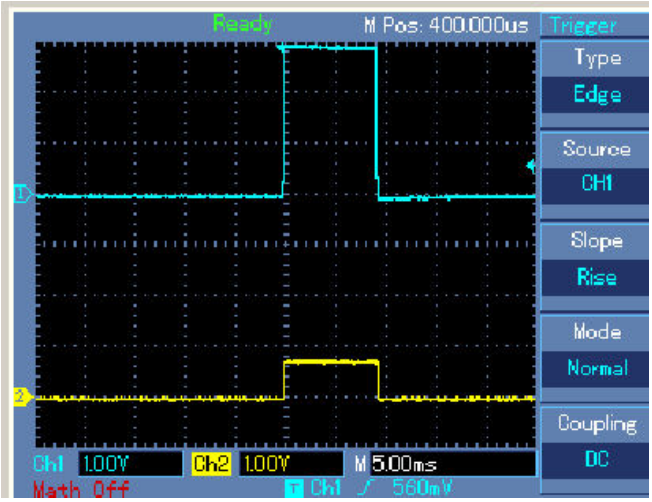


NORTH

Vane pointed North, at 1º. Ch 1 is direction excitation from the SIM. Ch 2 is the pot slider signal.
Ch 2 and the direction output pulse amplitude is 0v

Horizontal 5 ms/DIV

NORTH

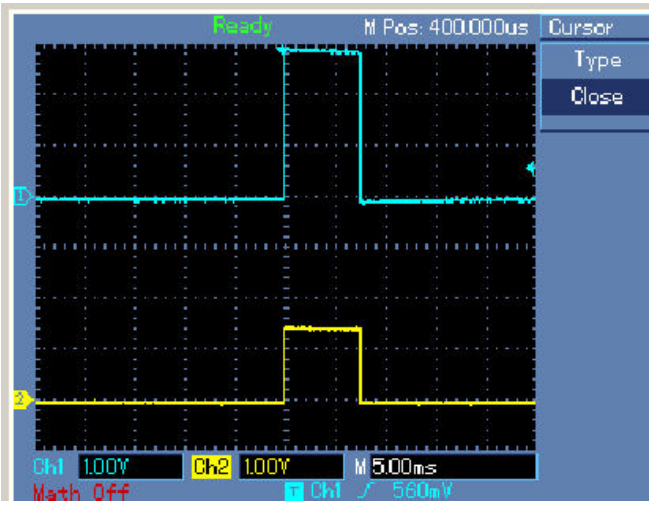


EAST

Vane pointed East, at 90º. Ch 1 is direction excitation from the SIM. Ch 2 is the pot slider signal.

Ch 2 and the direction output pulse amplitude is 0.75v.

Horizontal 5 ms/div

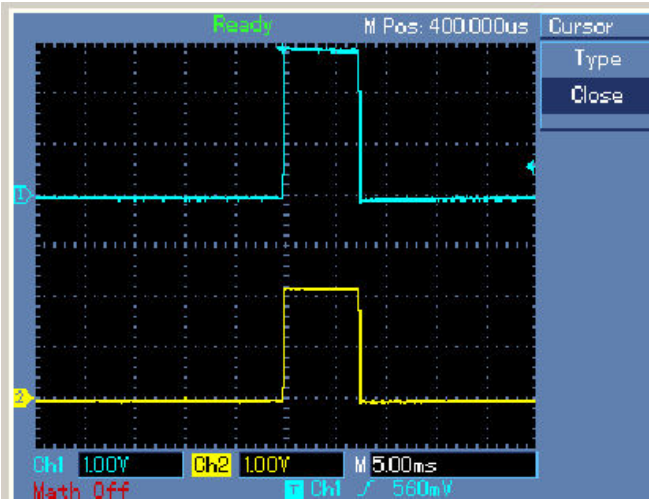


SOUTH

Vane pointed South, at 180º. Ch 1 is direction excitation from the SIM. Ch 2 is the pot slider signal.

Ch 2 and the direction output pulse amplitude is 1.5v.

Horizontal 5 ms/div

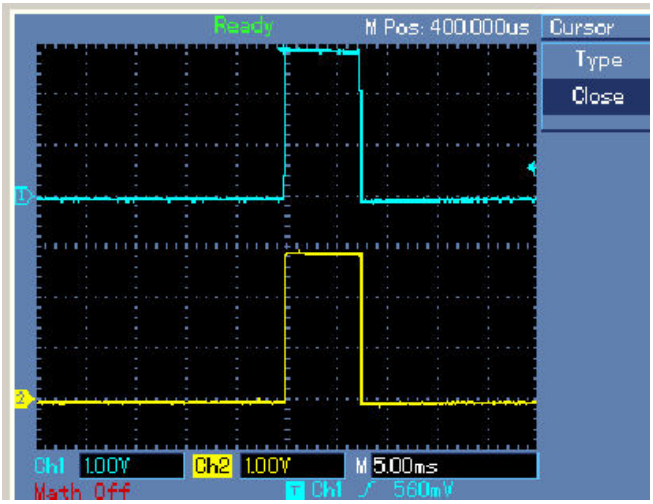


WEST

Vane pointed West, at 270º. Ch 1 is direction excitation from the SIM. Ch 2 is the pot slider signal.

Ch 2 and the direction output pulse amplitude is 2.25v.

Horizontal 5 ms/div

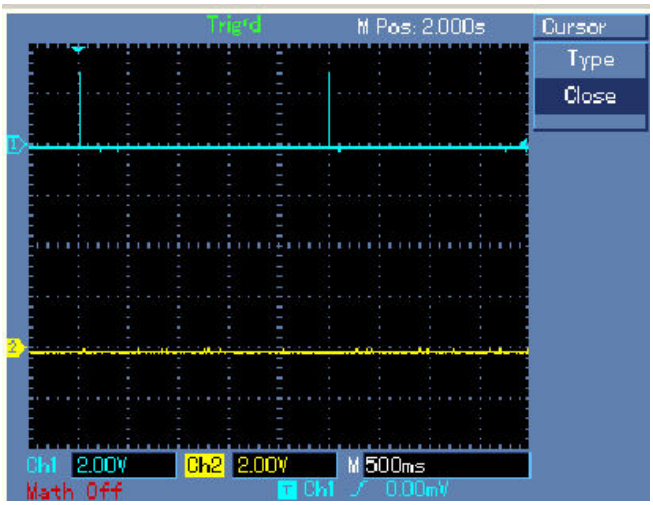


NORTH

Vane pointed North, at 359º. Ch 1 is direction excitation from the SIM. Ch 2 is the pot slider signal.
Ch 2 and the direction output pulse amplitude is 3v.

Horizontal 5 ms/div

The five waveshapes shown above show only 4 points on the compass. The potentiometer is analog and has an infinite number of points. This gives a resolution of 1º after the SIM converts the direction signal to digital.
Rotation of the potentiometer will give a smooth change in voltage level on the green wire.



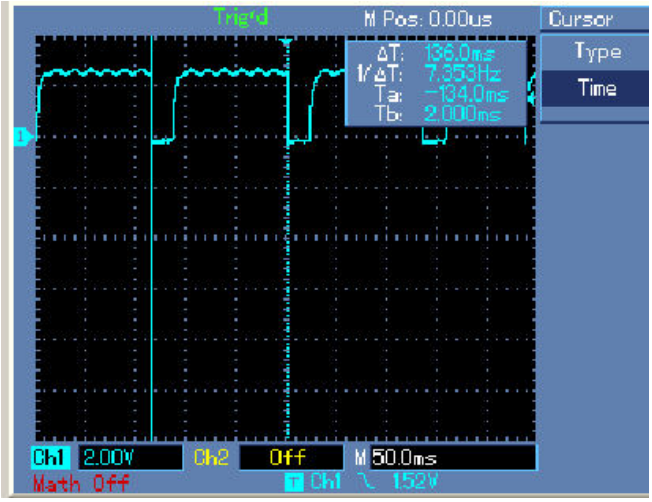
NORTH

Vane pointed North, at 1º. Ch 1 is direction excitation from the SIM. The Ch 1 pulses are 2.5 seconds separation.

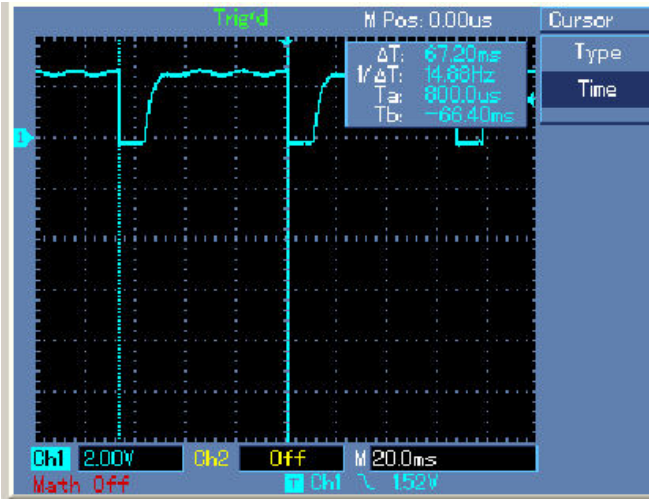
Horizontal 500 ms/DIV

B Anemometer Wind Speed

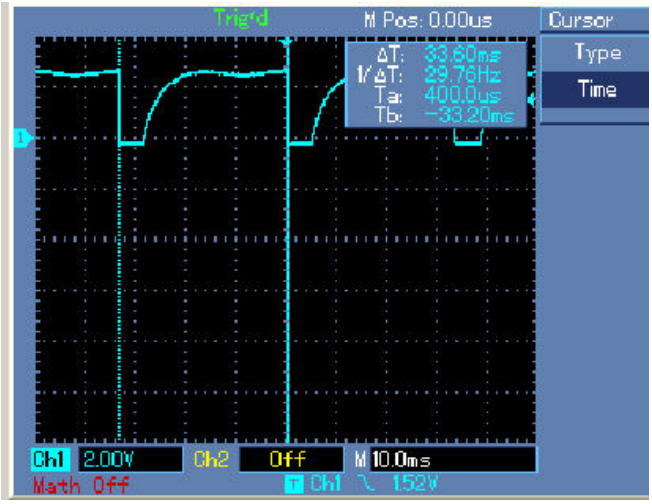
Annemometer wind speed = 17 mph



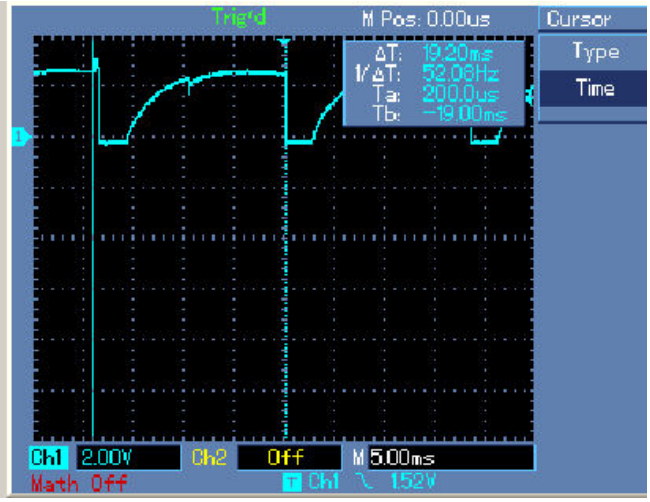
17 mph; 7.353 Hz; 136 ms period;
reed switch closed 20 ms



Annemometer wind speed = 34 mph
14.88 Hz; 67.2 ms period;
reed switch closed 10.4 ms



Annemometer wind speed = 62 mph
29.76 Hz; 33.6 ms period;
reed switch closed 4.8 ms



Annemometer wind speed = 95 mph
52.08 Hz; 19.2 ms period; reed switch closed 2.8 ms
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17 mph; 17 mph; 7.353 Hz; 136 ms period; reed switch closed 20 ms
34 mph; 14.88 Hz; 67.2 ms period; reed switch closed 10.4 ms
62 mph; 29.76 Hz; 33.6 ms period; reed switch closed 4.8 ms
95 mph; 52.08 Hz; 19.2 ms period; reed switch closed 2.8 ms
The jitter is worse at 95 mph as seen at the cursor.

References:

Potentiometer Specs	http://www.lexingtonwx.com/anemometer/assets/6639.pdf
Reed Switch Specs	http://www.lexingtonwx.com/anemometer/assets/reed_sw.pdf
Reed Switch Theory	http://www.lexingtonwx.com/anemometer/assets/Reed_Switch_Theory.pdf
Reed Switch with Magnets	http://www.lexingtonwx.com/anemometer/assets/Reed_Switch_Magnet.pdf

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