At the Repair Bench – Yaesu G-2700 – December 2024


Figure 1 - Yaesu G-2700XDS rotator system

As my regular readers are well aware, I enjoy taking on the oddball repairs and the repairs that other shops will not or cannot handle. Sometimes that penchant for the unusual will bite me, but for the most part, it has led to some interesting repair case histories. This one is no different.

I was asked by a regular customer to take a look at his Yaesu G-2700XDS azimuth rotator system (Figure 1) due to the fact that there is no motion indication on the panel meter of the controller. He brought me the motion unit, the G-2700 controller, and a second G-1000 controller. He had experimented with the second controller, and had gotten a limited response on the meter of that controller, about a ninety-degree swing, but it only occurred one time and he could not get it to repeat the behavior.

It must be understood that the positional display on the panel meter of the Yaesu rotators (and many others as well) is a co-operative effort between components inside the controller and components inside the motion unit. In a nutshell, there is a potentiometer inside the motion unit that is driven through a gearing arrangement that is connected through to the motor and its driven gear. There are multiple levels of reduction in both directions before we ever get to the potentiometer drive gear, and the gearing must be such to allow the full amount of rotator motion within a single swing of the potentiometer from one limit to the other. This is very important with some models of rotator, especially with those that have a turn and a quarter (450°) or a turn and a half or 540° of motion from limit switch to limit switch. The entire amount of that degree of rotation must occur within – and actually less than – a single rotation of the potentiometer, which in and of itself does *not* have a full 360° of rotational range between its stops.


Figure 2 - Condition of motion unit

The relationship between the potentiometer drive and the position of the rotating element is established through the various gears used in the drive system. There are a couple of important points to understand when assembling one of these units, however, that are related to the potentiometer. The first is that we must determine where the center-point of the unit rotational travel will be and position the unit in alignment with that center point when installing it. The second is that we must also determine where the mid-point of the potentiometer's rotational range is located and position the potentiometer at that mid-point for the assembly of the unit. It is only when both the motion system and the potentiometer are oriented at the centers of their rotational ranges that we can be assured of proper timing between the motion unit and the potentiometer.

Figure 3 - Condition of potentiometer drive gear

As a result of all of this, a varying voltage signal is available on one of the wire leads from the motion unit to the controller. The harness cable between the two units generally contains six wires, distributed as below:

- motor common;
- motor clockwise;
- motor counter-clockwise;
- potentiometer supply;
- potentiometer wiper; and
- potentiometer ground.

The potentiometer wiper lead is where we will find the varying voltage that indicates the relative position of the motion unit between its limits of motion. A nominal 6VDC is supplied to the potentiometer, being connected to one end of the potentiometer, while the opposite end of the potentiometer is connected to the system ground. The voltage on the potentiometer wiper will vary as the potentiometer rotates with the rotation of the motion unit, and that varying voltage is the input signal to the controller for driving the meter.

With this in mind, it should make sense that if we monitor that wiper lead while the motion unit rotates, we would expect to find a varying voltage available there. If there is no voltage, we have either a failed supply to the potentiometer, a failed (open) potentiometer, or an open circuit in one or more of the potentiometer's leads. If we measure a fixed voltage there while the motion unit rotates, we have a potentiometer that is either not being driven due to a failure in the drive system, or we have a seized potentiometer that cannot rotate.

In most of the Yaesu rotators, the potentiometer drive gear is a nylon gear that is fastened to the potentiometer shaft by way of a set-screw installed into the gear hub. In many units, this nylon gear is directly driven by one of the motion system gears. However, in the G-2700, there is a different arrangement for driving the potentiometer gear. In this design, the unit gearing drives a stamped steel gear that is mounted to a short shaft. That shaft extends through the motor mounting plate into the lower area of the rotator housing, where the potentiometer is installed. The lower end of that shaft has a small quill gear secured to the shaft, and it is that quill gear that in turn drives the potentiometer gear. As a result, when first opening up the motion unit, the potentiometer and its drive gear are hidden, out of sight below the motor mounting plate.

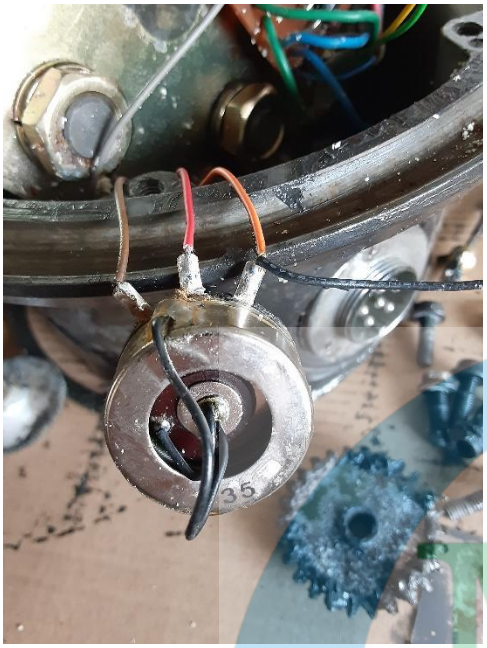
Figure 4 - Potentiometer dismounted

When I opened up this particular motion unit, I found plenty of indication of water entry into the housing, in the form of heavy corrosion on most of the internal parts (Figure 2). This included the stamped steel gear that drives the shaft that in turn drives quill gear that drives the potentiometer gear (Figure 3). In this illustration, it is quite difficult to see the drive gear – note the set-screw in the gear hub and then move out from there. The drive gear is the piece with all of the red corrosion on it.

I removed the cap screws that secure the motor mounting plate to the housing, and lifted the motor unit up and out so as to get to the potentiometer and gear. Next, I removed the stamped steel drive gear and the drive shaft by loosening the set-screw in the small quill gear at the lower end of the drive shaft. Once the shaft was out, I could remove that quill gear and had an isolated potentiometer and its drive gear. A quick check of the potentiometer gear for the ability to rotate showed that the potentiometer was seized. It only took a couple of minutes to remove the potentiometer gear and then the potentiometer itself from the unit (Figure 4).

I thought that it might just be a matter of replacing the potentiometer with a new one, but as it turned out, the seizure of the potentiometer caused damage to the hub of the gear. To start with, the gear hub, which like the gear is made of nylon, had fractured longitudinally along the length of the hub, in two diametrically-opposed locations. This meant that tightening the set-screw would not secure the gear to the potentiometer shaft, but would only serve to spread the fractures wider apart. I cured this by first cleaning the hub thoroughly with residue-free solvents. Then, I did some plastic-welding of the cracks in the hub, using the soldering iron. Finally, using some safety wire, I made a couple of wraps of wire around the hub and then twisted the ends tight, so as to form a clamp around the hub. This clamp would keep the hub from spreading as the set-screw was tightened.

The second manner in which the gear hub was damaged was that the hub bore was badly worn on the side opposite the set-screw. This is an apparent result of the gear rotating on the potentiometer shaft rather than turning the shaft. In any event, this wear caused the gear to be pulled off-square when the set-screw was tightened on the new potentiometer, leaving the gear to “wobble” on the shaft and causing changes in its mesh with the quill gear. I resolved this issue by building up the potentiometer shaft slightly, using two different lengths of copper tape applied to the potentiometer shaft opposite the point where the set-screw would touch the shaft. I first laid down a slightly longer strip of copper tape, and then applied a somewhat shorter length at the direct opposite point from the set-screw. This tape took up the slack in the bore of the gear hub, causing the gear to tighten securely and as squarely as possible,

The leads for the potentiometer were very short, making it extremely difficult to manipulate or maneuver the potentiometer in the housing to any extent. To aid in the installation of the new potentiometer, I extended the three leads, using 22AWG stranded wire of the same colors, and covering the soldered splices with heat-shrink tube insulation. When replacing this potentiometer, be sure to place the mylar sheet back in place under the body of the potentiometer, as it serves to ensure that there is no shorting of the potentiometer leads to the frame of the motion unit. I added four inches of wire to each lead.

I spent a lot of time cleaning the corrosion and contaminated lubricant out of the motion unit. The two rows of ball bearings required special attention as they had fine coatings of rust on many of the balls. The ball tracks in the housing halves were thoroughly cleaned, as was the remainder of the motion unit gearing and motor assembly.


Figure 5 - Condition of replaced ball bearings

Next, I reassembled the potentiometer and its drive system, positioning the potentiometer at the midpoint of its rotational range. I then lubricated the ball tracks and installed the cleaned ball bearings, replacing those that merited replacement. The balls were coated with lubricant as they were installed into their tracks, and then the installed row of balls had some additional lubricant applied to them for good measure. The lubricating grease on these ball bearings is the only water barrier present on this motion unit, so it is important to have adequate coverage of the lubricating grease on these ball bearings.

The motion system housing half was installed, positioning it in such a manner that the cast boss that operates the limit switches was aligned directly across the unit from the limit switch pair. This effectively sets the motion unit to the center point of its rotational range, and thus times it to the potentiometer.

The lower track of ball bearings was lifted into place against the housing, and then the entire unit was inverted so as to allow the installation of the capscrews that secure the housing halves to each other. Once the assembly of the motion unit was complete, it was tested operationally by connecting it to a known good controller and checking its operation throughout its full range of motion.

Next, it was time to test the G-2700 controller with the motion unit. The controller drove the unit successfully, but there was no meter indication of the motion of the rotator. I discussed the situation with the owner of the system, and he decided to use the second controller with this motion unit and not to spend any money on the G-2700 controller.

I assembled a test cable for the G-1000 controller to connect it to the G-2700 motion unit, and then checked the operation of that controller and its meter, to find that all was working as it should. The owner decided to leave those units paired, and said that he would bring me a length of cable for installation of the correct connectors at a later date.

This was a repair that brought some unexpected circumstances, but that turned out well in spite of that. It illustrates the point that with some ingenuity, most problems can be overcome.   When a strange condition turns up, stop and think it through. Consider all of your options, and then choose that option which has the best odds of success. Properly executed, your work should turn out as you want it to.