AMCI Frequently Asked Question

How Do I Test an AMCI Resolver System?

NOTE The resistance values given in this FAQ are for AMCI resolver transducers that are compatible with AMCI controllers, which means they all have a TR of 0.95. AMCI offers many resolver transducers that are designed to work with other systems and therefore have different electrical specifications. Please contact AMCI for electrical specifications if you are testing one of these resolvers.

- **Required Equipment:** Multimeter capable of measuring both resistance and AC voltage. A true RMS meter is very desirable, but not necessary.

There are three basic components of a resolver system, the resolver, the cable, and the controller. When operating, the controller sends a reference voltage to the rotor of the resolver. This signal is magnetically coupled to the resolver's two stators, each of which sends a signal back to the electronics module. The ratio of the two stator signals is then used to calculate the absolute position of the resolver. The two rotor signals are named R1 and R2 and the four stator signals, consisting of two pairs, are S1 and S3 and S2 and S4.

Out of the three components, the most likely cause of a system fault is a broken or mis-wired cable. The following procedure can be used to determine which of the system's three components is at fault.

NOTE

1) Different AMCI systems use different wiring configurations. Consult your user manual for your exact wiring diagram.
2) Two resolvers are used in each of the HTT-20-X multi-turn transducers. The two sets of R1 and R2 signals are connected together, however each of the eight stator signals, labeled coarse and fine, need to be tested separately.
3) Two resolvers are used in each of the HTT-20-1 transducers. In this case, the two resolvers are geared together 1 to 1, but are in no way electrically connected to each other.

Step 1: Measure Resolver Winding Resistances.

Disconnect the resolver from the cable. Use the following table to measure the resistance of the various resolver windings at the transducer connector. A column for you to note actual measurements is given. You can use these resistance measurements when testing the transducer cable on the following page.

AMCI Transducer	Pins	Function	Aprox. Value	Actual Value
R11X-J10/7 HT-20 HT-400 HT-20-(X)†	A to B C to E F to G	R1 to R2 S4 to S2 S1 to S3	15Ω 41Ω 41Ω	_____Ω _____Ω _____Ω
All H25's and HT-20C's	A to B C to E F to G	R1 to R2 S4 to S2 S1 to S3	28Ω 55Ω 55Ω	_____Ω _____Ω _____Ω
HTT-20-(X)† HTT-400-180 HTT-400-180-1-E HTT-425-(YYY)‡-100	A to B C to D E to F G to H I to J	R1 to R2 S4 to S2 Coarse Resolver S1 to S3 Coarse Resolver S4 to S2 Fine Resolver S1 to S3 Fine Resolver	8Ω 41Ω 41Ω 41Ω 41Ω	_____Ω _____Ω _____Ω _____Ω _____Ω
HTT-20-1 HTT-400-1	A to B C to D E to L J to I H to G F to N	R1 to R2 S4 to S2 S1 to S3 R1 to R2 S4 to S2 S1 to S3	15Ω 41Ω 41Ω 15Ω 41Ω 41Ω	_____Ω _____Ω _____Ω _____Ω _____Ω _____Ω

† (X) - Denotes number of turns in the transducer package and does not effect resolver measurements
‡ (YYY) - Denotes transducer connector type and placement and does not effect resolver measurements

HOW DO I TEST AN AMCI RESOLVER SYSTEM?

Step 1: Measure Resolver Winding Resistances. (continued)

NOTE

1) Measuring across any other pin combinations should read as an open.
2) Any measurement significantly different from what is listed above indicates a damaged transducer.

Step 2: Check Transducer Cable Wiring

Transducer cables are usually tested with a simple point to point continuity check from one end of the cable to the other. However, this can be difficult when the transducer and controller are a great distance apart! There is an alternate method once you have verified the resolver has no open or shorted windings. Simply plug the transducer back into its cable, disconnect the cable at the controller and take winding resistance measurements at the controller end of the cable. The table below shows wire colors for our CTL and CML cables.

AMCI Transducer	Cable Pairs↑	Function	Aprox. Value
R11X-J10/7 HT-20 HT-400 (all versions) HT-20-(X)† (All use CTL cable)	Blk/Red to Red Blk/Grn to Green White to Blk/Wht	R1 to R2 S4 to S2 S1 to S3	15Ω + 0.036Ω/ft 41Ω + 0.036Ω/ft 41Ω + 0.036Ω/ft
All H25's (All use CTL cable) All HT-20C's	Blk/Red to Red Blk/Grn to Green Wht to Blk/Wht	R1 to R2 S4 to S2 S1 to S3	45Ω + 0.036Ω/ft 55Ω + 0.036Ω/ft 55Ω + 0.036Ω/ft
HTT-20-(X)† HTT-400-180 HTT-400-180-1-E HTT-425-(YYY)‡-100 (All use CML cable)	Red to Blk/Red & Brown to Blk/Brn Green to Blk/Grn White to Blk/Wht Blue to Blk/Blue Yellow to Blk/Yel	R1 to R2 S4 to S2 Coarse S1 to S3 Coarse S4 to S2 Fine S1 to S3 Fine	8Ω + 0.018Ω/ft 41Ω + 0.036Ω/ft 41Ω + 0.036Ω/ft 41Ω + 0.036Ω/ft 41Ω + 0.036Ω/ft
HTT-20-1 HTT-400-1	Blk/Red to Red – Resolver 1 Blk/Grn to Green – Resolver 1 White to Blk/Wht – Resolver 1 Blk/Red to Red – Resolver 2 Blk/Grn to Green – Resolver 2 White to Blk/Wht – Resolver 2	R1 to R2 S4 to S2 S1 to S3 R1 to R2 S4 to S2 S1 to S3	15Ω + 0.036Ω/ft 41Ω + 0.036Ω/ft 41Ω + 0.036Ω/ft 15Ω + 0.036Ω/ft 41Ω + 0.036Ω/ft 41Ω + 0.036Ω/ft

↑ Cables contain individually shielded twisted pairs. The pairs are made up of a black wire and a colored wire.
† (X) - Denotes number of turns in the transducer package and does not affect resolver measurements
‡ (YYY) - Denotes transducer connector type and placement and does not affect resolver measurements

NOTE

1) A transducer cable has three or six black wires. A common wiring problem is cross connecting the black wires on the controller connector. Please verify that the black wires are connected properly before continuing.
2) The *Approx. Value* column shows the resistance of the resolver winding and the expected resistance of ten feet of the transducer cable. Calculate your cable resistance as 0.036Ω * (Cable Length in feet). For example, a 150 foot cable has a resistance of 0.036Ω * (150) = 5.4Ω.
3) All CML cables use two pairs wired in parallel to the resolver rotors. Therefore, when measuring this connection, attached one multimeter lead to both the Red and Brown wires and the other multimeter lead to both of the Black wires of the pairs. The resistance per foot of cable is half the normal value so you will have to calculate cable resistance as 0.018Ω * (Length in feet).

Step 2: Check Transducer Cable Wiring (continued)

If you wrote down the resolver resistance measurements on the previous page, you can calculate your expected cable resistance and use the sum of these two measurements to accurately predict the total resistance of the system. A measured resistance that is significantly higher than what is calculated (+20%) is indicative of an improper cable, a cold solder joint, or other wiring problems.

Step 3: Check Controller Signals

1) Reconnect the cable between the resolver and the controller. All of the following tests will be performed at the controller.
2) Use the multimeter to measure across pins R1 and R2 and record the value. The type of AMCI controller and the meter used will determine what is measured, but if you are using a true RMS meter, the most common values will be either 3.25Vrms or 2.85Vrms.
3) Place the common of the meter on the S1 signal. (On some AMCI controllers this signal will be paired with the S2 signal.)
4) Place the meter's positive probe on the S3 signal. As the transducer's shaft rotates, you should measure between 0 and what was measured on pins 1 and 2.
    - On all single turn transducers, there should be two complete zero-to-maximum cycles for every turn of the transducer's shaft.
    - For the HT-20-(X), there should be two complete 0 to maximum cycles for every (x) turns of the transducer's shaft.
    - For the HTT-20-100 and HTT-20-180, there should be two complete zero-to-maximum cycles on the fine resolver for every turn of the transducer's shaft and *almost* two complete zero-to-maximum cycles on the coarse resolver.
    - For the HTT-20-1000 and HTT-20-1800, there should be two complete zero-to-maximum cycles on the fine resolver for every ten turns of the transducer's shaft and *almost* two complete zero-to-maximum cycles on the coarse resolver.
5) Place the common of the meter on the S2 signal. (On some AMCI modules this signal will be paired with the S1 signal.)
6) Place the meter's positive probe on the S4 signal. As the transducer's shaft rotates, you should measure between 0 and what was measured on pins 1 and 2. The number of turns you must complete to see two complete cycles are the same as outlined in step 4 above.

- **If you are testing a controller that takes in multiple single turn transducers, Repeat steps 3 through 6 for each transducer.**
- **If the transducer being tested is an HTT-20-(X), repeat steps 3 through 6 for S1–S3 and S2–S4 windings of the second resolver in the transducer. If the controller takes in two HTT-20-(X) transducers, repeat steps 3 through 6 for both resolvers of the second transducer.**
- **If the resolver transducer being tested is an HTT-20-1, repeat steps 2 to 6 for the second resolver, because the second resolver will have its own R1 to R2 reference voltage signal.**

Interpreting the Results

Use the results of the above measurements and the following table to determine the most likely cause of the resolver systems problem.

Problem	Cause
The maximum voltage readings on both of the stator windings are greater than the reference voltage.	A high capacitance cable has been used in the system that does not meet AMCI's cable specifications.
The maximum voltage readings on the stator windings are significantly different (>±10%) or significantly below (>-15%) the reference voltage.	The problem most likely lies in the cable. It is very uncommon for a resolver winding to fail without it shorting out or going completely open.
The resolver signals appear to be correct at the controller, but the controller reads a transducer fault.	Cycle power to the controller. If the problem persists, there is a problem with the controller.
The voltage reading across the R1–R2 terminals at the controller is zero.	Cycle power to the controller. If the problem persists, there is a problem with the controller.
One or both of the voltage readings on the stators (S1–S3, S2–S4) reads zero.	Verify that the reference voltage is going to the transducer. If it is, disconnect the problem stator winding from the controller connector and measure the voltage on it while rotating the transducer shaft. If you now see a voltage, the problem is the controller. If you don't see a voltage, the problem is with the cable or transducer. Verify that the black wires in the pairs are not crossed.