DDM101
Dual Driver Module

+1 413 233 1888

www.governors-america.com

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1 OVERVIEW

The DDM101 is an dual actuator accessory module used to support fuel and exhaust temperature balancing adjustments to both banks of the engine, enabling each bank to receive the same amount of fuel to produce the same amount of power, safely.

This module is primarily installed with two actuators to support a single engine with two independent diesel fuel injection pumps or two gaseous throttle body actuators (ATB). It is controlled with a single GAC electronic speed controller (ESD). Thermocouple sensors are required to gather the exhaust information used to balance the engine.

Recommended electronic speed controllers are listed in Table 1. Recommended actuators are listed in Table 2.

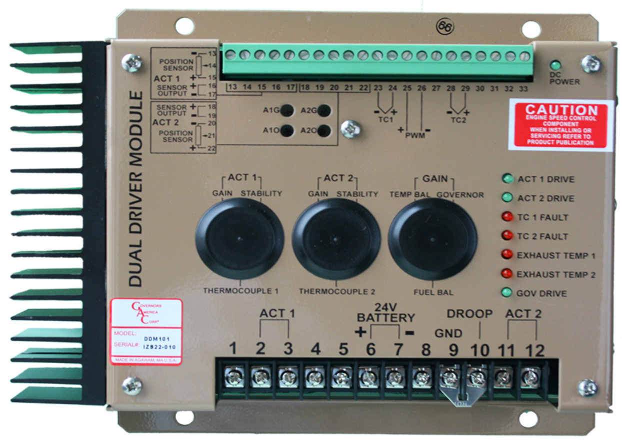


TABLE 1: RECOMMENDED GAC SPEED CONTROLLERS

MODEL	DESCRIPTION
ESD5111	Standard Electronic Speed Controller
ESD5221	Single Element Speed Switch / 10 A Relay Output

TABLE 2: RECOMMENDED GAC FEEDBACK SENSOR EQUIPPED ACTUATORS

ACTUATOR	DESCRIPTION
ATB T1F Series	25 mm to 40 mm Bore Size / 24 V DC / Packard Connector / Sealed to 5.0 Bar
ATB T2F Series	45 mm to 65 mm Bore Size / 24 V DC / Packard Connector / Sealed to 5.0 Bar
ATB T3F Series	75 mm Bore Size / 24 V DC /Packard Connector / Sealed to 5.0 Bar (Also T4)
ATB T4F Series	75 mm to 95 mm Bore Size / 24 V DC / Packard Connector / Sealed to 5.0 Bar
ADD175F*	Bosch ‘P’ 3000 - 7000 Fuel Injection Pump/ 24 V DC/ Right hand Rack/ Packard Connector
ADD176AF	Bosch ‘A’ Size Fuel Injection Pump/ 24 V DC/ Left Hand Rack/ Packard Connector
ACE275K	Bosch ‘P’ 3000 - 7000 Fuel Injection Pump/ 24 V DC/ Heavy Duty Bearing Retention/ Packard Connector
ACE295F-24	Bosch ‘P’ 9000 - 10,000 Fuel Injection Pump/ 24 V DC/ Packard Connector with Mating Connector

* Recommended for the Cummins QST30 upgrade.

2 SPECIFICATIONS

POWER INPUT	
DC Input Voltage	18 - 32 V DC (Nominal 24 V DC) Transient protected to +/-250 V DC
Actuator 1 Current	Up to 15 A, Short Circuit protected
Actuator 2 Current	Up to 15 A, Short Circuit protected
PWM Drive from Speed Controller	550 Hz MIN from 12 - 32 V DC MAX amplitude
Actuator Position Sensors	5 V DC excitation 1 to 4 V DC output

ENVIRONMENTAL	
Operating Temperature	-40 to +85 °C [-40 to 185 °F]
Humidity	up to 100 %
RELIABILITY	
Vibration	1 g, 20 - 100 Hz
Shock	10 gf [11 msf]
EMC	CE EN55011, EN50081-2, and EN50082-2

3 DDM101 INSTALLATION

The DDM101 is designed to equally drive two feedback-equipped electric actuators so that each engines bank or cylinder group receives equal fuel levels. To equalize the fuel to each cylinder bank the DDM101 has two advanced features, fuel and exhaust temperature balance. Two exhaust temperature probes are also required.

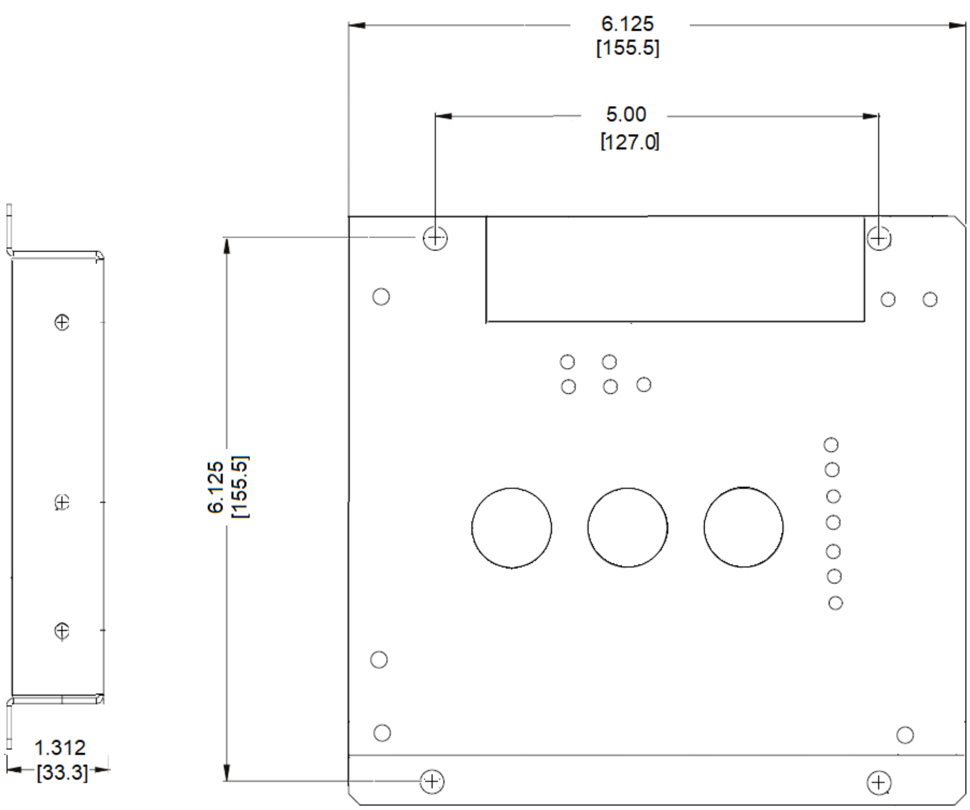
Each actuator driver circuit has its own GAIN [ACT 1 and ACT 2] adjustment to optimize the feedback control loop response. The actuators should be of similar types with similar position sensors with equal outputs. GAC approved actuators are listed in Table 2.

Figures 2 through 4 detail available connections. DDM101 was designed to work with and electronic speed controller (ESD) and references the ESD5111 terminal callouts.

When mounting the DDM101 attach it to a vertical surface to prevent any moisture from collecting on the circuit board. The normal precautions outlined in the related ESD manual should be followed for the DDM101 as well.

An overspeed shutdown device, independent of the governor system, should be provided to prevent loss of engine control which may cause personal injury or equipment damage. Do not rely exclusively on the governor system electric actuator to prevent overspeed. A secondary shutoff device, such as a fuel solenoid must be used.

FIGURE 1: DDM101 DIMENSIONS



Vertical orientation allows for the draining of fluids in moist environments.

Mount in a cabinet, engine enclosure, or sealed metal box. Ensure adequate ventilation for cooling.

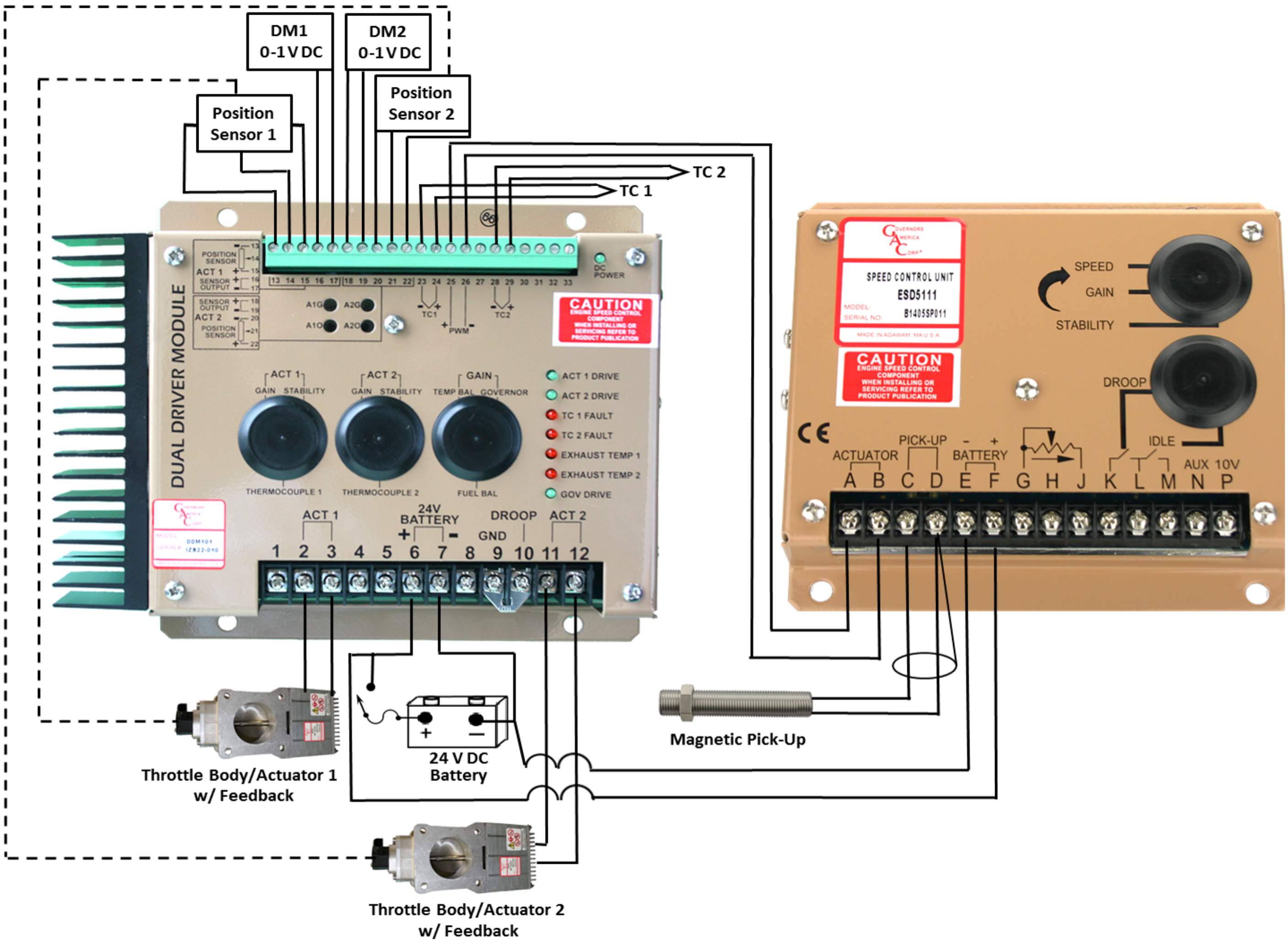
Do not mount on engine.

Avoid extreme heat. Do not mount next to turbocharger, exhaust manifold, or other high temperature equipment.

DDM101 INSTALLATION (CONTINUED)

The DDM101 works with the specified ESD models. Placement should allow for wiring between both controllers as shown in Figure 2. The complete wiring diagrams in the Wiring section of this guide show all the wiring options. Figure 2 shows the most common setup.

FIGURE 2: DDM101 TO ESD5111 INSTALLATION AND PLACEMENT



4 EXHAUST GAS TEMPERATURE SENSORS INSTALLATION

Engine power is balanced by measuring the exhaust gas temperature reading at each bank.

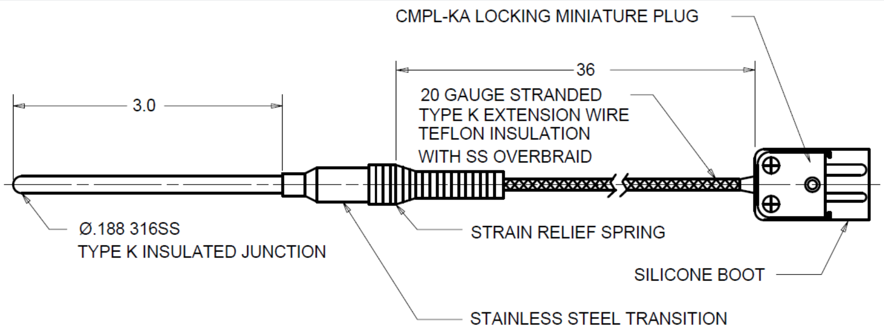
The exhaust temperature probe is located in the engine exhaust outlet as near as possible to the point where all of the cylinders merge. Alternatively, the sensor can be placed in the manifold outlet pipe. A weld bung or tapped hole must be used and care should be taken such that the tip of the probe is well within the outlet exhaust flow. The sensor is mounted using a 1/8 in NPT fitting. Drill and tap the determined mounting location using the provided dimensions.

When using thermocouples, if the cabling length must be extended, use the same type grade thermocouple wire to prevent temperature compensation errors. Contact your GAC contact for details on the cabling recommendations.

- Use caution installing thermocouples as they are easily damaged.
- Use Type-K wire and connectors only.
- Do not mix dissimilar metals.

NOTE If not using thermocouples, place a 10 k Ω resistor between Terminals 23 and 24, and Terminals 28 and 29 to prevent the TC 1 FAULT and TC 2 FAULT LEDs from indicating a fault.

FIGURE 3: TYPE K THERMOCOUPLE



Exhaust Gas Temperature Sensor

GAC PN STE101: Type K Thermocouple with 1200 °F [649 °C] Maximum. Mating Connector is included.

Using the mounting hardware included in the STE101 kit, install one thermocouple in each exhaust gas stream.

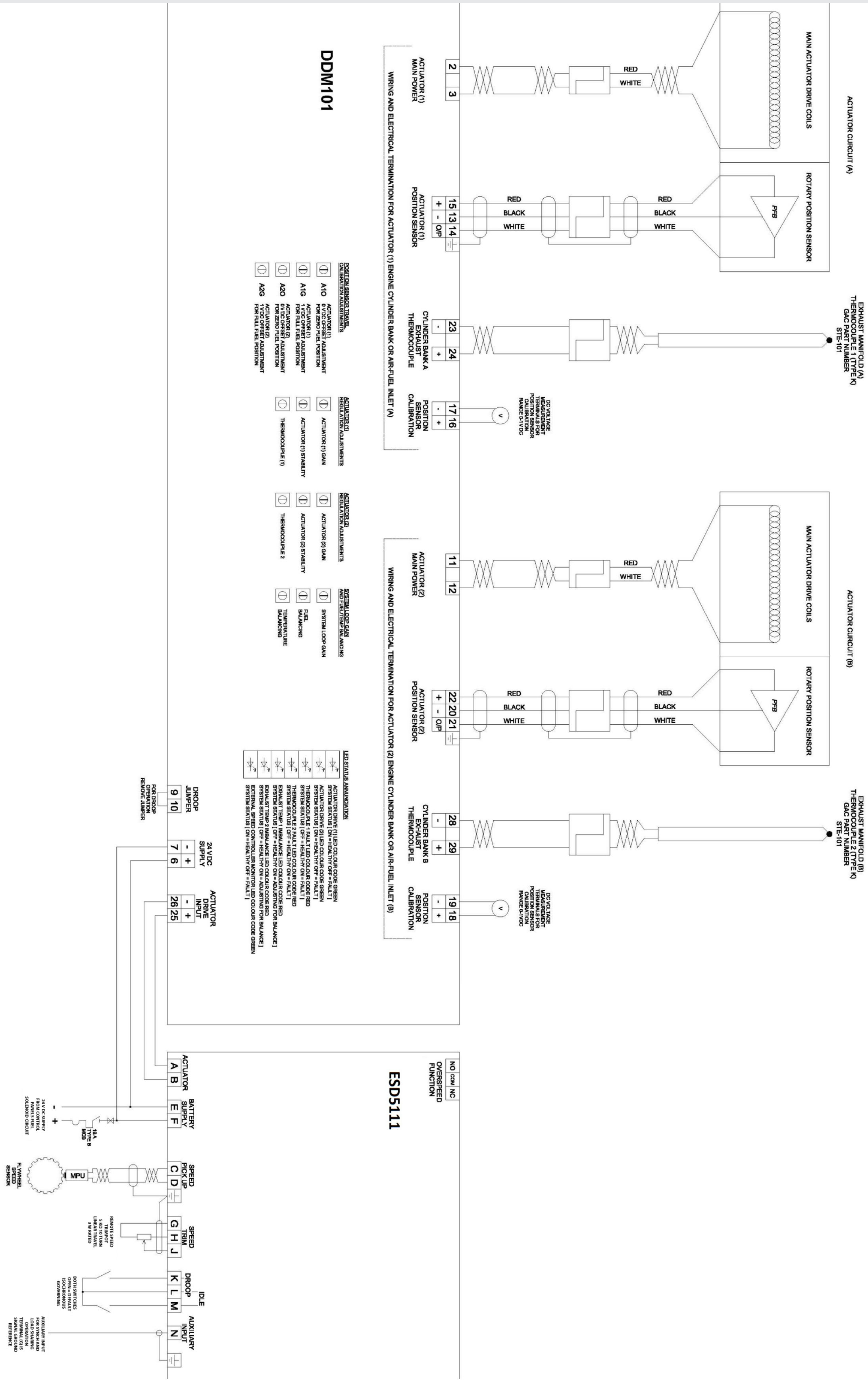
THERMOCOUPLE TEMPERATURE SENSOR INSTALLATION PROCEDURE

1. Determine placement of the thermocouples:
   a. Locate the exhaust temperature probe in the engine exhaust outlet as near as possible to the point where all of the cylinders merge. Alternatively, the sensor can be placed in the manifold outlet pipe.
   b. Thermocouples measure temperatures at their tip. The tip should be placed in the center of the exhaust stream to accurately measure the hottest point. The exhaust gas exits the thermocouple cylinder in a conical, flame, shape, with the center of the shape being the hottest and a potential 200° difference from the center of the flame to the edge.
2. Drill and weld bung the installation hole.
3. Dry fit the sensor. Ensure the tip of the probe is well within the outlet exhaust flow.
4. Apply thread sealant to the sensor.
5. Mount the sensor using a NPT fitting.
6. Thread the sensor finger tight plus two full turns.

5 WIRING (CONTINUED)

The DDM101 works in tandem with a speed control unit. Figure 4 details the wiring diagram and specific wiring sections of the DDM101 capabilities. Figures 2 and 4 detail wiring used in the ESD5111 as the basis for terminal callouts. Check your speed controller wiring for confirmation of terminal.

FIGURE 4: DDM101 TO ESD5111 WIRING DIAGRAM



CONNECTING TO AN ESD

When connecting an ESD to the DDM101 ensure the actuator voltage driver type uses a PWM output and not a current driver output. In normal actuator usage with a GAC ESD one side of the actuator is typically at near ground level voltage.

1. Connect Terminal B on the ESD (the low side of the actuator drive) to Terminal 26 on the DDM101.
2. Connect Terminal A on the ESD (the high side output of the actuator) to Terminal 25 on the DDM101.
3. Install a jumper between Terminals 9 and 10 on the DDM101.

CONNECTING DDM101 TO THE ACTUATORS

Before wiring the actuators to the DDM101, determine if droop will be used. Droop reduces the reference speed as fuel position (load) increases through changes in frequency.

NO DROOP REQUIRED

1. If droop is not required, connect the actuators as shown in Figure 2 and 4 directly to the DDM101.
2. Install jumper between Terminal 9 and 10 on the DDM101.

DROOP REQUIRED

If your application requires droop, then the current in Actuator 1 is best suited for the droop signal.

1. Disconnect Terminal 26 on the DDM101 from Terminal B on the ESD.
2. Connect Terminal 3 the minus (-) of Actuator 1 on the DDM101 to Terminal B on the ESD.
3. Connect Terminal 3 on the DDM101 to Terminal E on th ESD.
4. Adjust droop proportional to the current in Actuator 1, on the ESD. See your speed control unit's manual for droop adjustment details.

FOR PROPORTIONAL DROOP

If the application requires that droop be proportional to Actuator 2:

1. Remove the jumper from DDM101 Terminals 9 and 10.
2. Disconnect Terminal 26 on the DDM101 from Terminal B on the ESD.
3. Connect Terminal 10 on the DDM101 to Terminal B on the ESD.
4. Connect Terminal 9 of the DDM101 to Terminal E on the ESD.

POSITION SENSOR WIRING GENERAL INFORMATION

- Each position sensor cable should be three-wire shielded type with the shields connected only to the case on the DDM101.
- The actuator feedback sensor (AB feedback sensor type) is a three, sensor-terminated wire with an AMP connector, (Table 3.) for accessory parts.
- For proper connection from the feedback sensor or the cable harness to the DDM101 see Table 4.
- Case ground (right or left corner screw) should be connected to battery minus (Terminal 7) with a separate cable for the best EMC ratings.
- Cables used on the terminals for Actuator 1 or 2 handle full actuator current, therefore they must be sized properly to handle the current (Table 5).

TABLE 3: ACCESSORIES

ACTUATOR	POSITION SENSOR MATING CONNECTOR	POSITION SENSOR MATING HARNESS
ADD175F-24	EC1523	CH1243
ADD176AF-24	EC1515	CH1515
ACE275K	EC1515	CH1515
ACE295F-24	EC1515	CH1515
ATB T1 Series	EC1523	CH1243
ATB T2 Series	EC1515	CH1515
ATB T3 Series	EC1515	CH1515
ATB T4 Series	EC1523	CH1243

TABLE 4: WIRE SIZE

RECOMMENDED WIRE SIZE	
ACTUATOR	RECOMMENDED WIRE SIZE FOR TYPICAL APPLICATION*
ATB Series: T1F/T2F/T3F/T4F	14 AWG
ADD175F	16 AWG
ADD176AF	16 AWG
ACE275K	16 AWG
ACE295F-24	16 AWG

*Compensation for length and temperature will affect wire size.

5 WIRING (CONTINUED)

TABLE 5: CONNECTION - FEEDBACK SENSOR / CABLE HARNESS

CONNECTION								
	Position Sensor Connector		Harness CH1515		Harness CH1243		DDM101	
Signal	Number	Color	Number	Color	Pin	Color	Act 1	Act 2
+5V	1	Red	1	Red	A	Red	15 (+)	22 (+)
GND	2	Black	2	Black	B	Black	13 (-)	20 (-)
Out	4	White	4	White	C	White	14 (‹)	21 (‹)

BEFORE STARTING THE ENGINE

Before starting the engine, check and/or restore potentiometer values to the factory settings.

TABLE 6: DDM101 FACTORY SETTINGS

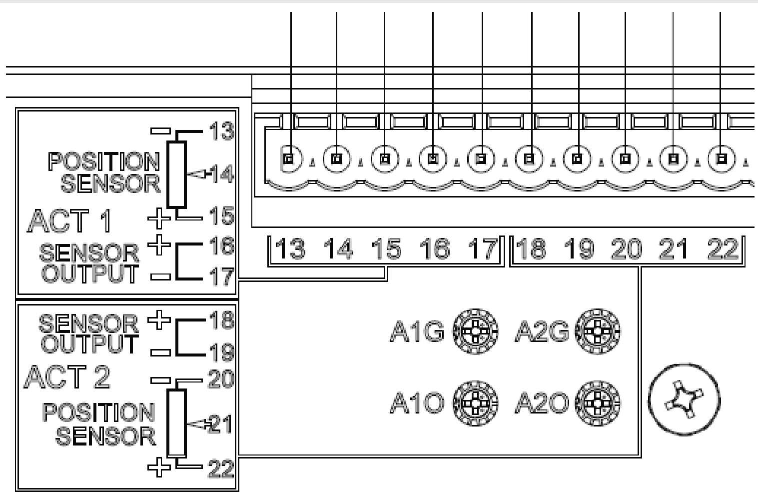
FACTORY SETTING OF THE POTENTIOMETERS			
	Potentiometer	**Type**	**Setting**
ACT 1	Gain	270˚ Turn	30˚
	Stability	270˚ Turn	50˚
	Thermocouple	270˚ Turn	CCW 1 turn
ACT 2	Gain	270˚ Turn	30˚
	Stability	270˚ Turn	50˚
	Thermocouple	270˚ Turn	CCW 1 turn
GAIN	Temp Balance	270˚ Turn	50˚
	Governor	270˚ Turn	30°
	Fuel Balance	25 Turn	CW 12 turn

6 PRE ENGINE-START ADJUSTMENTS

RACK POSITION CALIBRATION

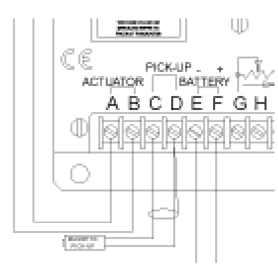
To calibrate rack position on each actuator, without starting the engine, apply voltage to the DDM101.

1. Measure the voltage at Terminals 16(+) and 17 (-) for actuator 1 at the closed position. Adjust voltage to zero volts using A1O.
2. Move the actuator to maximum power and adjust A1G to 1 V DC.
3. Measure the voltage at Terminals 18 (+) and 19 (-) for actuator 2 in the closed position.
4. Adjust voltage to zero volts using A2O.
5. Move the actuator to maximum position and adjust A2G to 1 V DC.



To manually move the actuator to the maximum position, use your finger to push the actuator to maximum position or move the wire from Terminal A on the ESD and connect the wire to Terminal F on the ESD.

If you moved wire on the ESD make sure you do not leave on Terminal F for more than a minute. Longer than 1 minute may cause failure of the actuator.



7 ENGINE ADJUSTMENTS

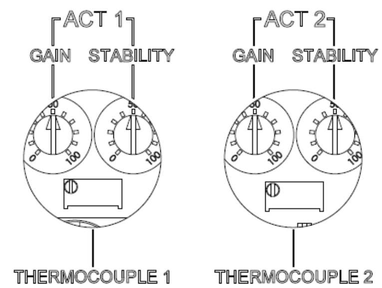
Some mechanical calibration of the actuator linkage and the fuel rack is required usually at idle fuel or a mid point at load control. With the engine running, stable operation should be achieved by properly adjusting the ESD and the altering the following on the DDM.

Start the engine and follow the setup procedure outlined in the ESD user guide. After starting the engine, the following adjustments can be made.

ADD POSITION LOOP GAIN

Each actuator driver circuit has its own actuator GAIN [ACT 1 and ACT 2] adjustment on the DDM101 to optimize the feedback control loop response.

1. Adjust ACT 1 and ACT 2 as high as possible without developing engine or actuator instability.
   a. Adjust Actuator 1 by rotating the ACT 1 GAIN potentiometer CW until instability develops.
   b. Gradually move the adjustment CCW until stability returns. Move the adjustment 1/8 of a turn CCW to ensure stable performance.
   c. Adjust the ACT 2 GAIN potentiometer following the same steps as for Actuator 1.
   d. Poke or disturb the actuator to try to induce instability.
   e. On the speed controller, adjust the GAIN and STABILITY adjustments for best response from the actuators.

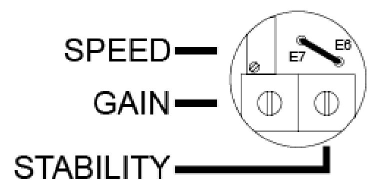


The SPEED and GAIN adjustment on the ESD and the GAIN [ACT 1 and ACT 2] adjustments on the DDM101 can have some interaction. It is possible to turn one up and the other down and get similar results. The GAIN adjustments on the DDM101 must not be turned to low or speed control performance may suffer. A mid-range setting or higher for all of the GAIN adjustments is recommended.

GAIN ADJUSTMENT

With the engine running at rated speed, adjust gain and stability (PID) at the ESD for optimum performance. To adjust the ESD, see your speed control unit's manual for details on the following:

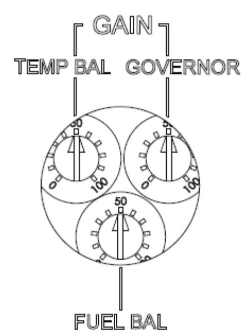
- For best performance, ESD gain adjustment should be set between 40 - 60 % of range.
- If the ESD GAIN adjustment is below 25 % the DDM101 GAIN adjustment should be rotated CCW to a lower setting.
- Readjust the ESD PID settings for optimum transient performance.



GAIN GOVERNOR ADJUSTMENT

Adjusting the DDM101 can also be accomplished by analyzing PWM (Terminals 25 and 26).

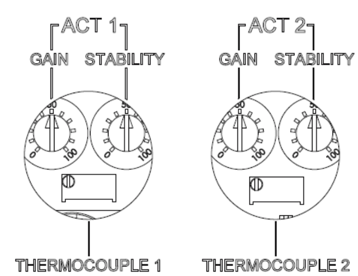
- The voltage between Terminals 25 and 26 should measure 7 V DC at no load and 14 V DC at full load.
- If the measured voltage is lower than desired range, the DDM101 GAIN GOVERNOR adjustment is set too high and should be rotated counter-clockwise. This should increase the voltage across Terminals 25 and 26 on the DDM101.
- If the measured voltage is higher than the desired range, the DDM101 GAIN GOVERNOR adjustment is set too low and should be rotated clockwise. This should decrease the voltage across Terminals 25 and 26 on the DDM101.



ACTUATOR STABILITY ADJUSTMENT

Each actuator has its own actuator stability ACT 1 STABILITY and ACT 2 STABILITY adjustment to optimize system stability. Adjust both ACT 1 and ACT 2 STABILITY adjustments as high as possible without engine or actuator instability.

1. Adjust Actuator 1 first by rotating the ACT 1 STABILITY adjustment CCW until instability in the engine develops.
2. Gradually move the adjustment CW until stability returns. Move the adjustment 1/8 of a turn CW to ensure stable performance.
3. Adjust Actuator 2 via the ACT 2 STABILITY adjustment following the same steps as for Actuator 1.
4. Poke or disturb the actuator to induce instability. Adjust the GAIN and STABILITY for best response of the actuator.

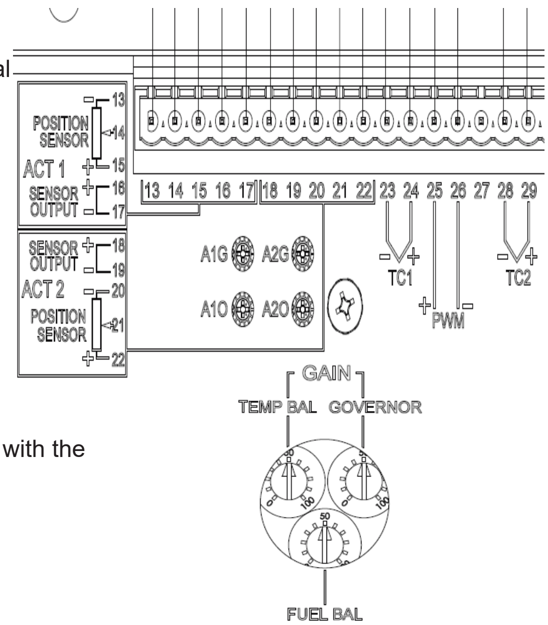


FUEL BALANCE ADJUSTMENTS

The fuel balance adjustment allows for equalization of the fuel being delivered by each actuator. The FUEL BAL adjustment is set to equal engine cylinder power at near 100 % of engine load. To achieve the minimum difference at any load point the mechanical linkage adjustments should be set equal at 20 % power, with the electrical adjustments set equal at 80 % power.

1. With the engine running at no load, using a multimeter, measure the DC voltage output of the feedback sensors from each actuator.
   - Voltage measurement for Actuator 1 is taken across Terminals 13 and 14.
   - Voltage measurement for Actuator 2 is taken across Terminals 20 and 21.
2. Both voltage measurements should have an operational range of 1 to 4 V DC.
3. If the voltage readings are not equal, adjust the FUEL BAL potentiometer on the DDM101 until the voltage readings are equalized and the exhaust temperatures are balanced.

Any differences noted by the actuator position sensors is nullified by the electronics so that the position sensors track equally throughout the range, unless compensated with the FUEL BAL adjustment on the DDM101.



EXHAUST TEMPERATURE DIFFERENCE MONITORING AND CONTROL

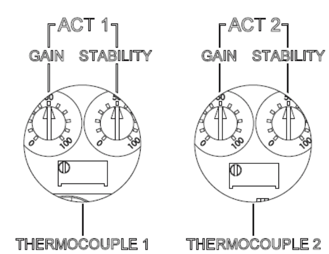
Do not alter the factory settings of THERMOCOUPLE 1 or THERMOCOUPLE 2 adjustments unless a significant imbalance exists.

If an imbalance occurs first try to correct the issue using the standard mechanical and electronic balancing methods described previously. If a problem persists determine which exhaust channel is higher in temperature and adjust the bank's THERMOCOUPLE1 or THERMOCOUPLE2 adjustment counter-clockwise to equalize the exhaust temperature. Adjusting the cooler banks THERMOCOUPLE adjustment clockwise may also equalize the exhaust temperature.

The DDM101 requires the use of exhaust temperature thermocouples to balance the load precisely with the dynamic balancing function.

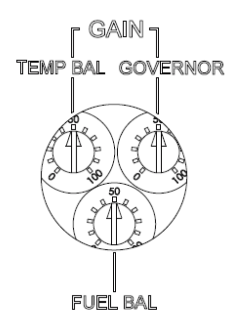
Placement of thermocouples in the exhaust gas stream does not guarantee that equal measurements provide equal power from each bank. Exhaust temperature is, however, a good indication of balance and the exhaust temperature control loop will actively trim the system.

With two industrial rated Type K type thermocouples installed in the exhaust pipe of each bank the DDM101 can measure and track two exhaust temperatures.



- The thermocouple adjustments (THERMOCOUPLE 1 and THERMOCOUPLE 2) are calibrated at the factory to receive equal input signals from the thermocouples.
- If a difference in either bank's exhaust temperature is measured by the DDM101, the control loop will readjust the fuel balance automatically to minimize the difference.
- If a measured difference is still found, the operator can manually change the balance and increase the temp control loop authority by rotating the GAIN TEMP BAL adjustment CCW.

If at any time, one or both of the thermocouples signals are lost (open circuit detected) the TC 1 or TC 2 fault LED will light and the balancing function will shut off (Table 7).



7 ENGINE ADJUSTMENTS (CONTINUED)

TABLE 7: LED LIGHTS

LED	FUNCTION
ACT 1	Actuator drive circuit 1 is receiving a drive signal from the controller.
ACT 2	Actuator drive circuit 2 is receiving a drive signal from the controller.
TC 1 FAULT	Thermocouple 1 has a fault or open circuit.
TC 2 FAULT	Thermocouple 2 has a fault or open circuit.
EXHAUST TEMP 1	Unbalanced exhaust temperatures; control is actively trimming fuel to actuator 1 to balance the system.
EXHAUST TEMP 2	Unbalanced exhaust temperatures; control is actively trimming fuel to actuator 2 to balance the system.
GOV DRIVE	Drive signal from external speed controller is being removed to open up the throttle.

8 TROUBLESHOOTING

GENERAL ISSUE	POSSIBLE SOLUTION	
Instability: erratic engine behavior	Non-Periodic	Increasing the GAIN should reduce the instability but not totally correct it. If this is the case, there is most likely a problem with the engine itself. Check for: • engine mis-firings • an erratic fuel system • load changes on the generator set voltage regulator. If throttle is slightly erratic, but performance is fast, then remove the jumper from E6 to E7.
Unsatisfactory performance: engine overspeed	Do Not Crank. Apply DC power to the governor system.	After the actuator goes to full fuel, disconnect the speed sensor at Terminals C and D. If the actuator is still at full fuel-speed then the speed control unit is defective.

Unsatisfactory performance	Manually hold the engine at the desired running speed.
	
	Measure DC voltage between Terminals A(-) and F(+) on the speed control unit.
		If the voltage reading is 1.0 to 2.0 V DC:
		• SPEED adjustment is set above desired speed
		• Defective speed control unit
		• If voltage reading is above 2.0 V DC then check for:
		  • actuator binding
		  • linkage binding
		• Set point of overspeed shutdown device set too low.
		• If the voltage reading is below 1.0 V DC most probably a defective speed control unit. Call GAC.

Overspeed shuts down engine after running speed reached	• Speed adjustment set too high. • OVERSPEED set to close to running speed. • Actuator or linkage binding. • Speed control unit defective.	
Actuator does not energize fully	Measure the voltage at the battery while cranking.	If voltage is less than 7 V DC or 14 for a 24 V DC system, check or replace the battery.
Overspeed shuts down engine	Momentarily connect Terminals A and F.	The actuator should move to the full fuel position. • Actuator or battery wiring in error • Actuator or linkage binding • Defective actuator • Fuse opens. Check for short in actuator or harness.
Engine remains below desired governed speed	Measure the actuator output, Terminals A and B, while running under governor control.	If voltage measurement is within 2 V DC of the battery supply voltage level, then fuel control is restricted from reaching full fuel position, possibly due to mechanical governor, carburetor spring, or linkage interference. SPEED parameter set too low.

8 TROUBLESHOOTING (CONTINUED)

GENERAL ISSUE	POSSIBLE SOLUTION	
Insufficient magnetic speed signal	• A strong magnetic speed sensor signal eliminates missed or extra pulses. The speed control unit will govern well with 1.0 V AC speed sensor signal. A speed sensor signal of 3 volts V AC or greater at governed speed is recommended. • Measure signal at Terminals C and D. • To raise the amplitude of the speed sensor signal, reduce the gap between the speed sensor tip and the engine ring gear. The gap should not be < 0.025 in (0.64 mm). When the engine is stopped, back the speed sensor out by 1/4 turn after touching the ring gear tooth to achieve a satisfactory air gap.	
Thermocouples not responding	If one or both of the thermocouple signals are lost (open circuit detected) the TC 1 or TC 2 fault LED will light and the balancing function will shut off. Do not alter the thermocouple factory settings. • Adjust the GAIN TEMP BAL potentiometer on the DDM101. • If a problem persists: • Determine which exhaust channel is higher in temperature and adjust the bank's THERMOCOUPLE adjustment counter-clockwise to equalize the exhaust temperature. • Adjust the cooler banks THERMOCOUPLE adjustment clockwise to equalize the exhaust temperature. • Examine protection tubes for excessive corrosion, wear, oxidation and physical damage. Protection tubes exhibiting damage and/or excessive corrosion should be replaced. • Examine wiring for damaged insulation and tight connection points.	
TC 1 FAULT and TC 2 FAULT Light when not using thermocouples	If not using thermocouples, placing a 10 k Ω resistor between Terminals 23 and 24, and Terminals 28 and 29 to prevents the TC 1 FAULT and TC 2 FAULT LEDs from indicating a fault.	
System inoperative	• Positive (+) and negative (-) refer to meter polarity. Should normal values be indicated during troubleshooting steps, and then the fault may be with the actuator or the wiring to the actuator. • Tests are performed with battery power on and the engine off, except where noted. • See your GAC representative for additional help for inoperative system issues after reading this manual.	
System inoperative	F(+) and E(-) Battery Supply Voltage (24 V DC)	• DC battery power not connected. Check for blown fuse. • Low battery voltage. • Wiring error.
System inoperative	C(+) and D(-) 1.0 V AC minimum while cranking	• Gap between speed sensor and gear teeth too great. Check Gap. • Improper or defective wiring to the speed sensor. Resistance between D and C should be 160 to 1200 Ω. See specific mag pickup data for resistance. • Defective speed sensor.
System inoperative	P(+) and G(-) 10 V DC, Internal Supply	Short on Terminal P. Defective speed control unit.
System inoperative	F(+) and A(-) 1.0 - 2.0 V DC while cranking	• SPEED parameter set too low. • Short/open in actuator wiring. • This may be a defective speed control. See your GAC representative for more information.
Instability: The engine jitters at 3Hz or faster.	Fast Periodic	• Turn off other electrical equipment that may be causing interference. Readjust the GAIN and STABILITY for optimum control. • Remove the E6 to E7 jumper to reduces sensitivity to high frequencies. • If system is still unstable, remove the E1 to E2 jumper and readjust GAIN and STABILITY.

Instability: Irregular speed below 3Hz	Slow Periodic	• Readjust the GAIN and STABILITY.
		• Set DIP switches 1 and 2 to ON in the following order: First SW1, Second SW2.
		• Check fuel system linkage during engine operation for:
		  • binding
		  • high friction
		  • poor linkage
		• Adjust the deadtime compensation on the DDM101 by adding a capacitor from posts E2 to E3 (negative on E2). Start with 10 mfds.