LCC108B
Locomotive Speed & Load Control

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1 INTRODUCTION

The LCC108B (LCC) is a combination engine speed control (LCC108B-1) and generator excitor control system (LCC108B-2) for Cummins KTA50 engine powered locomotive applications. This design provides 8 speeds and 8 power levels from the engine generator to power the diesel electric locomotive traction motors. The engine develops a specific power for each notch position.

Engine speed input is received from the magnetic sensor that is measuring flywheel speed. The output current of the speed control module drives the ADB120E4 proportional electric actuator/fuel valve which controls fuel from the PT fuel pump and into the common rail fuel injectors of the engine.

Speed selection is performed through a four wire coded speed selector system. This unit uses only 8 notches for speed setting with each a separate independent speed adjustment.

The speed controller features: Gain, Stability, Droop, Dead Time Compensation, and other functions such as a block gain reduction, lead / lag compensation, damping, droop enhancement, and speed ramp control (acceleration / deceleration) for smooth transitions between notch settings. There is also built-in overspeed sensing and crank termination with internal relays for shutting off the fuel pump and starter motor.

The excitation circuits are designed to control the main generator field current to regulate engine power. The load control section has 8 adjustable power settings, one for each notch.

The output of the load control section of the LCC is a field current control circuit which operates on supply voltages from 60 -110VDC

Field currents from the main generator as high as 10A can be controlled with this integrated circuit. Field currents greater than 12A cause the field currents to automatically shut down. An external field current limiting resistor may be required to limit the maximum current. The Green EXCITATION SUPPLY LED indicates if the field supply voltage is above 50VDC.

The dynamics of the excitor control circuits are supervised by the LOAD RAMP, LOAD GAIN (sensitivity) and Load STABILITY adjustments for smooth, stable, and responsive engine power output. Added features of the excitor control loop are wheel slip control circuits and a LOAD DERIVATIVE adjustments.

If the main generator's AC voltage or its AC current exceeds the internal setting, the LCC will reduce the field current until it is held at or below the set limits.

The LCC accepts an AC voltage, proportional to generator voltage, up to 150VAC. For most applications, a small step down isolation transformer, typically 800 - 80VAC, is used to interface the high generator voltages to the control. The AC power absorbed by the control at terminals 11 & 12 is less than 1VA.

The AC current input is typically from a 5A CT on the main generator. A 0 - 5A signal proportional to the main generator current is applied to Terminals 21 & 22. The internal burden resistance on the CT is 0.05 Ω (1.25VA).

Sixteen adjustments, one voltage and one current limit for each of the eight notches, are alerted by the provided LEDs which indicate when the system is under a voltage or current limit control. If neither is lit, the system is under engine power control.

2 PRE-INSTALLATION & BASIC WIRING

The speed control has been preset at the factory to meet the specification and needs no adjustment until the engine has been installed with its new generator and final control circuits.

NOTE The notch selector switch applies 75V to the notch code wires to select the appropriate notch. Terminal 5 is the common connection point for the notch selectors and must be connected to the minus side of the 75VDC supply. This is the return path for the internal isolated opto-couplers on the notch control inputs.

The overspeed protection circuit relay contacts, Terminals L & M, are typically connected in series with the stop solenoid on the fuel pump. In the event the overspeed circuits operates, the red LED lights, and the contacts will remove the power to the stop solenoid.

NOTE Refer to the wiring diagram for the correct connections. A 15Ω, 150W external resistor must be placed in series with the 24V actuator when the supply is 75VDC.

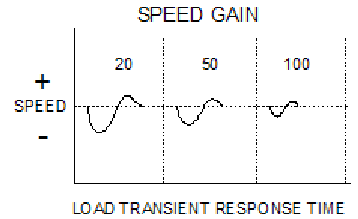
The DC power supply to the speed control should be from a 75VDC battery supply having good regulation for currents up to about 5A and should be fused for 10A. Note the optional external power-conditioning filter in the 75VDC supply. The input wires to the filter must be separated from the output wires of the filter by at least 2cm for proper isolation.

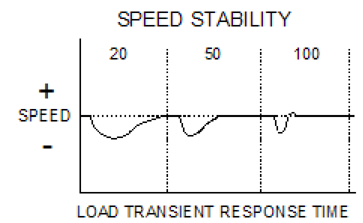
The case of the LCC is electrically isolated from its circuits. There is a security cover over the calibration adjustments. Removing the 6 cover screws allows access. On the underside of the cover is a diagram of the adjustment locations. After adjusting the controls, replace the cover and secure with the screws.

The power amplifier module will have to dissipate up to 30Watts of heat. Place this module in a location where the heat sink can receive adequate air circulation. (Max. ambient = 55°C)

3 SPEED CONTROL - ADJUSTMENTS DESCRIPTION

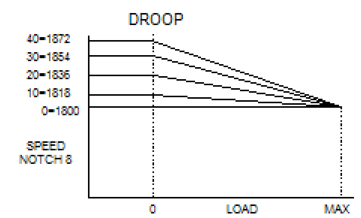
GAIN Clockwise adjustment increases the sensitivity of the governor speed control loop. A 30 - 1 adjustment range is provided, 100 = highest sensitivity. In addition, dip switch SW3 #4 allows a Gain reduction of 2 . Turn ON this switch to reduce the speed loop Gain.

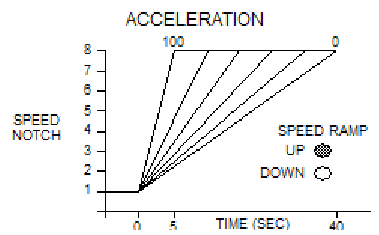




STABILITY Clockwise adjustment shortens the time response of the governor. A 25 - 1 range is provided. The longest time constant and the most stable position is the 0 setting.

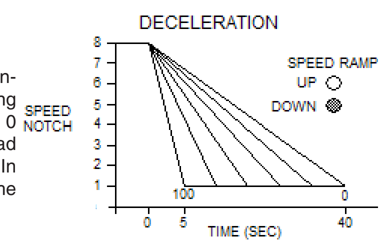
DROOP Clockwise adjustment of the droop control will add speed droop to the speed control loop. 0 = Isochronous. 100 = Maximum Droop (about 5%). Droop is proportional to the actuator current change. A small amount of droop can be added to insure optimal stability at low speeds without interfering with the control system's performance capabilities.





ACCELERATION The rate of engine speed acceleration when changing notch settings can be set with this control. The rate as long as 40 sec. or as short as a few seconds from Idle to rated speed can be set. 0 = Slowest acceleration.

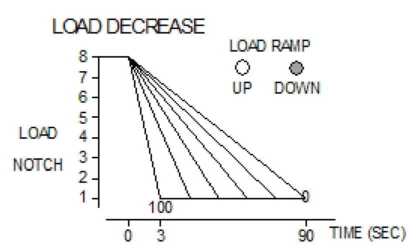
DECELERATION The LCC allows the rate of engine speed deceleration to be set. A rate as long as 40 sec. from rated speed to idle is possible. 0 = slowest deceleration. The engine and its load inertia will limit the maximum deceleration rate. In this case, the closed throttle deceleration will be the fastest possible deceleration.



SPEED NOTCH ADJUSTMENTS 1 - 8 Each notch position has a standard limited range of adjustment. This is usually wide enough to allow for normal variations in the operating speed at each notch. See the specifications for the ranges.

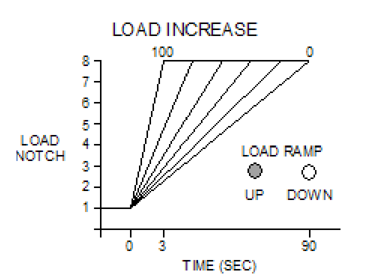
4 LOAD CONTROL - ADJUSTMENTS DESCRIPTION

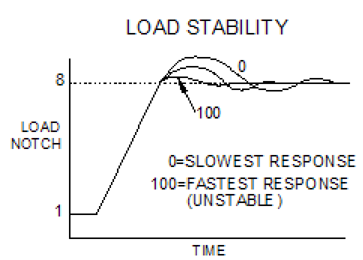
LOAD RAMPING A CW adjustment of the LOAD RAMPING shortens the load ramp time and loads the engine more quickly through the excitation control circuits. The range of adjustment allows for a very slow rate, exceeding 80 sec., or a fast rate of less than 3 sec.



R=RESISTOR LOCATED BETWEEN POSTS E10 & E11

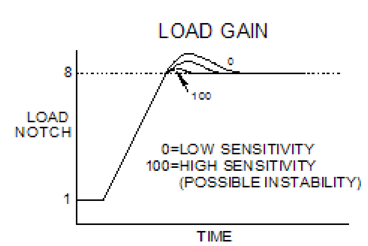
IF R=0, RATE=SPEED DECELERATION RATE SETTING
IF R=INFINITY, DECREASE RATE=INCREASE RATE



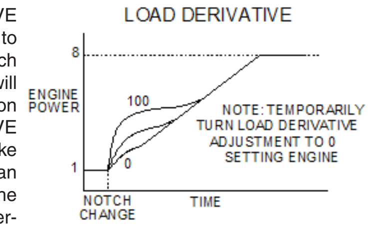


LOAD STABILITY The LOAD STABILITY is a time rate adjustment that allows optimization of the load control loop. CCW adjustment compensated for a slow surging of the load. The most stable position is 0 but it also results in the slowest load response.

LOAD GAIN The LOAD GAIN (sensitivity) adjusts the load control loop sensitivity. High sensitivity is required for stable and responsive load control. This adjustment should be used to obtain the highest sensitivity without instability.



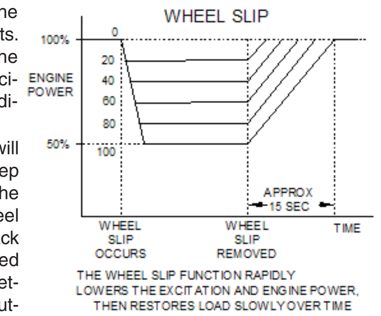
LOAD DERIVATIVE: The LOAD DERIVATIVE adjustment is a feature that allows the operator to modify the load change dynamics. When a notch setting has been increased, the engine speed will accelerate. To maintain the power to the traction motors, or increase it, the LOAD DERIVATIVE adjustment can be advanced CW. This will make the engine temporarily supply more power than the notch power setting for a few seconds. The ideal LOAD DERIVATIVE setting must be determined when the locomotive system is in its completed form.



WHEEL SLIP #1 When a wheel slip condition has been detected, applying 75VDC to Terminals 6(+) & 7(-) will operate the wheel slip function's internal relay.

A wheel slip adjustment is provided to adjust the magnitude of reduction to the exciter circuits. If the adjustment is set to 0, the function of the wheel slip will be to hold the present PWM excitation output condition until the wheel slip condition disappears.

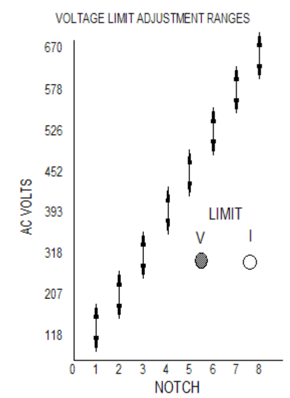
Turning the "Wheel Slip" adjustment CW will cause the excitation output to decrease in a step and then hold at that new PWM output until the wheel slip condition disappears. When the wheel slip contacts open, the excitation will ramp back up to the original load of the currently selected notch position. The higher the "Wheel Slip" setting, the greater the drop in excitation PWM output.

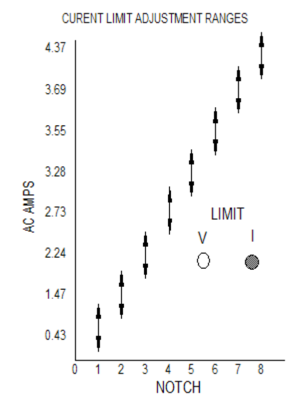


WHEEL SLIP #2 When wheel slip contact #2 is closed, the field excitation is immediately removed.

INTERNAL LOAD CONTROL OPTIONS There are additional control options for the load control loop located inside the LCC. These are described in the Special Features section and include: dead time compensation, setting of the load regulation, and a load deceleration rate adjustment.

AC VOLTAGE and AC CURRENT LIMIT adjustments are provided for each notch position. These 16 adjustments are factory set to the listed specifications. If either the AC VOLTAGE or AC CURRENT sensed by the LCC exceeds the set point for the requested notch position, the limiting circuits will start to control the field current and maintain this voltage or current. The LIMIT LED being lit will note this condition. A loop gain control for the voltage and current limits is located below the voltage and current limit adjustments.





5 ENHANCEMENTS

LOAD RESET ADJUSTMENTS When the LCC control module is put into the reset position (72VDC applied to Terminals 13 and 14), the load control function will be set to a low power setting (not zero). This setting is adjusted by using the RESET potentiometer shown in the WIRING DIAGRAM in Section 12. A CW adjustment will increase the load setting so that when the reset function is switched OFF, the power from the main generator will come on quickly (without delay) and then ramp to the operator's requested load setting of the notch selector switch. This virtually eliminates the delay in power supplied to the locomotive's traction motors when coming out of reset.

Over Voltage Protection for the 75 VDC circuits If the 75VDC supply ever rises to a level beyond 150VDC for a period of over 0.5 seconds, the control circuits connected to this 75VDC supply will automatically be disconnected to protect the low voltage electronics and shut down the engine. Once this has occurred, it will maintain that condition until the supply has been reduced to below 82VDC. The circuits will then automatically reconnect below 82VDC and restart normal operation. If this protection occurs, an LED that is labeled OVER VOLTAGE will light and indicate that the circuit has taken this action. If an occasional flickering of the LED occurs, it means that short transients above approximately 91VDC are being detected. This should not cause any problems, but should be investigated to find the cause of the surge before it becomes a consistent over voltage issue and shuts down the engine.

Short Circuit Protection for the Actuator Control Circuit If at any time the actuator circuit current reaches a level above 8A, the actuator circuit will automatically shut off to protect itself. This will be maintained for less than 1 second after the short is removed and normal operation will be restored. An LED labeled OVER CURRENT will indicate that the circuit has been activated. Once the reason for the current surge has been eliminated, the actuator circuits will return to normal operation.

Additionally, EMI filter networks have been added to all sensitive inputs. The CT input circuit has been protected against erroneous high voltage transients. These enhancements do not affect the unit's compatibility with previous LCC units.

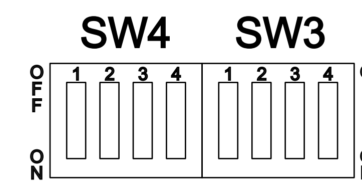
Actuator Frequency Control (AFC) A potentiometer located next to SW4 is available for further stability enhancement.

6 ADJUSTMENTS

The control system has been factory set to provide a stable, accurate system. The final application is dynamically different from the laboratory settings and the control system should be readjusted to match the characteristics of the locomotive application. The following steps should be used as a guide to this setup procedure. When following this procedure, the control system has several convenient adjustments that the installer should optimize. There are also several internal functions that can be added and are described in the Special Features section.

ADJUSTMENT PROCEDURE			
1.	Select Notch (Idle)		No wires energized
2.	Apply 75VDC power to the speed control system	2.1	Note that the LED of Notch 1 should be lit.
		2.2	The actuator should be in the shut off position.
3.	Crank and start the engine	3.1	The actuator should be on and the engine should accelerate up to the Notch 1 (idle) setting.
		3.2	The cranking termination green LED should light during the acceleration.
		3.3	Allow the engine to warm up before adjusting the governor.
4.	Speed control system adjustments. Adjust the GAIN and STABILITY to stabilize the system at idle	4.1	Turn the GAIN CW until the system becomes unstable.
		4.2	Turn the GAIN CCW until stability is restored.
		4.3	Reduce teh GAIN setting one more division CCW.
		4.4	Turn the STABILITY CW until system is unstable.
		4.5	Turn the STABILITY CCW until system is stable.
		4.6	Reduce the STABILITY setting one more division CCW.
Quickly push and release the actuator to disturb the system. The system is considered stable if the response is rapid and without large over or undershooting.			
NOTE: If good stability is not achieved, or the GAIN adjustment is set below 20, readjust the DIP switches by first determining the frequency of instability. Fast instability is more than 2Hz., slow is 2Hz. or less.			

FAST Speed Instability Determine the present DIP switch settings and compare them to the table below. Readjust the settings to the next highest numbered step.



SW4 TABLE				
STEP	1	2	3	4
1	OFF	OFF	OFF	OFF
2	OFF	OFF	OFF	ON
3	OFF	OFF	ON	OFF
4	OFF	OFF	ON	ON
5	OFF	ON	ON	OFF
6	OFF	ON	ON	ON
7	ON	ON	ON	OFF
8	ON	ON	ON	ON

After adjusting SW4, repeat the ADJUSTMENT PROCEDURE as described above. Continue changing the SW4 switches until the system is stable or Step 8 is reached. If the fast instability is not eliminated reset the following DIP switches (see chart below) and repeat Section 4 of the above ADJUSTMENT PROCEDURE after each step.

DIP SWITCHES	
1.	Turn OFF SW3 #2 (Lead)
2.	Turn ON SW3 #4 (Gain)
3.	Turn OFF SW3 #1 (Enhanced droop)
4.	Turn ON SW3 #3 (Damping)
5.	Turn the DROOP adjustment CW a small amount (20), more if necessary.

SLOW Speed Instability Find the present DIP switch settings in the SW4 TABLE above. Readjust the settings of DIP switch SW4 to the next lower numbered step. After each change of the switch settings, readjust the GAIN and STABILITY as noted in ADJUSTMENT PROCEDURE. If the slow instability is not eliminated, reset the following DIP switches and repeat Section 4 of the above ADJUSTMENT PROCEDURE after each step.

DIP SWITCHES	
1.	Turn ON SW3 #2 (Lead)
2.	Turn OFF SW3 #4 (Gain)
3.	Turn ON SW3 #1 (Enhanced droop)
4.	Turn OFF SW3 #3 (Damping)
5.	Turn the DROOP adjustment CW a small amount (20), more if necessary.

If low speed instability is still present, slowly adjust the AFC adjustment CCW until stable operation is achieved with best settings above.

SPEED SETTING ADJUSTMENTS Once the governor is set for stable operation at idle speed (Notch 1), trim the speed to the setting listed in the specifications if necessary. Select the Notch 2 through 8 positions and adjust each notch speed setting according to the specification.

Acceleration and Deceleration Adjustments Return to the Notch 1 setting. Quickly switch from Notch 1 to Notch 8 and adjust the ACCELERATION setting for the desired ramp time, usually about 15 sec. Quickly switch from Notch 8 to Notch 1 and adjust the DECELERATION setting for the desired ramp time, usually 5 - 10 sec. Once the basic speed governor settings have been calibrated and the stability is good over the entire range, the excitation control loop can be operated and adjusted.

NOTE The two SPEED RAMP LEDs (UP or DOWN) indicate when the LCC is in the ramping mode.

7 EXCITATION CONTROLS

The field control circuit power the main generator and determines the power that the engine must produce. Since this is a closed loop control system, the LCC has total control of the field current. The field current can vary between 0 and maximum at any notch position. In the start up phase (Notch 1) the output of the control may be preset for either 0 or maximum field current.

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To start the operation from 0 field current, the control must be reset by applying 75VDC to the excitation reset relay at Terminals 13(-) & 14(+). This will hold the field output at 0A until the RESET switch is opened. A smooth but slower response will occur when the switch is opened.

If it is desired to have the system rapidly increase engine power, no switch is necessary. In this case, as soon as DC power is applied to the excitation circuits, Terminals 25 & 26, the field current will rise rapidly until the AC current or AC voltage limit functions take control of the generator or the system comes under power control. When the main generator's current and voltage fall below the set limits, the system will be back on power control for the notch position.

Rapid removal of field excitation can be accomplished at Wheel Slip #2 by applying 75VDC at Terminals 29(+) & 30(-). This action will immediately turn off the field voltage. Due to the inductive nature of the field, it will take a short time for the field current to reach zero. A low level 400Hz. PWM excitation control signal from 0 - 9V is available at Terminal 8. This can be used as a test point where 9V = Full Excitation.

LOADING the ENGINE The following adjustments should be made with the engine / generator connected to a load bank (box). Set the control to the Notch 1 position. Open the excitation reset switch if used. The power control should quickly rise up to the level set by the speed control.

Engine load stability should then be adjusted. The LOAD GAIN and LOAD STABILITY adjustments allow the load control loop to be optimized.

Adjust the LOAD GAIN CW until the load becomes unstable. Quickly turn the LOAD GAIN CCW to restore stability. The LOAD GAIN should be set as high as possible, without instability, for the best performance.

Adjust the LOAD STABILITY CW until the load becomes unstable. Quickly turn the LOAD STABILITY CCW to restore stability. The system should be stable and the LOAD GAIN should not be set to less than 20.

Evaluating Load Stability To determine if the load control loop is stable, momentarily close the Wheel Slip #2 relay at Terminals 29 & 30. This will cause the load to decrease and then recover when the connection is removed. The load control system should respond and correct the load smoothly without instability. The load control loop operates much more slowly than the governor speed control loop.

Once the load control loop is stable, adjust the power lever for each of the 8 notch positions. DO NOT adjust the engine power to levels that approach the maximum power the engine is capable of developing. Instability can result if this requested power level exceeds the engine's capacity.

It is good practice to monitor and record the actuator current and the engine power at each notch position. Also, recording the excitation output from the control, Terminal 8, will be useful for future reference.

NOTE Voltage test points/posts located next to each load control pot can be measured and recorded for future reference. The post above notch 1 load pot is the common (-) post.

LOAD RAMPING Once the power at each of the 8 notch positions has been set, the load ramp time can be adjusted for an appropriate setting. 100 is the shortest ramp time and 0 is the longest. The two LEDs labeled LOAD RAMP indicate when the LCC is in the UP or DOWN load ramping mode. If the speed is ramping, the load will also be ramping.

Proper adjustment of the LOAD RAMP and engine speed acceleration will affect the amount of exhaust smoke. In no case can the load ramp be set faster than the speed ramp. If such a case occurred, the engine could be temporarily overloaded if the speed was not high enough to support the requested load.

Load rates as slow as 80 sec. from Notch 1 to Notch 8 can be obtained. The speed ramp time should be approximately one half the load ramp time from Notch 1 to Notch 8. The dynamic performance of the locomotive operation and the amount of exhaust smoke that can be tolerated will dictate the specific settings.

LOAD DERIVATIVE To boost the traction power when a notch is stepped up, adjust the derivative CW to 20 - 40. This will temporarily boost engine power.

VOLTAGE and CURENT LIMIT The generator voltage input is from a 10:1 step down transformer that provides an isolated low voltage AC signal. The input current signal is from a standard 5A current transformer (CT). Each notch has a reference setting for limiting the AC voltage or current. The 16 adjustments are individually calibrated according to the limits of the generator. The factory settings are listed in Section 10. When the voltage or current exceeds the calibration setting, the limiting circuit assumes control of the field current and maintains the limit setting. This occurrence will be noted when a LIMIT LED is lit. The AC input signals must be present at all times or the limiting protection will be lost. A loop limit gain control is provided for stable operation. Set this adjustment as high as possible without causing instability.

WHEEL SLIP #1 The wheel slip function in the LCC is operated by closing a sensing contact that applies 75VDC between Terminals 6 (+) & 7(-). Note the WHEEL SLIP LED. On wheel slip contact closure, the excitation output is latched at the present setting. The amount of instantaneous change of the excitation from the present setting to a lower value is determined by the "Wheel Slip" adjustment. At a setting of 0 there is no change in the excitation. The higher the "Wheel Slip" setting, the greater the step reduction in excitation.

Once the wheel slip relay is opened, the excitation will respond and control at a new point, lower than the original excitation. The excitation will then ramp up to the setting of the notch selected. The ramp time for this is fixed at about 15 sec. The higher the "Wheel Slip" setting, the greater the drop in excitation and the longer the time to ramp back to the original setting.

WHEEL SLIP #2 It is advised to use wheel slip circuit #1 for all normal wheel slip conditions. If a rapid reduction of all generator power is required, a 75VDC connection to Terminals 29 (+) & 30 (-) will turn off all field voltage.

During shut downs or emergencies, removing the DC supply voltage from Terminal 25 will also rapidly reduce the field current to 0. Under no circumstances should the field be opened when the system is in operation. Due to the high inductance of the field, this could damage the field or the LCC if performed repeatedly.

OVERSPEED TEST The overspeed circuit is set to operate at 4987Hz (2100rpm). If the engine speed reaches this frequency, the overspeed circuit will automatically shut down the engine. To test the overspeed function at no load, go to Notch 8. Pushing the TEST button will cause the overspeed circuit to operate. The RESET button will clear the function. It is suggested that the overspeed function occasionally be verified by operating at Notch 8 and pushing the TEST button to confirm that the engine shuts down.

An internal adjustment, the blue potentiometer near the SPEED ACCELERATION, sets the overspeed calibration point. CW rotation increases the speed at which the circuit will trip. The overspeed relay contacts at Terminals L, M, and N are rated at 6A.

CRANK TERMINATION The crank termination function is set at the specification frequency of 825Hz (350 rpm). As the engine speed passes this frequency, the green LED will light and the crank termination will occur. An internal adjustment, the blue potentiometer near the SPEED GAIN, sets the overspeed calibration point. CW rotation increases the speed at which the circuit will trip. The relay contacts, Terminals P, R, and S, are rated at 6A and should be used to disconnect the cranking motor. In order to reset the crank termination function, the 75VDC power must be removed from the unit.

8 SPECIAL FEATURES

LOAD REGULATION The load regulation in the LCC is 0. If regulation of the load, or a lowering of the load loop gain, is required, a resistor can be soldered between posts E1 and E2 on the circuit board. A 5MΩ resistor will provide approximately 10% regulation, or reduce the load loop gain by a factor of 0.9.

LOAD RAMPING (Decreasing) The LOAD RAMPING adjustment is used to both increase and decrease the load ramp time. If it is desired to make the load decrease faster than the load increase, a resistor can be soldered between posts E10 and E11. A 50KΩ resistor will change the load decrease time by approximately 30%. A jumper wire soldered between the posts will make the load decrease time equal to the speed deceleration setting. (Factory configuration)

TERMINAL	TERMINAL INFORMATION
G	Battery minus / Signal ground
H	Speed error signal
K	Internal +10V supply
J	Voltage proportional to actuator current
17	Battery minus / Signal ground
16	Load ramping monitor
19	PWM output for field excitation

9 TROUBLESHOOTING

SYMPTOM	PROCEDURES
Speed Control Inoperative	1. Apply 75VDC to the unit, set in the IDLE position, DO NOT crank the engine.
	Measure and observe the following points and voltages relative to battery minus. 1. Notch 1 (LED ON) 2. Voltage between Terminals E and F, 0 + 0.5 V 3. Terminal H (Higher than 3.8V) 4. Terminal K (2.0 + 0.25V)
	2. Crank the Engine
	Measure and observe the following points and voltages relative to battery minus. 1. Voltage between Terminals E and F, 73V (2V less than battery voltage) 2. Terminal H (Less than 3.8V) 3. Terminal K (5.5 + 0.25V) 4. Voltage between Terminals A and B, Minimum 1.0VAC
	3. Check Engine Fuel System
Engine Overspeeds	Make measurements indicated in "Speed Control Inoperative". If they are correct, unplug the actuator connector and try restarting the engine. If the engine starts and still overspeeds, the actuator is binding. Clean or repair the assembly
Engine Load Instability	If the engine load is periodically unstable, and the LOAD GAIN and LOAD STABILITY cannot compensate for this condition, refer to the INTERNAL LOAD CONTROL OPTIONS paragraph in Section 4.

NOTE: Note, do not confuse load instability with speed instability. Slight readjustment of the speed Gain and speed Stability may be required if Load control loop (Load Gain and Load Stability) do not remedy the problem.

10 SETTINGS

NOTCH	SPEED GOVERNING: SPEED (RPM)	RANGE (Hz)	Hz	POWER CONTROL: ACTUATOR CURRENT (LCC108B)	RANGE (Amps) (LCC108B)
1	700	1480-1900	1656	0.89 Amps	0.69 - 1.20
2	1000	1825-2800	2367	1.00 Amps	0.75 - 1.25
3	1200	2000-3550	2840	1.10 Amps	0.85 - 1.40
4	1300	2100-4000	3076	1.15 Amps	0.90 - 1.45
5	1400	2750-4000	3313	1.20 Amps	0.95 - 1.55
6	1500	2750-4100	3550	1.25 Amps	1.05 - 1.65
7	1650	3500-5200	3905	1.35 Amps	1.10 - 1.70
8	1800	3500-5200	4260	1.45 Amps	1.20 - 1.80

VOLTAGE LIMIT and CURRENT LIMIT GAINS AT RANGE SETTINGS

NOTCH	VOLTAGE RANGE (VAC)	SETTING (VAC) (LCC108B)	CURRENT RANGE (Amps AC)	SETTING (Amps AC) (LCC108B)
1	30 - 300	125	0 - 1.5	1.15
2	105 - 400	230	0.4 - 3.0	1.47
3	150 - 450	380	1.0 - 3.3	1.80
4	200 - 550	530	1.5 - 3.8	2.13
5	300 - 650	605	2.0 - 4.1	2.46
6	350 - 750	665	2.3 - 4.2	2.79
7	400 - 800	780	2.3 - 4.3	3.11
8	450 - 850	815	2.3 - 4.4	3.44

FACTORY SETTINGS

SPEED GAIN	40	OPTION SWITCH SW3		LOAD RAMP	70
SPEED STABILITY	50	1 OFF	2 ON	LOAD GAIN	70
DROOP	10	3 ON	4 OFF	LOAD STABILITY	50
SPEED RAMP ACCEL	50			LOAD DERIVATIVE	0
SPEED RAMP DECEL	50	OPTION SWITCH SW4		WHEEL SLIP	0
CRANK TERMINATION	825Hz	1 OFF	2 OFF	JUMPER	E10 - E11
OVERSPEED	4987Hz	3 ON	4 ON	AFC	125 Hz (Notch1)

11 SPECIFICATIONS

ENVIRONMENTAL	
Temperature Range	-20°C to +55°C (-4°F to +131°F)
Humidity	up to 100%
RELIABILITY	
Vibration	Per IEC #77
Shock	10G, 11ms
INPUT / OUTPUT PARAMETERS	
Power Supply	75VDC ± 20% Minimum Voltage to Operate
Excitation Supply	60 - 110VDC at Maximum of 10A
Current Consumption (Power On & Engine Not Running)	60 ma
(Power On & Engine Running)	100 ma
Transient Voltage Protection	Above 240V
Magnetic Pickup Voltage Requiremnt	0.5 - 50VAC (10VAC Suggested At 1800RPM)
Nominal Pickup Resistance	80 - 200 Ω
Maximum Actuator Current	10A Requires External 15Ω, 150W Resistor
Nominal Actuator Resistance	8Ω
Relay Contact Ratings	6A Maximun

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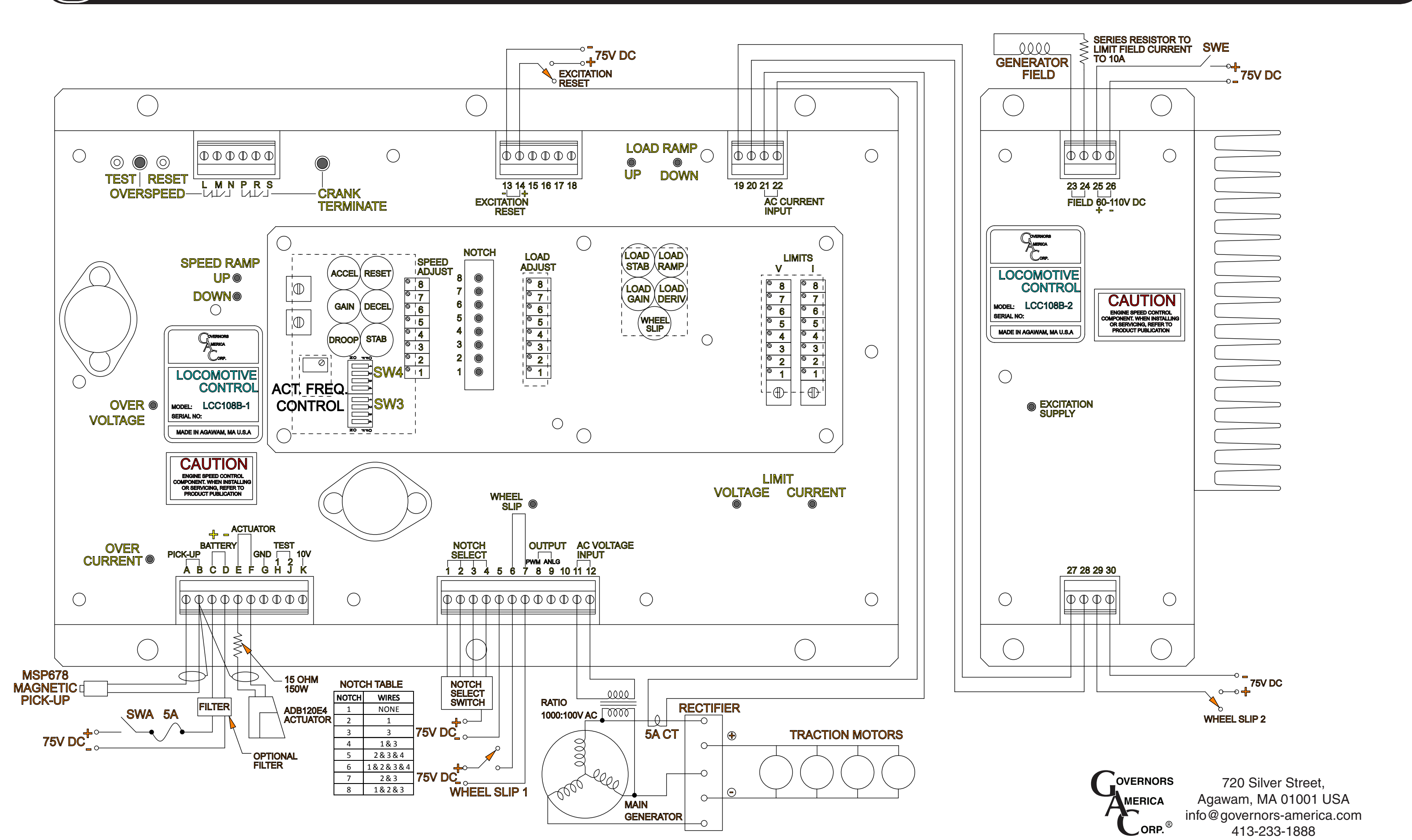
12 WIRING DIAGRAM



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