SERIES / PARALLEL OPERATION
625 SERIES

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SERIES / PARALLEL OPERATION
625 SERIES SYSTEMS

Series/ parallel is a concept used to describe the operation of the automatic STORE mode of the 625 or 610 series automatic leveling systems. The drawings and discussion in this exercise is for the 625 system. Although the theory and end result is the same for the 610 system, the manner in which the series/parallel operation is achieved is somewhat different.

The purpose of the series/parallel operation is to allow the system to use less current and less power during the automatic STORE mode. The leveling system solenoid valves run cooler and the load on the electrical system is reduced. The reason this is done is because the valves normally are turned on for a longer period of time during the STORE mode. Depending on the jack size and air temperature, the valves may remain on for ten minutes or longer.

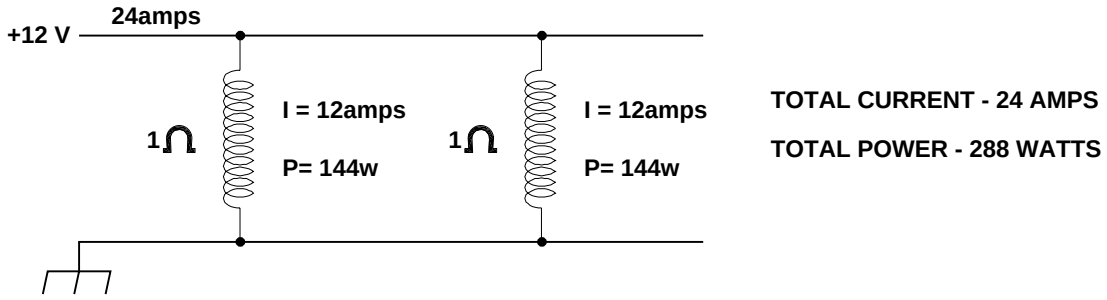
The main principal that we deal with for series/parallel operation is that the amount of voltage needed to pull in the coil of our solenoid valves is greater than the voltage needed to hold in the coil. The HWH solenoid valves will pull in between 7 and 8 volts but only need about 2 to 3 volts to stay on. This allows us to reduce the voltage at each valve after the valve has been turned on.

There are three formulas that make it easier to understand this process.

V (voltage) = I (current/amps) x R (resistance/ohms) V = IR
I (current/amps) = V (voltage) ÷ R (resistance/ohms) I = V/R
P (power/watts) = V (voltage) x I (current/amps) P = VI

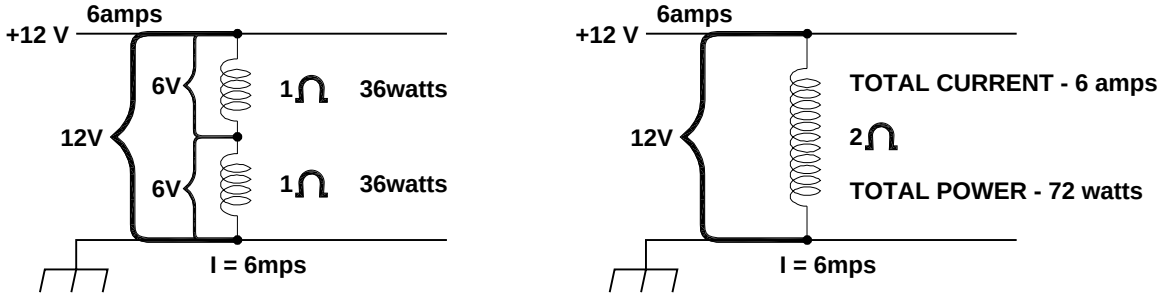
The following examples represent the operation of the HWH solenoid valves under normal operation and when the valves are placed in series operation. ***THE ACTUAL RESISTANCE VALUE FOR THE HWH SOLENOID VALVES IS SLIGHTLY DIFFERENT AND THE FOLLOWING EXAMPLE SHOULD NOT BE USED TO DIAGNOSE SOLENOID VALVE PROBLEMS.***

NORMAL (PARALLEL) OPERATION



The system voltage is 12 volts. The resistance of each valve coil is 1 ohm. I (current) = 12 (V) ÷ 1 (R) or 12 amps per solenoid valve. The power needed to operate each valve is P (power/watts) = 12 (V) x 12 (I) or 144 watts.

SERIES OPERATION



Again the system voltage is 12 volts. The individual resistance of each valve coil is 1 ohm but the valves are now arranged in series so the actual resistance is the combined resistance of both coils, or 2 ohms. The current in this circuit is I (current) = 12 (V) ÷ 2 (R) or 6 amps. The voltage at each coil is V (voltage) = 6 (I) x 1 (R) or 6 volts.
The power each coil uses is P (power/watts) = 6 (V) x 6 (I) or 36 watts.

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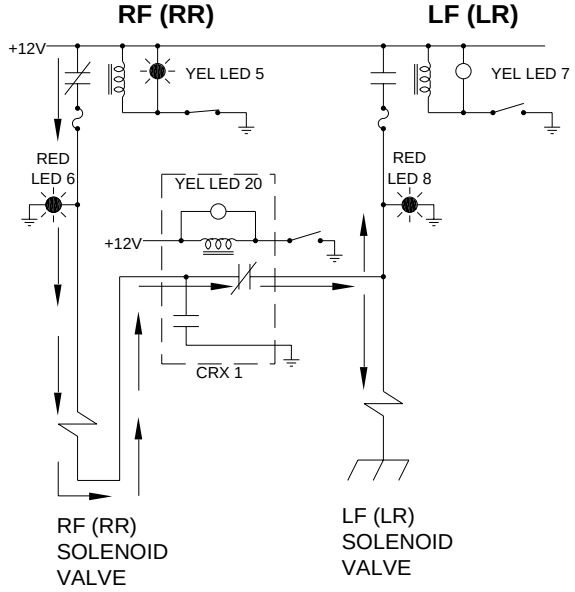
SERIES OPERATION (CONTINUED)

The power used by each coil when there are two coils in series is ¼ the power used by an individual coil. The total power used by both coils in series is ½ the power used by an individual coil. If all four solenoid valves were on at the same time, they would uses a total of 576 watts of power. When they are run in series in two pairs, they use only 144 watts of power. **An easy way to understand what is happening would be to consider the heat generated by a 25 watt light bulb as compared to the heat generated by a 100 watt light bulb. The same thing applies to the solenoid valves when placed in series. The solenoid valves in series will run cooler.**

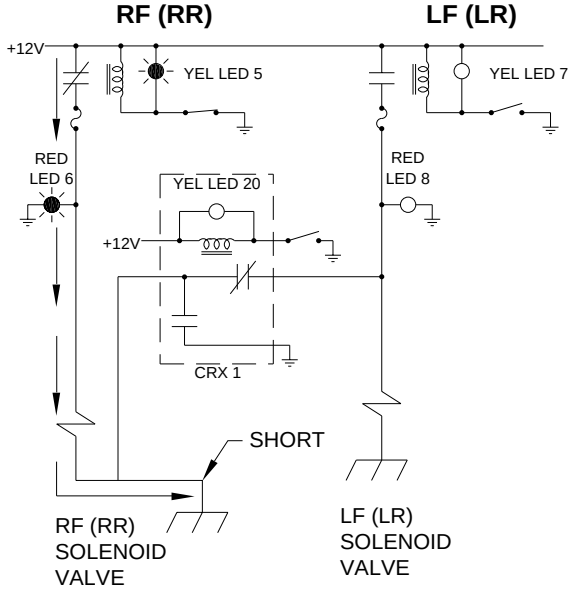
The operation of the solenoid valves in this manner does create one diagnostic problem if the series/parallel operation is not understood. The series/parallel operation is accomplished by a combination of relays in the control box. The ground wire for two of the solenoid valves, the right front and the right rear, is routed to the control box. The other two valves are grounded directly at the manifold. **Under normal operation, any extend function or manual retract, each valve is operated with its own ground. Only in automatic STORE are the valves placed in series.** After the STORE mode is initiated, the right front and the left front are placed in series, and then the right rear and the left rear are placed in series by the use of what we call the CRX relays. After the right front and left front valves are turned on, the ground for the right front is connected to the left front valve. These two valves are now in series. Then, after the right rear and left rear valves are turned on, the right rear ground wire is connected to the left rear valve. These two valves are also in series now.

The symptom that is usually misdiagnosed is as follows. The system functions as it should when operated manually, both when extending and retracting the jacks. The system also functions correctly in the automatic mode of leveling. The only malfunction occurs in the automatic store mode. The jacks will start to retract but the left front or left rear will stop retracting after a few seconds. The jack that malfunctions can then be manually retracted. **The valve operating the jack that stops retracting is ok, but is usually the one that is changed. The valve that needs to be changed is for a jack that retracts fully.** What happens is the coil of the right front or left front valve becomes shorted to ground on the ground side of the coil. **Voltage will always take the path of least resistance.** Voltage will seek a ground through the short, which allows that valve to function under any operation. In auto store, after the valves have been turned on, the valve in series with the shorted valve will turn off because the +12 voltage will seek ground through the short and will not continue on to the other valve. The following diagrams show what is happening. The right front and left front are in series. If the left front jack stops retracting after a few seconds, replace the right front solenoid valve. The right rear and the left rear are in series together. If the left rear stops retracting after a few seconds, replace the right rear solenoid valve.

NORMAL SERIES OPERATION



SERIES OPERATION WITH VALVE SHORTED TO GROUND



The following series of diagrams takes you step by step through the series/parallel operation. They start with the system off and go through the automatic store function operating properly with the last page showing the system with two shorted solenoid valves. The arrows in the diagrams indicate the voltage paths to ground for the solenoid valves. **Note the front jacks are retracted for five seconds before the rear solenoid valves are turned on to retract the rear jacks.** This is done so the front jacks don't drag if the chassis moves when the jacks are retracted.

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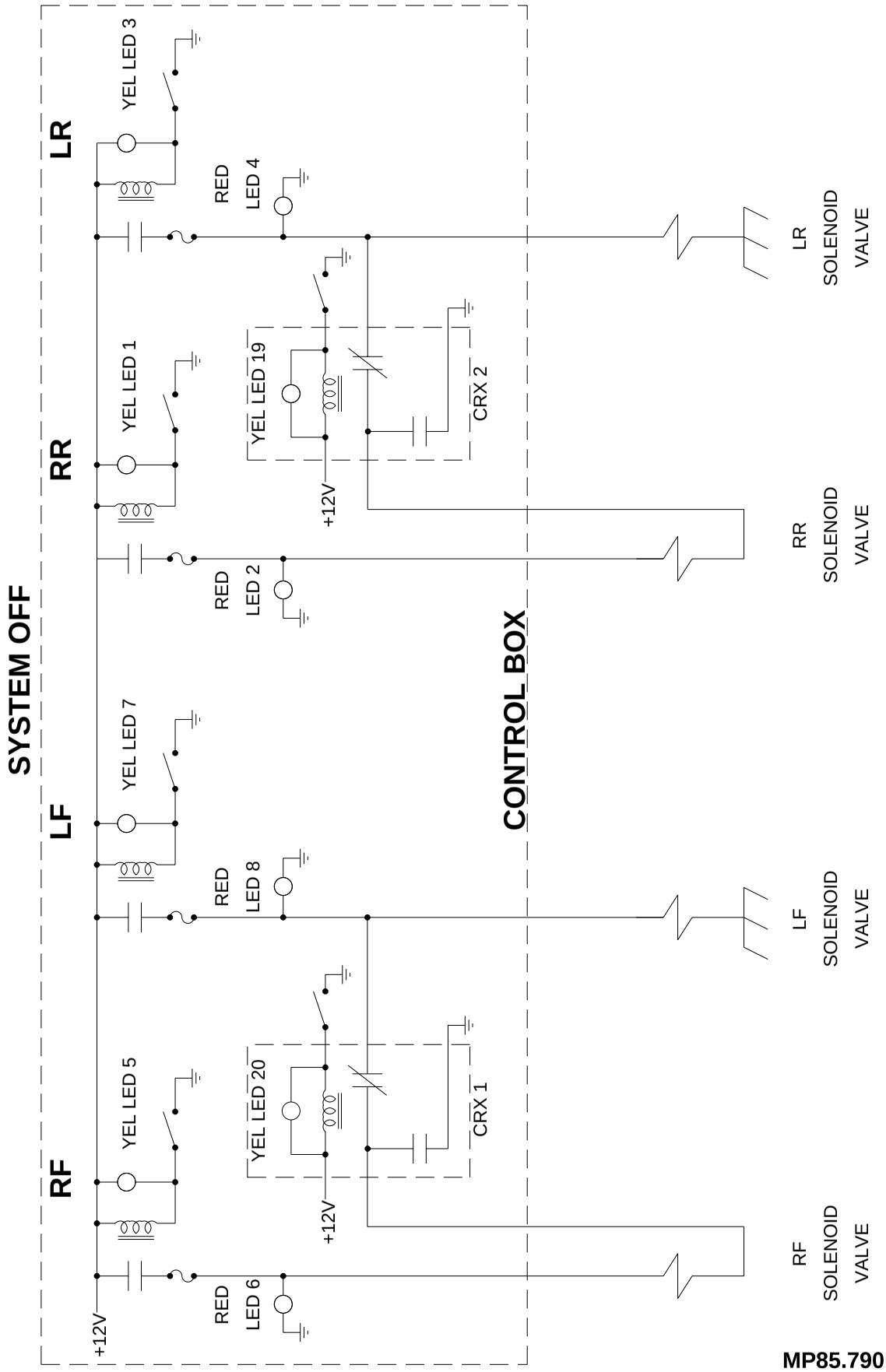

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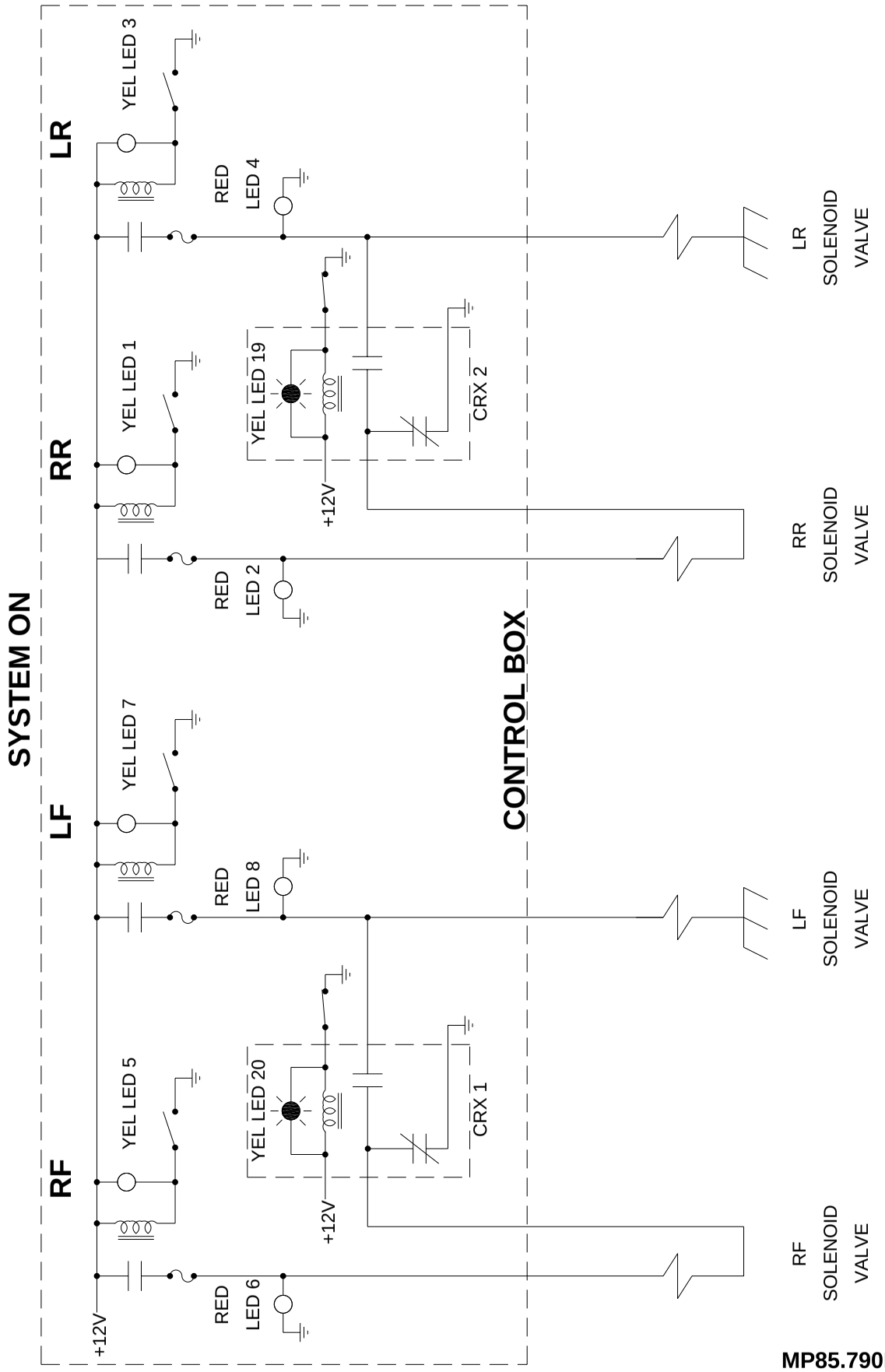

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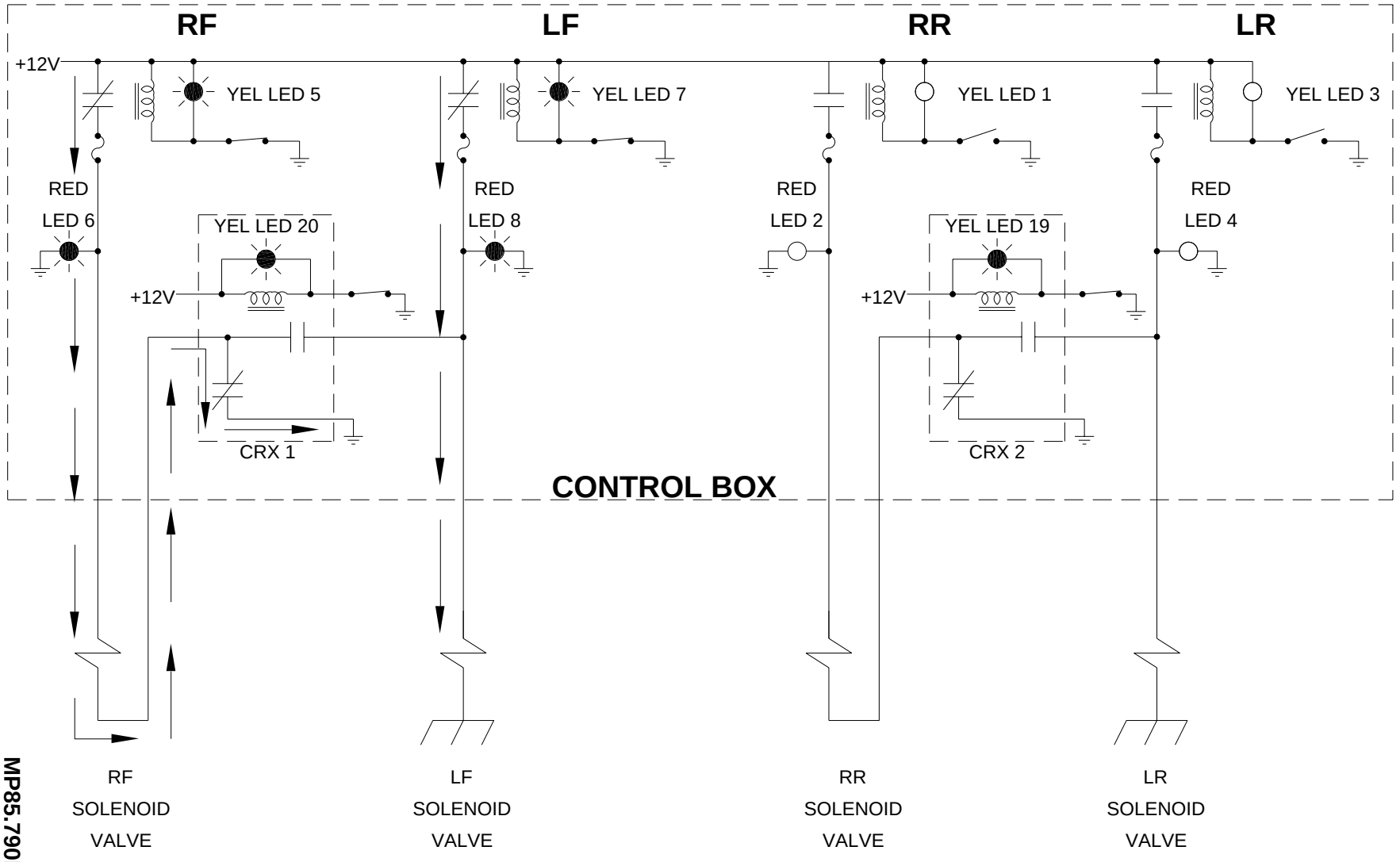
MANUALLY EXTEND OR RETRACT FRONT JACKS

AUTOMATICALLY EXTEND FRONT JACKS



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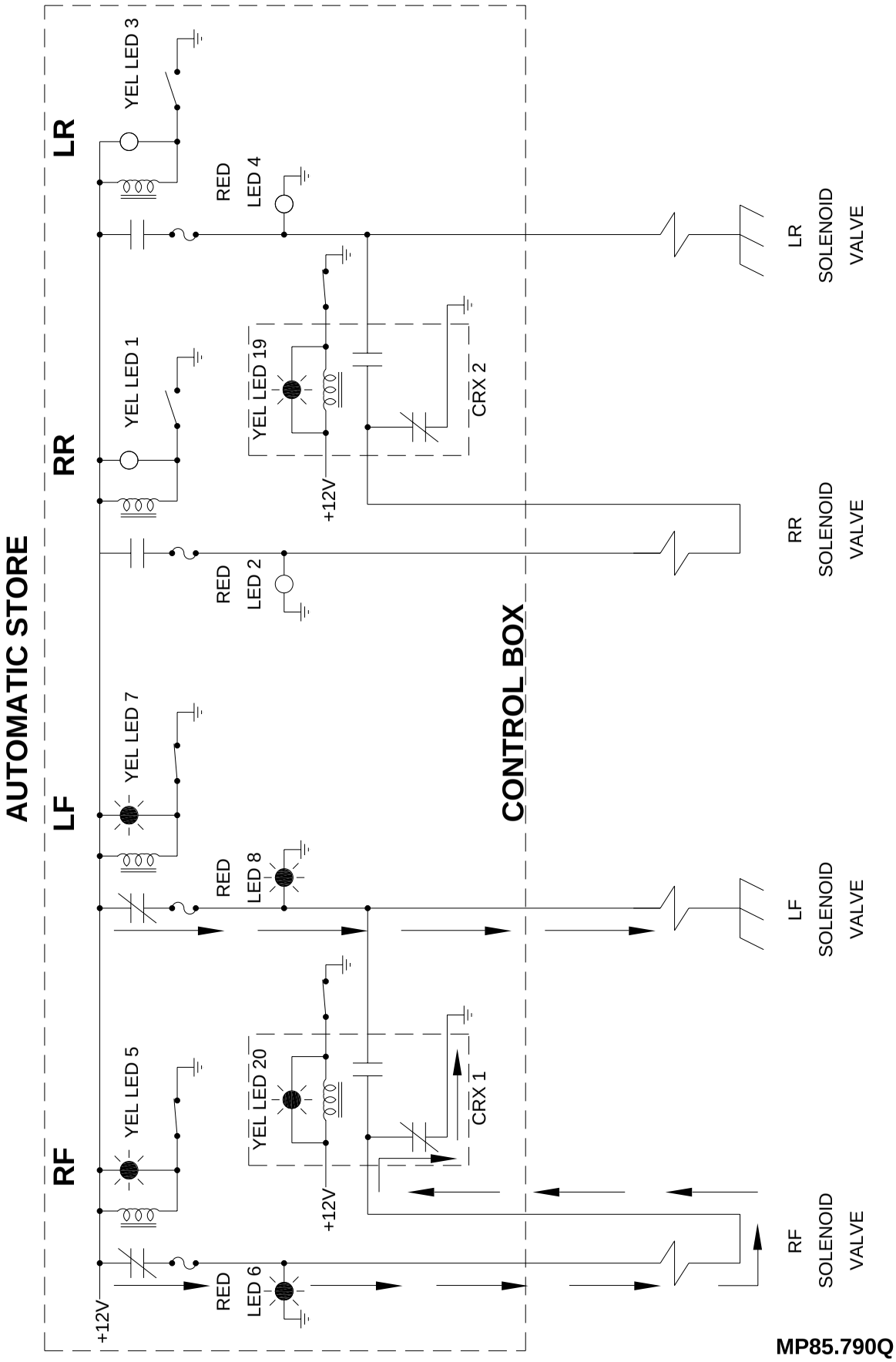

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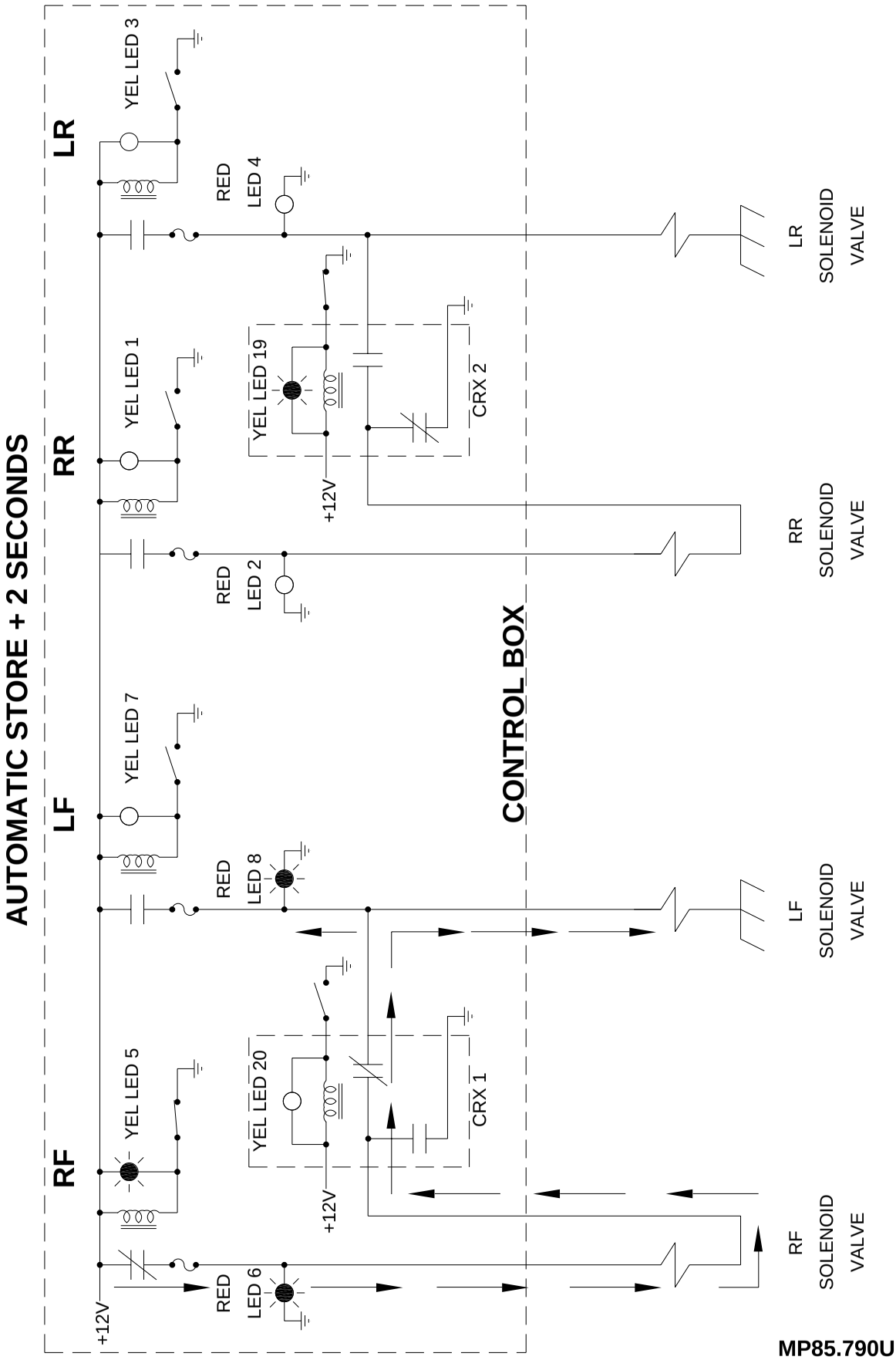

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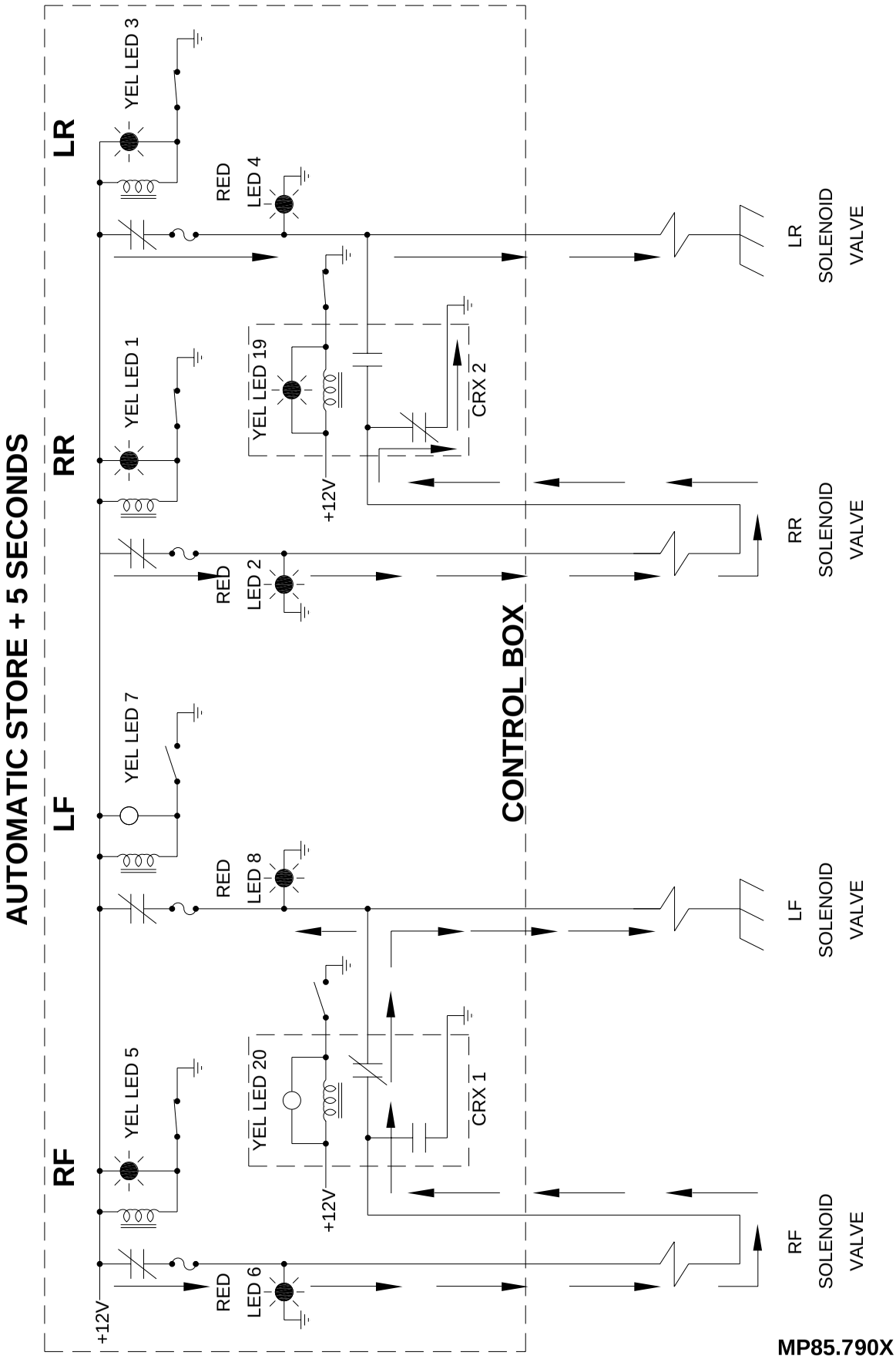

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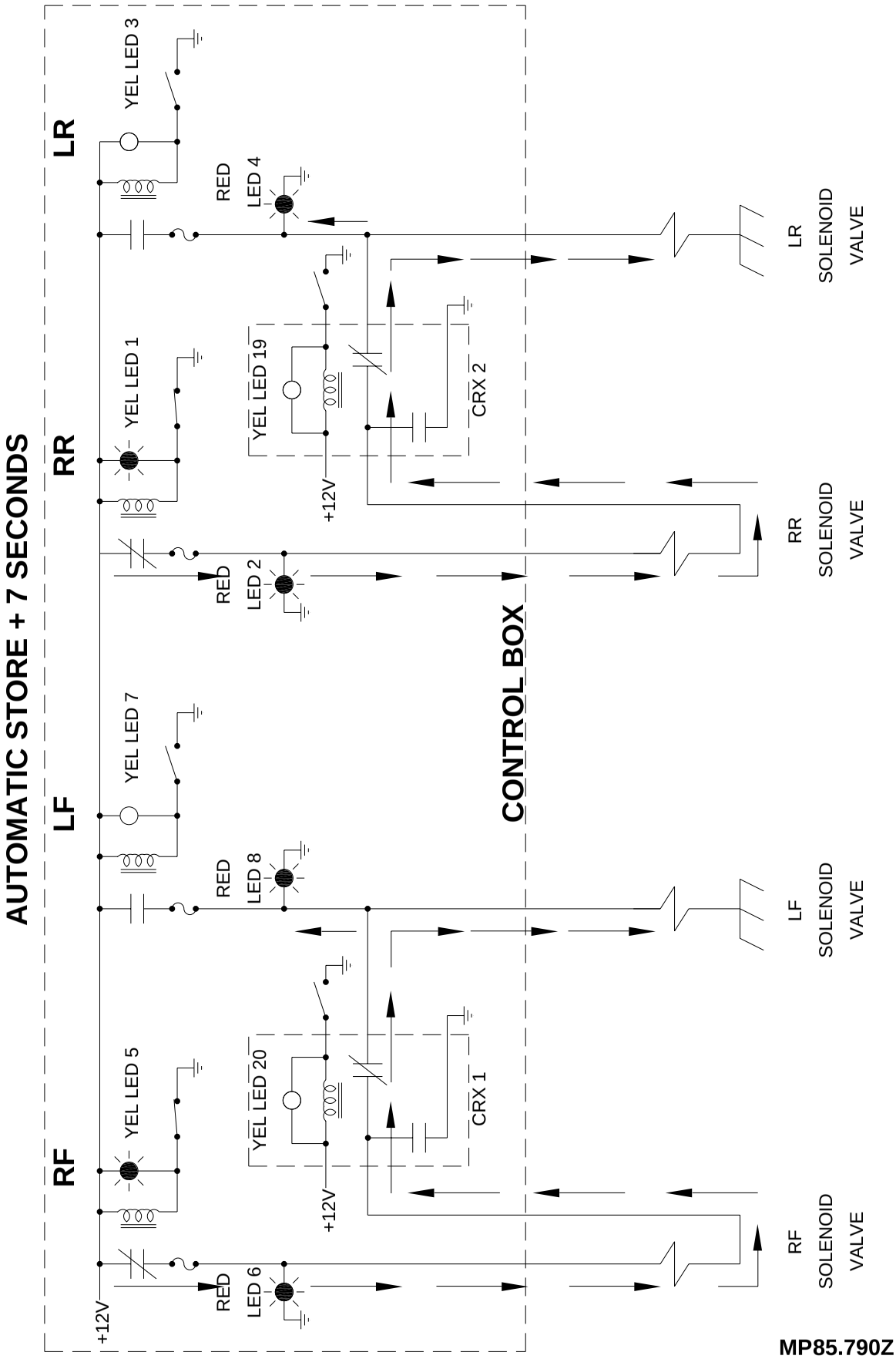

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AUTOMATIC STORE + 7 SECONDS WITH
2 SOLENOID VALVES SHORTED TO GROUND