

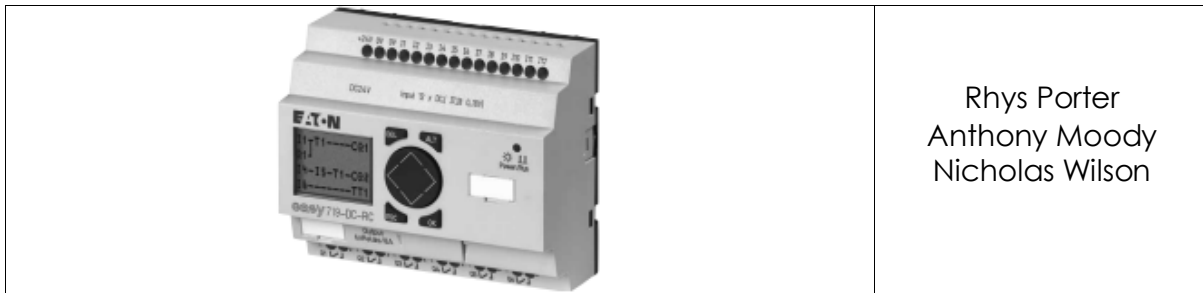
# MOELLER BASED TRAIN LEVEL CROSSING MANAGEMENT SYSTEM

Datasheet v1.0

## Abstract

Providing a safety conscious low cost alternative to existing level crossing management systems boasting diagnostic memory and basic fault recovery

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## Key Features:

- Proximity Based Train Detection
- Safety Conscious Design
- Verbose Fault/Warning Memory for Diagnosis and Reporting
- Some Automatic Fault Recovery
- Intersection Obstruction Detection
- 10 effective outputs from 6 SSRs
- Emergency Stop
- Fail Safe on Controller Power Loss

## Intended Usage Case

This intersection controller is designed for use at a level rail crossing where passenger vehicles are permitted to cross a railway track where the train contains an operator with the ability to slow or stop the train if required.

The system is suited to a crossing with the following properties:

- ❖ The train has three signal lights (Red, Amber, and Green)
- ❖ A boom gate either side of the tracks with limit switches
- ❖ Road oriented traffic hazard lights in clusters of four
- ❖ A blocked intersection sensor
- ❖ An emergency stop button
- ❖ An ability to sense the distance of any train from the intersection as an analog input

The majority of this controller's signalling is determined by within which threshold the closest train is found to be. That is, the warning lights are triggered when the train is detected at one threshold and the lowering of the boom gates is triggered when the train reaches another threshold. This is done to provide a safer scenario should a train be speeding where delayed boom may not have lowered as much or at all once the train reaches the intersection.

## Effective Outputs

1. Audible train warning signal
2. Boom Lights 1
3. Boom Lights 2
4. Booms Up
5. Booms Down
6. Boom 1 Power
7. Boom 2 Power
8. Train Red
9. Train Amber
10. Train Green

## Special Case Functions

Case Description	Expected Behaviour
Controller Power Loss	<ul style="list-style-type: none"> <li>➤ Audible warning signal is to sound</li> <li>➤ Both booms are to lower completely</li> <li>➤ Train to be given Red Signal</li> <li>➤ Two of the four red lights on each boom are to be lit</li> </ul>
Both limit switches triggered simultaneously on one boom	<ul style="list-style-type: none"> <li>➤ Audible warning signal is to sound</li> <li>➤ Both booms are to be lowered</li> <li>➤ Train to be given fault signal (1.9s Red 0.1s Amber/Green)</li> <li>➤ Controller will attempt to clear the error periodically</li> <li>➤ Attributable memory bit(s) set</li> </ul>
Intersection obstructed while moving booms or booms down	<ul style="list-style-type: none"> <li>➤ Booms are to be stopped from moving while obstruction is detected (and will resume operation once cleared)</li> <li>➤ Train to be given a Red signal</li> <li>➤ Boom lights and bells are to continue</li> <li>➤ Attributable memory bit set</li> </ul>
Train enters third threshold before receiving green signal	<ul style="list-style-type: none"> <li>➤ Red signal to train</li> <li>➤ Booms to continue lowering operation</li> <li>➤ Attributable memory bit set</li> </ul>
Emergency stop triggered	<ul style="list-style-type: none"> <li>➤ Red signal to train until reset</li> <li>➤ Booms to stop in position</li> <li>➤ Audible warning signal and flashing boom lights if a train is detected</li> <li>➤ Attributable memory bit set</li> </ul>
Both "raise boom" and "lower boom" functions triggered at the same time	<ul style="list-style-type: none"> <li>➤ Lower boom function will take priority and the boom gates will lower</li> <li>➤ No interruption to standard signalling</li> </ul>
No train detected	<ul style="list-style-type: none"> <li>➤ Red signal to train</li> </ul>

## Signalling

Signal	Meaning	Causes
Train		
Red	Intersection unsafe	<ul style="list-style-type: none"> <li>• Booms not down, train inside third distance threshold</li> <li>• No train detected</li> <li>• Emergency stop pressed</li> <li>• Power loss to controller</li> </ul>
Amber	Approach with caution	<ul style="list-style-type: none"> <li>• Booms moving, train within second distance threshold</li> </ul>
Green	Intersection clear	<ul style="list-style-type: none"> <li>• Booms down, intersection clear</li> </ul>
Red with Orange or Green Flashes	Intersection likely unsafe	<ul style="list-style-type: none"> <li>• Fault condition detected</li> </ul>
Booms		
Lights Flashing	Train detected	<ul style="list-style-type: none"> <li>• Train detected closer than first threshold</li> </ul>
Lights Solid, Booms Down	Road crossing unsafe	<ul style="list-style-type: none"> <li>• Power loss to controller</li> </ul>

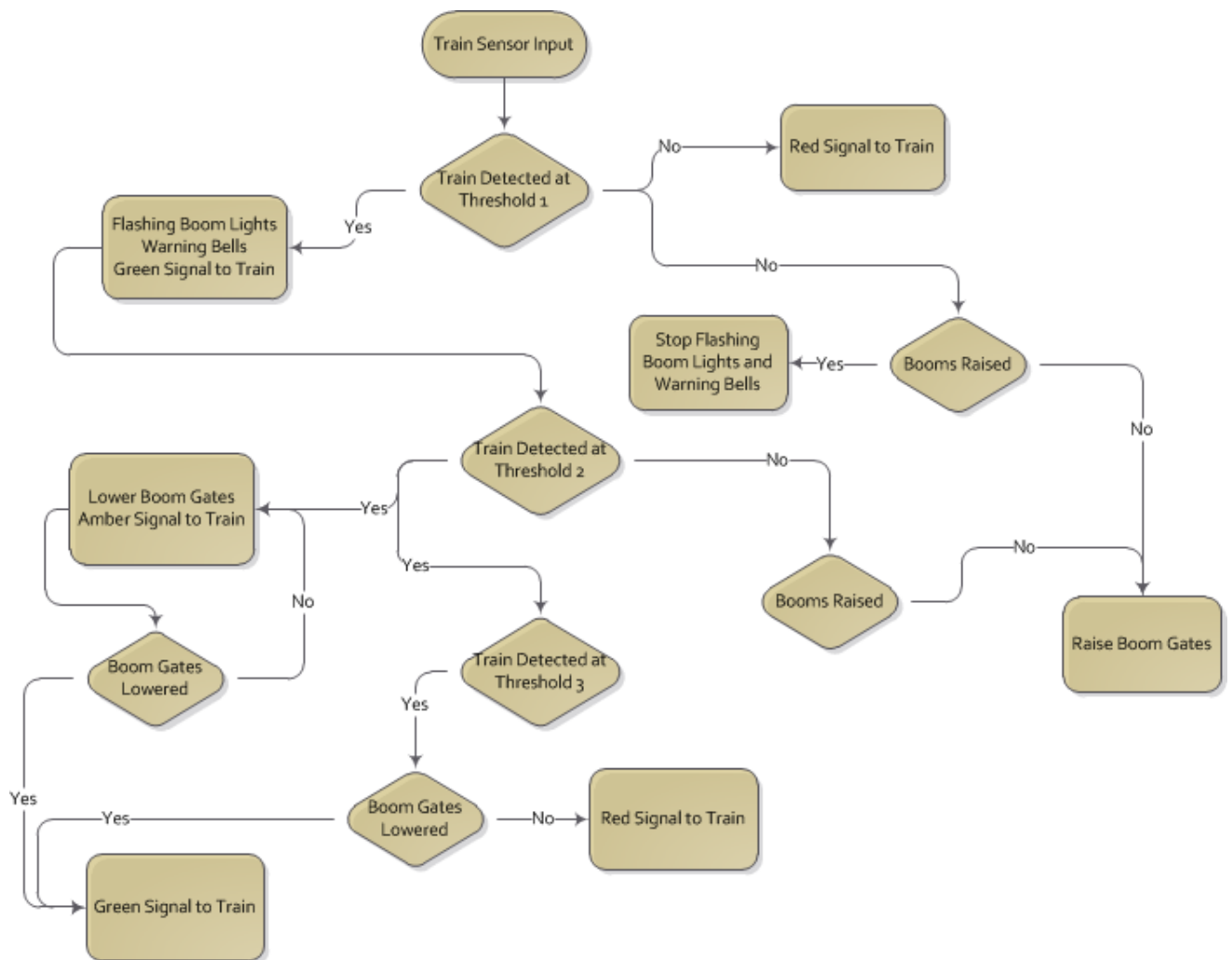
## Fault/Warning Memory Conditions

Code	Name	Description
M10	Obstruction Occurred	Intersection blocked while booms lowering
M11	Boom Danger Occurred	Train entered third threshold before booms were lowered
M12	Boom 1 Limit Switches	Both upper and lower limit switches activated simultaneously
M13	Boom 2 Limit Switches	Both upper and lower limit switches activated simultaneously
M14	Emergency Stop	Manual/Emergency Stop Activated
M15	Permanent Fault Memory	Persistent memory of previous faults except obstruction
M16	Active Fault Detection	Limit switch error detected, system will attempt to clear the active error after a set interval of time

### Input Connections

Input	Usage	Description
I01	Active Low	Boom 1 Down limit switch
I02	Active Low	Boom 2 Down limit switch
I03	Active Low	Boom 1 Up limit switch
I04	Active Low	Boom 2 Up limit switch
I05	Active Low	Intersection obstruction sensor
I06	Active Low	Emergency Stop
I07	Analogue	Train Proximity sensor
I08	Unused	Unused
I09	Active High	Clear Fault Codes (except M15 : persistent fault memory)

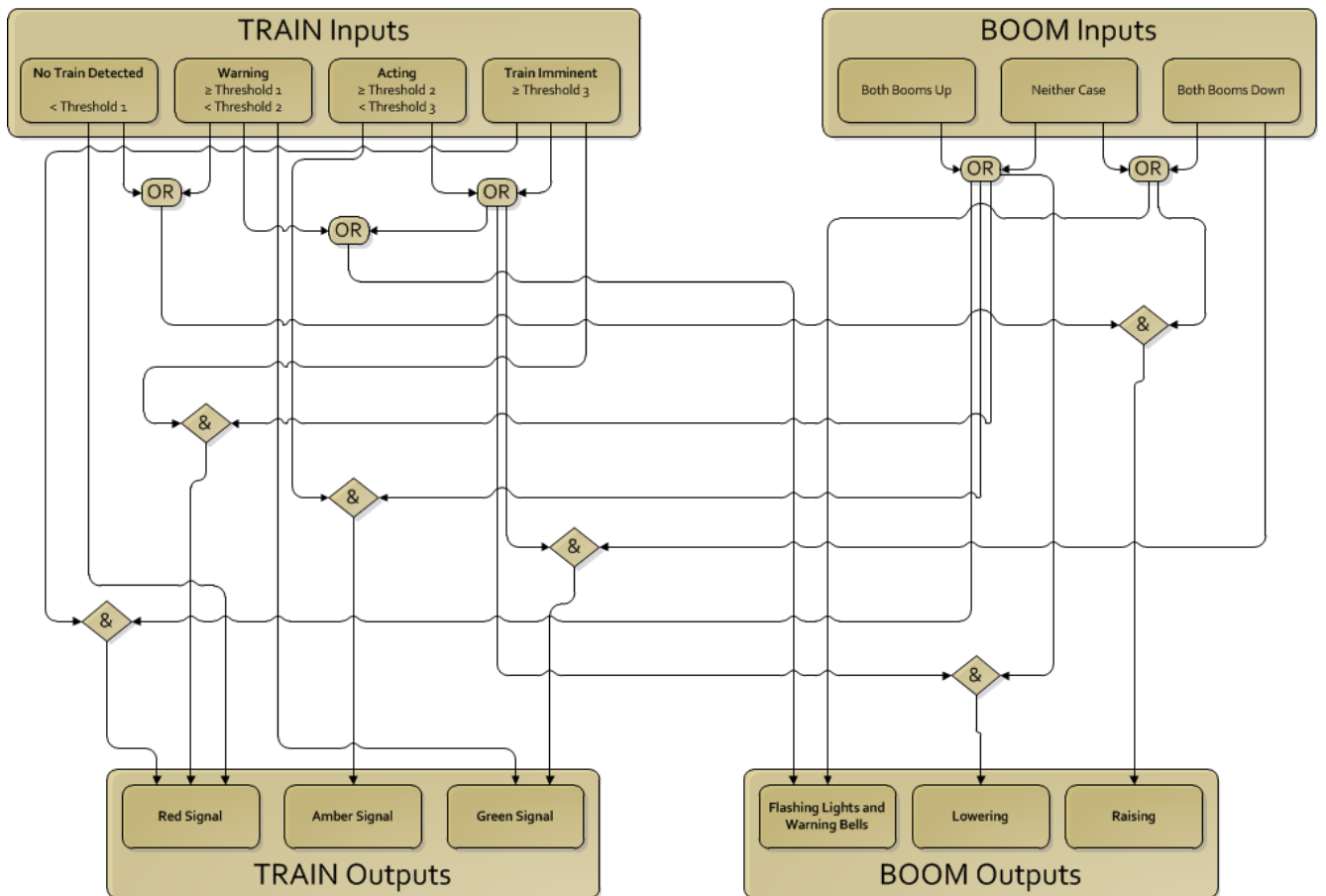
### Typical Program Flow Chart



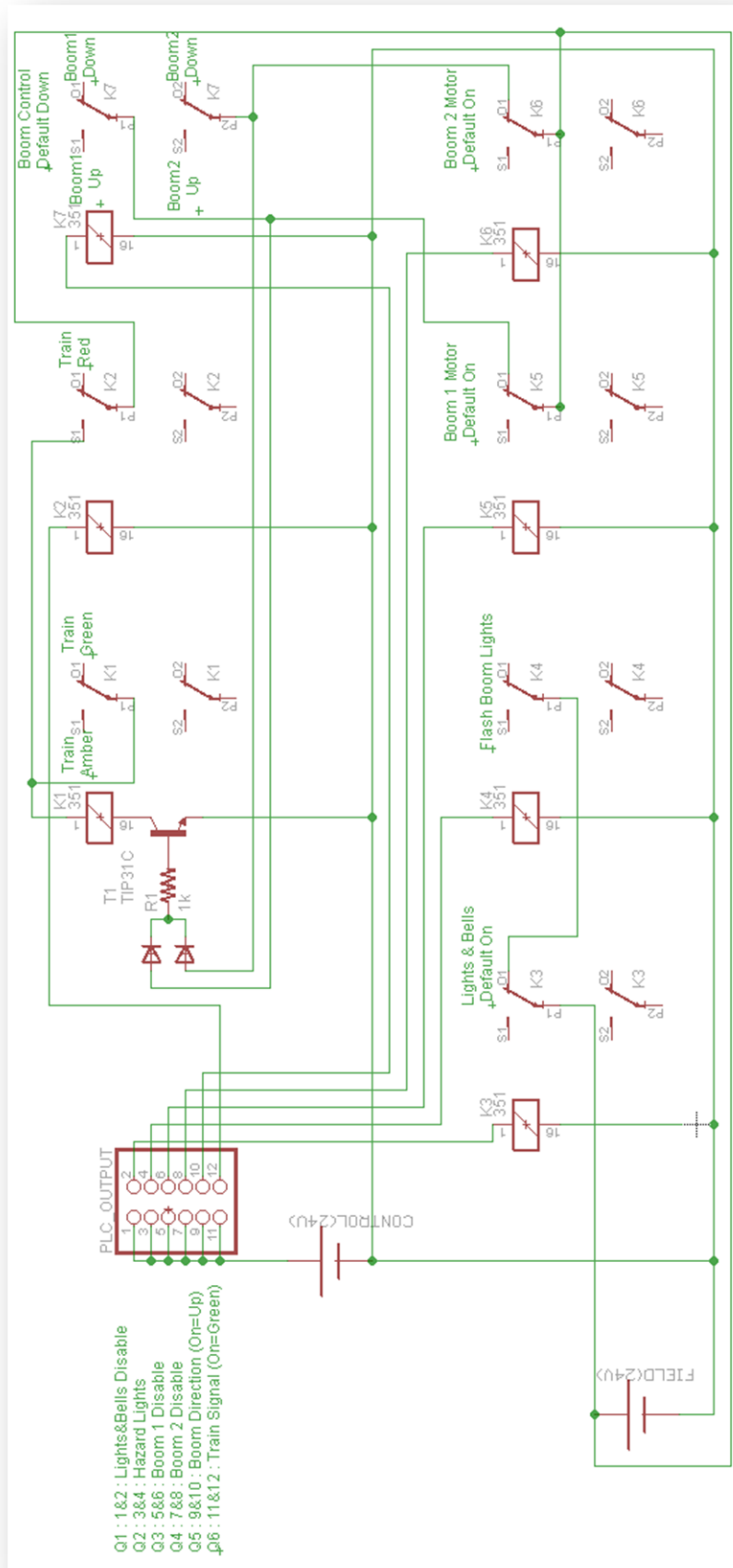
Typical Zone Based Functions

Zone	Zone 1	Zone 2	Zone 3	Zone 4
Definition	< Threshold 1	≥ Threshold 1 < Threshold 2	≥ Threshold 2 < Threshold 3	≥ Threshold 3
Train Side	Red Signal	Green Signal	if Booms Lowered { Green Signal } else { Amber Signal };	if Booms Lowered { Green Signal } else { Red Signal };
Road Side	if Booms Raised { Stop Flashing Lights Stop Warning Bells } else { Raise Booms };	if Booms Raised { } else { Raise Booms };  if Flashing Lights { } else { Start Flashing Lights Start Warning Bells };	if Booms Lowered { } else { Lower Booms };	if Booms Lowered { } else { Lower Booms };

Typical Logical Operations



Output Wiring for Up/Down Sensing Boom Motors





Output Wiring for H-Bridge Reversible Boom Motors

