

2-Lane Drag Race Timer

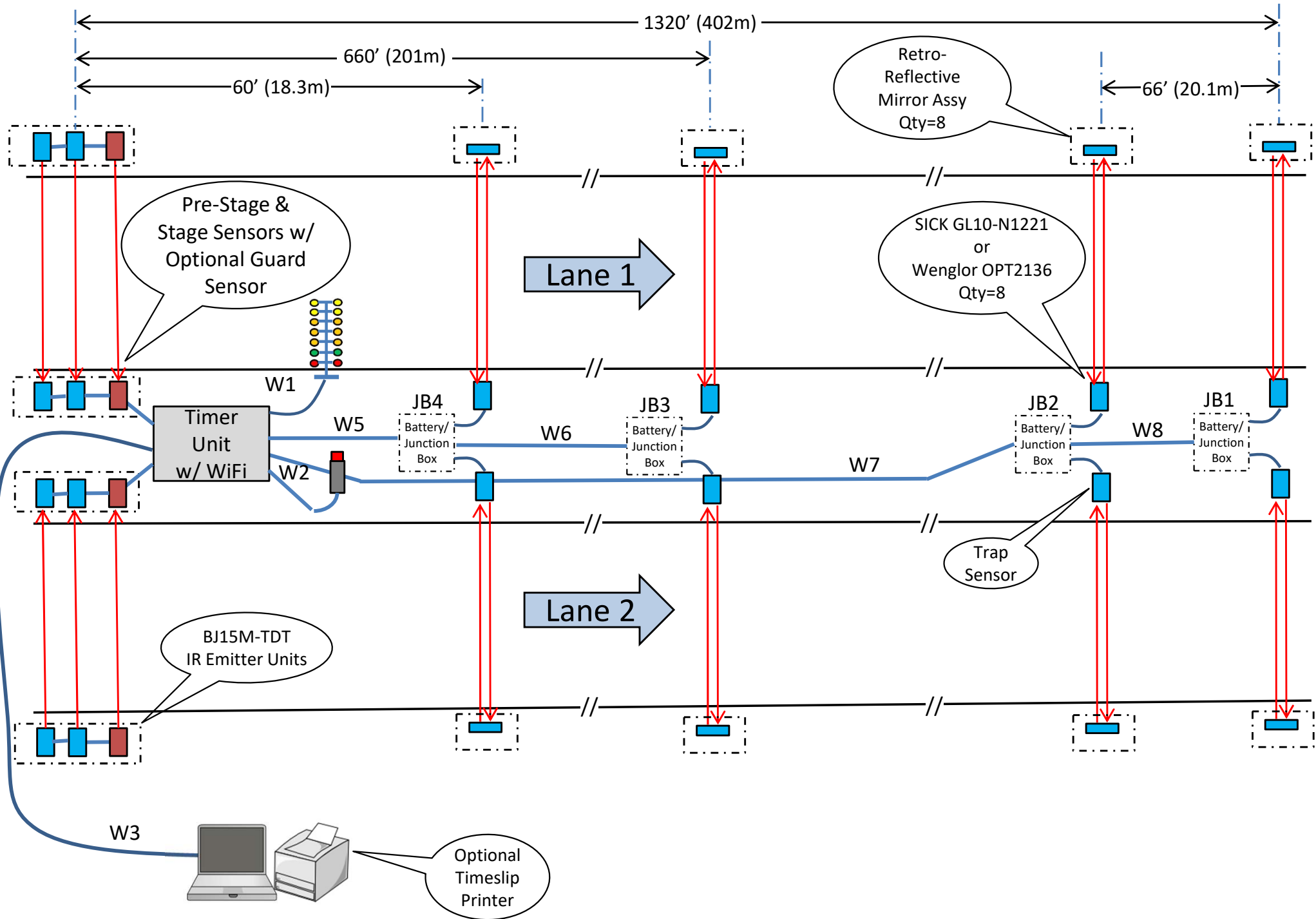
Ver. 14

This timer design incorporates functions that mimic electronic timing systems associated with professional drag strips. This version provides the following:

- Handicapped (Bracket) racing capability
- A functional Light Tree (Christmas Tree)
- Vehicle staging with Christmas Tree indication
- Measurement/Display of:
 - Reaction time (RT)
 - 60 Ft elapsed time (ET),
 - 1/8 Mile elapsed time (ET)
 - 1/4 Mile elapsed time (ET) & speed
 - Overall time & Margin
- Selectable Standard (Sportsman)/Professional/Outlaw Tree Operation
- Selectable Manual/Auto start timing
- Selectable 1 or 2 Racer Mode
- Winner indication on Light Tree & optional finish line win lights
- Generation & printout of Time Slips at conclusion of each race

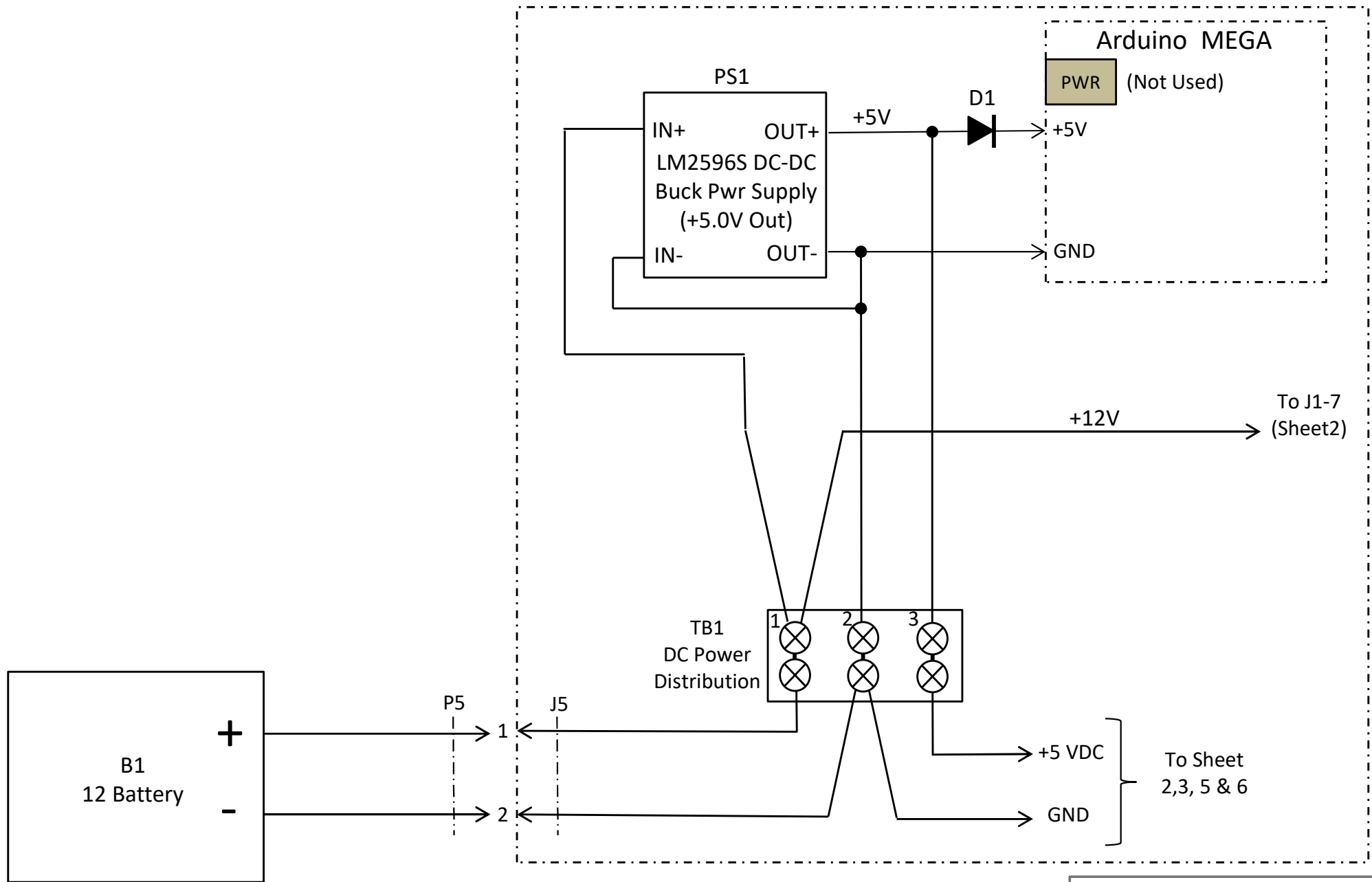
This version uses the Autonics™ BJ15M-TDT Trough Beam photo electric sensor (<https://www.autoniconline.com/>) for the pre-stage & stage positions and the SICK™ GL10-N1221 Retro-reflective sensor (<https://www.sick.com/us/en/>) for all down-track positions. The Wenglor™ OPT2136 or the Banner™ SBL1 Retro-reflective sensors can be used as alternatives to the SICK™ GL10-N1221. This version also positions the sensors on the inboard side of each lane to simplify the electronics and reduce the number & length of down-track cable runs.

Track Layout (Mirrors outboard, Sensor units Inboard)



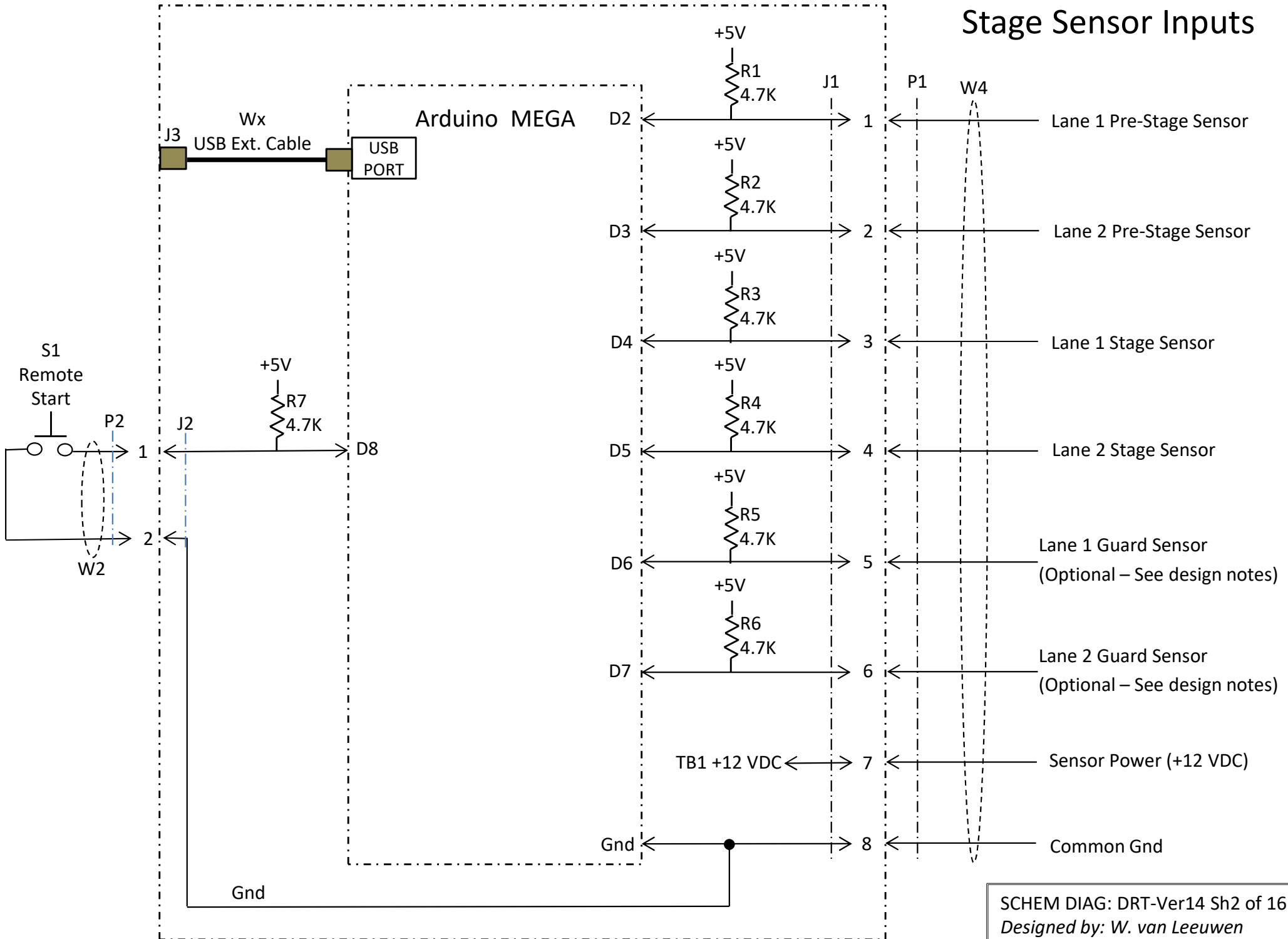
Main Timer Unit

Power Distribution



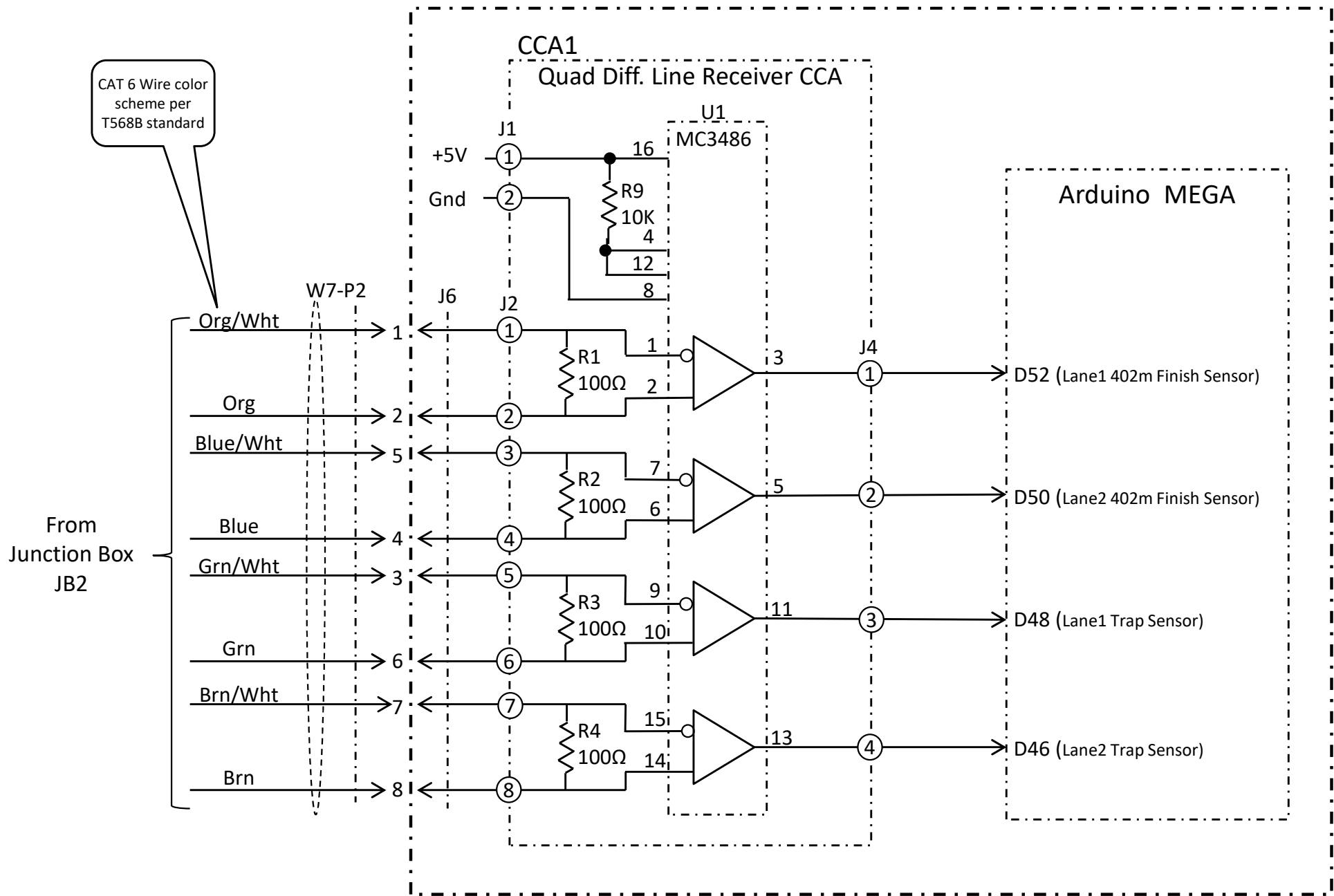
SCHEM DIAG: DRT-Ver14 Sh1 of 16
Designed by: W. van Leeuwen
Email: billv923@outlook.com

Stage Sensor Inputs

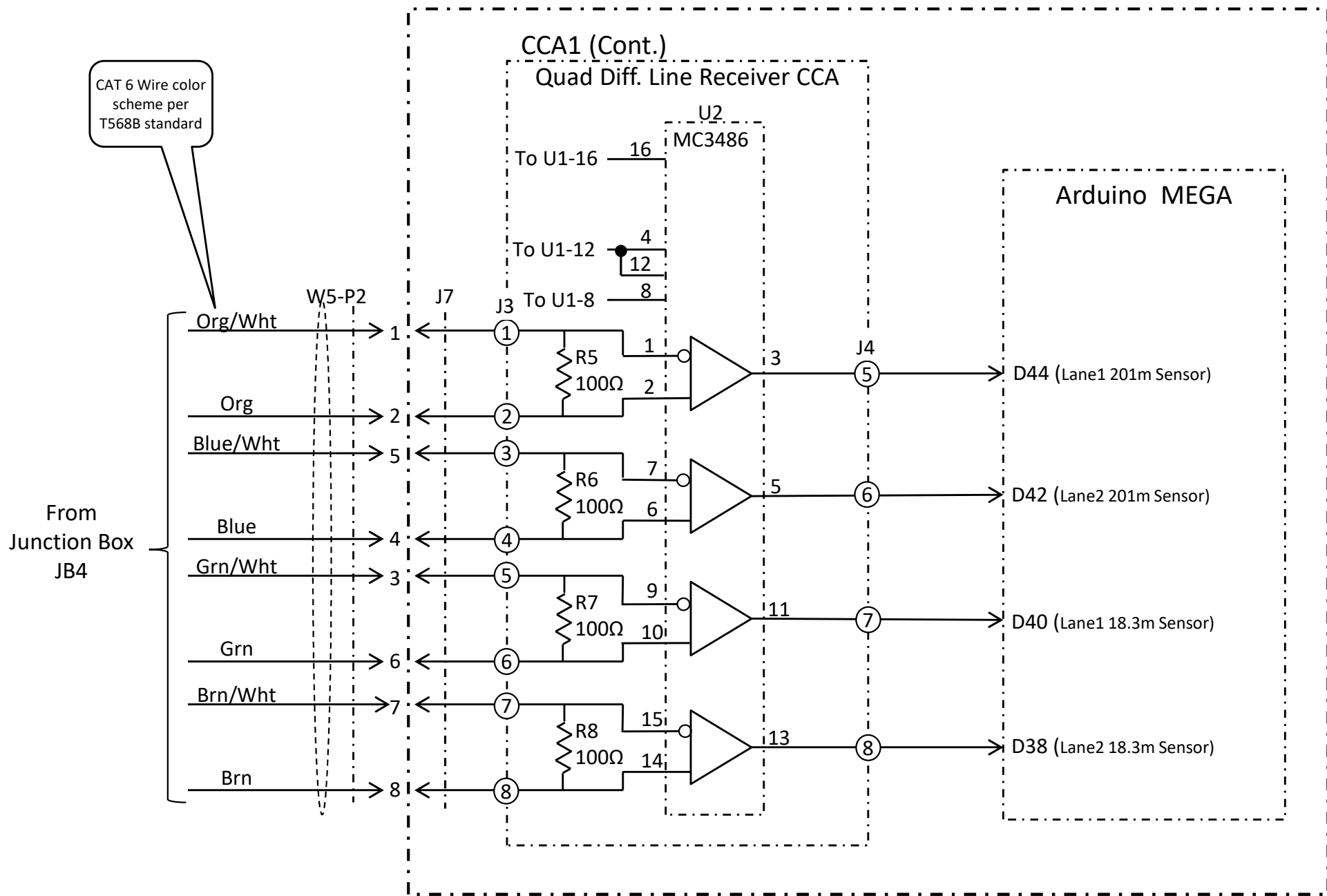


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Designed by: W. van Leeuwen
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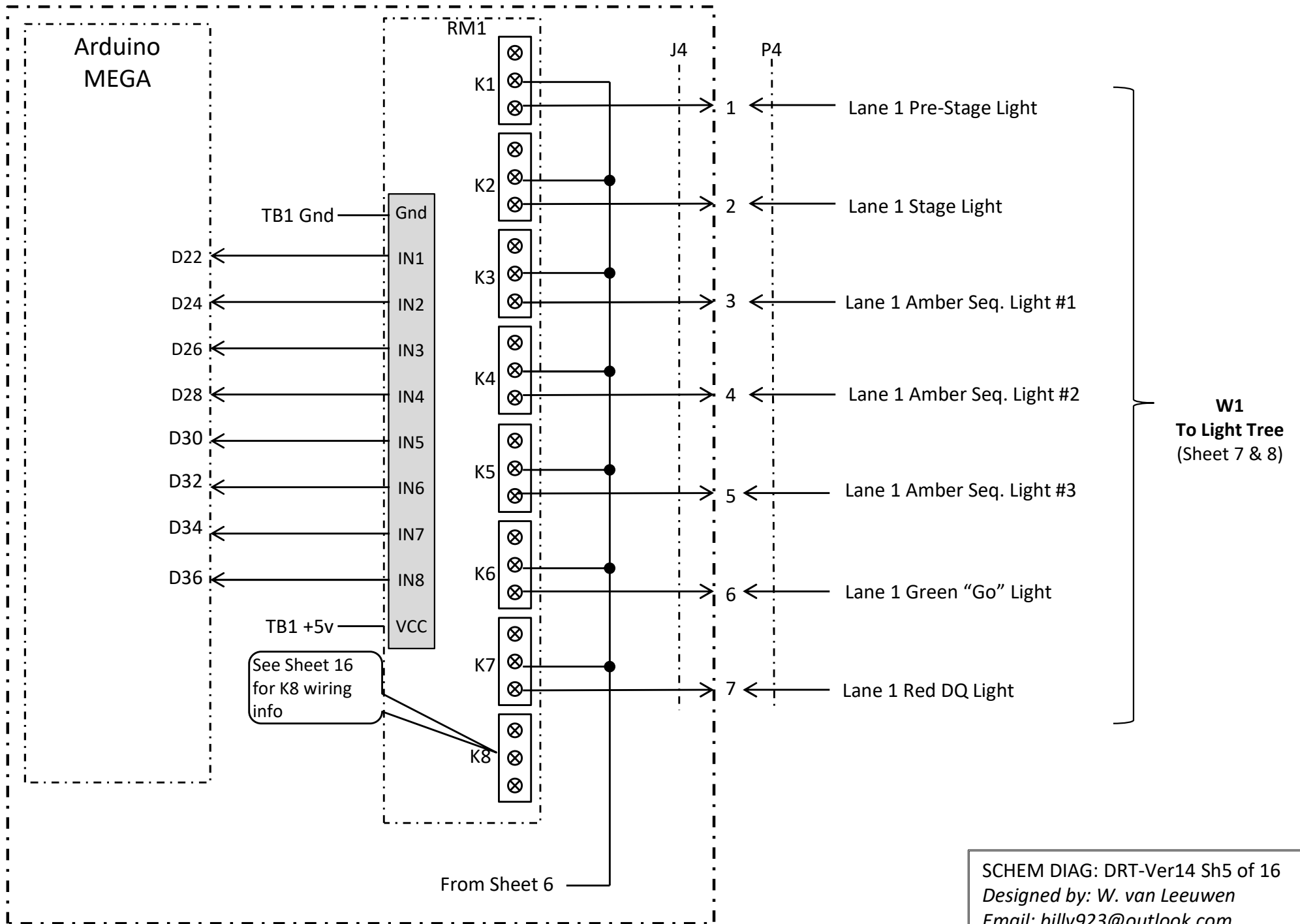
Main Timer Unit – Down-Track Sensor Inputs



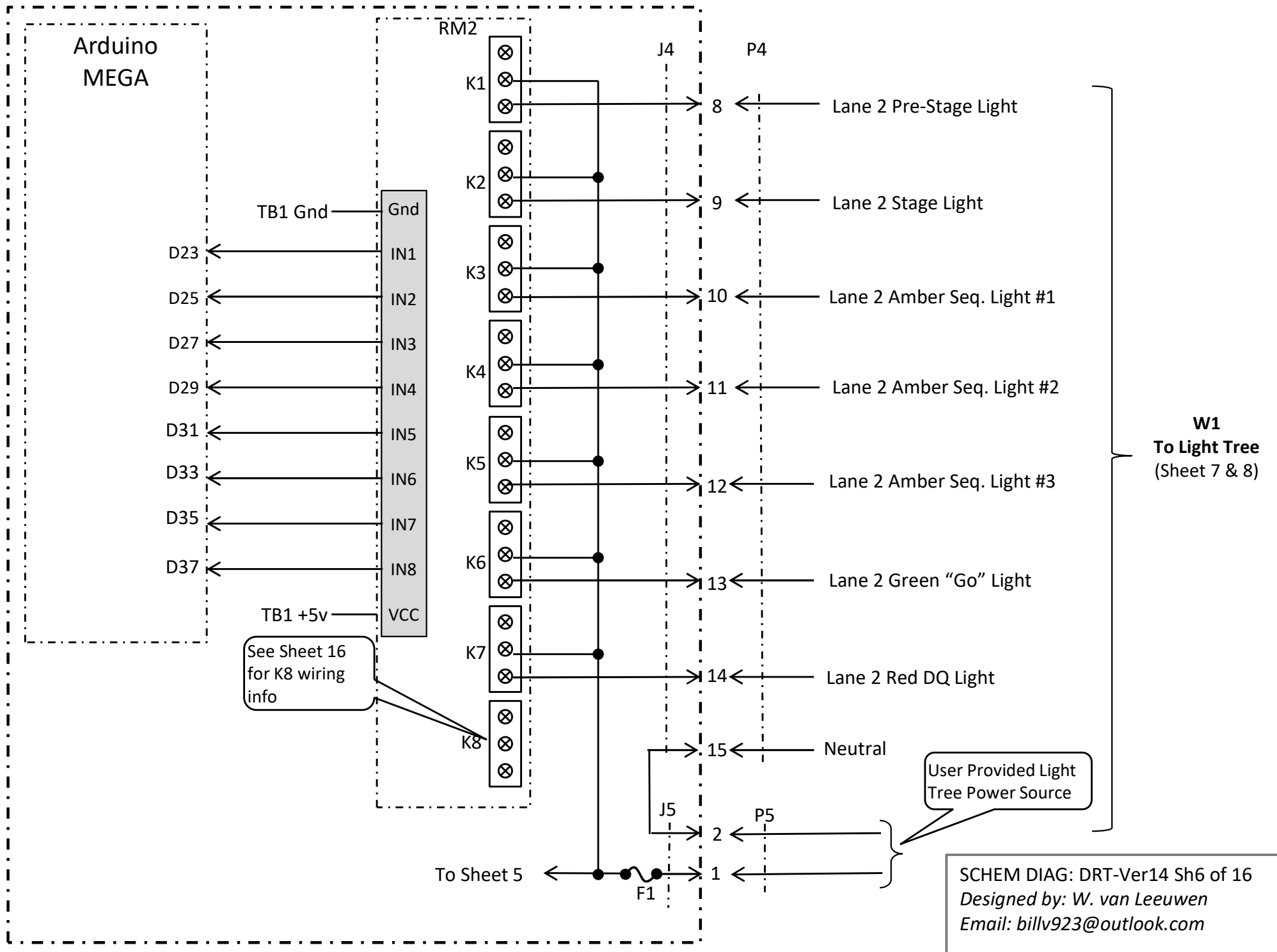
Main Timer Unit – Down-Track Sensor Inputs



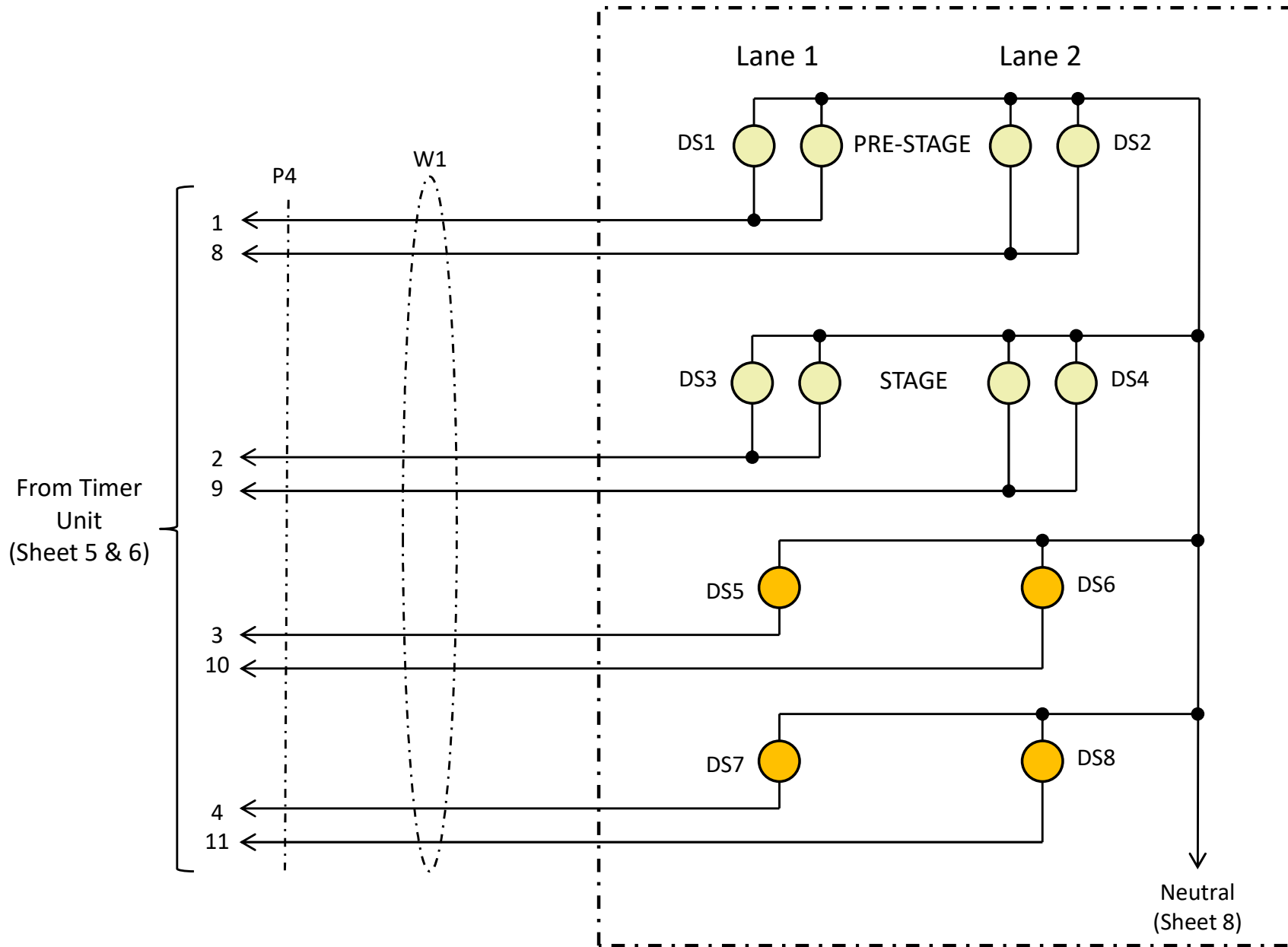
Main Timer Unit – Light Tree Interface



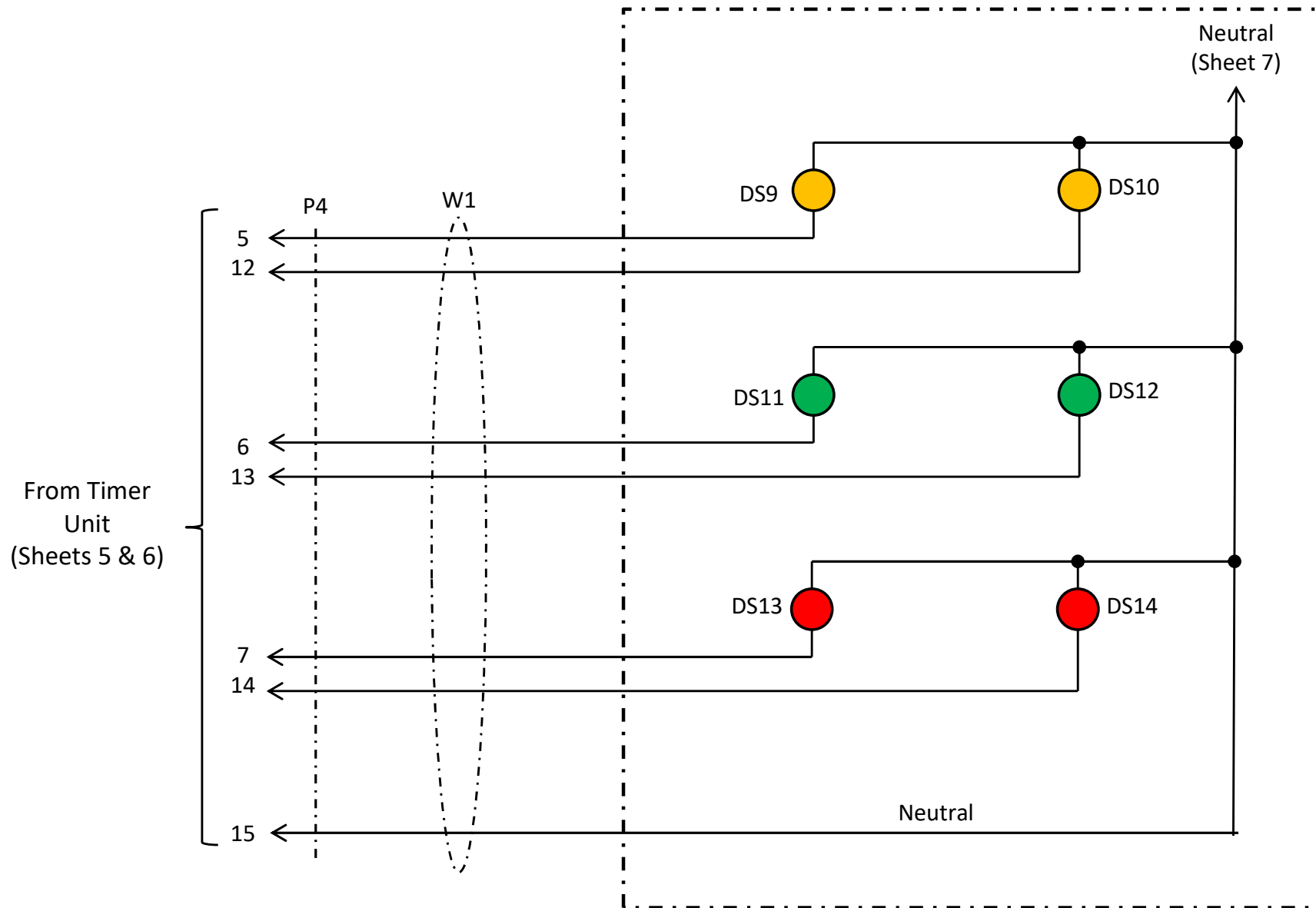
Main Timer Unit – Light Tree Interface (Cont.)



Light Tree Lights

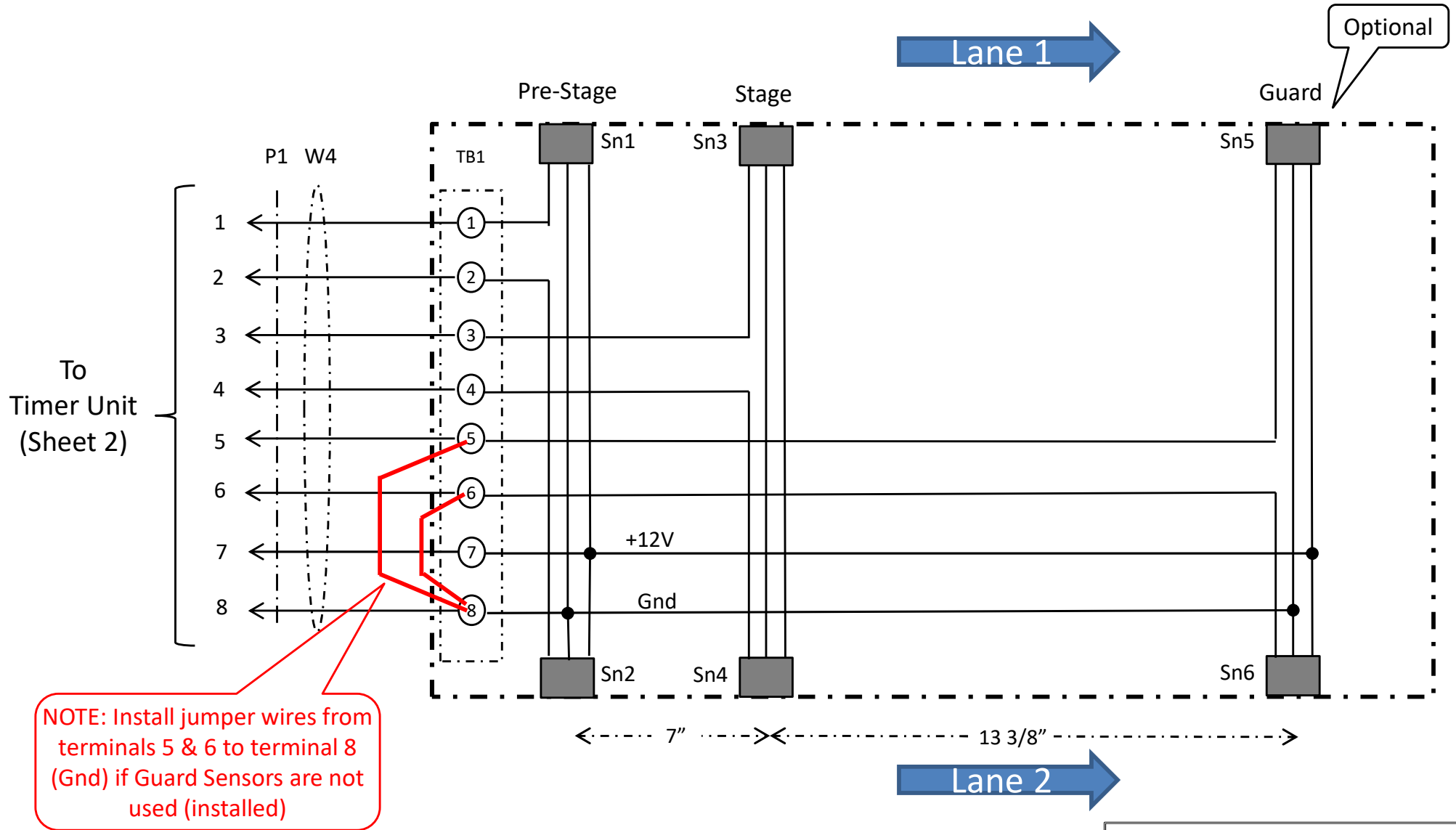


Light Tree Lights (Cont.)



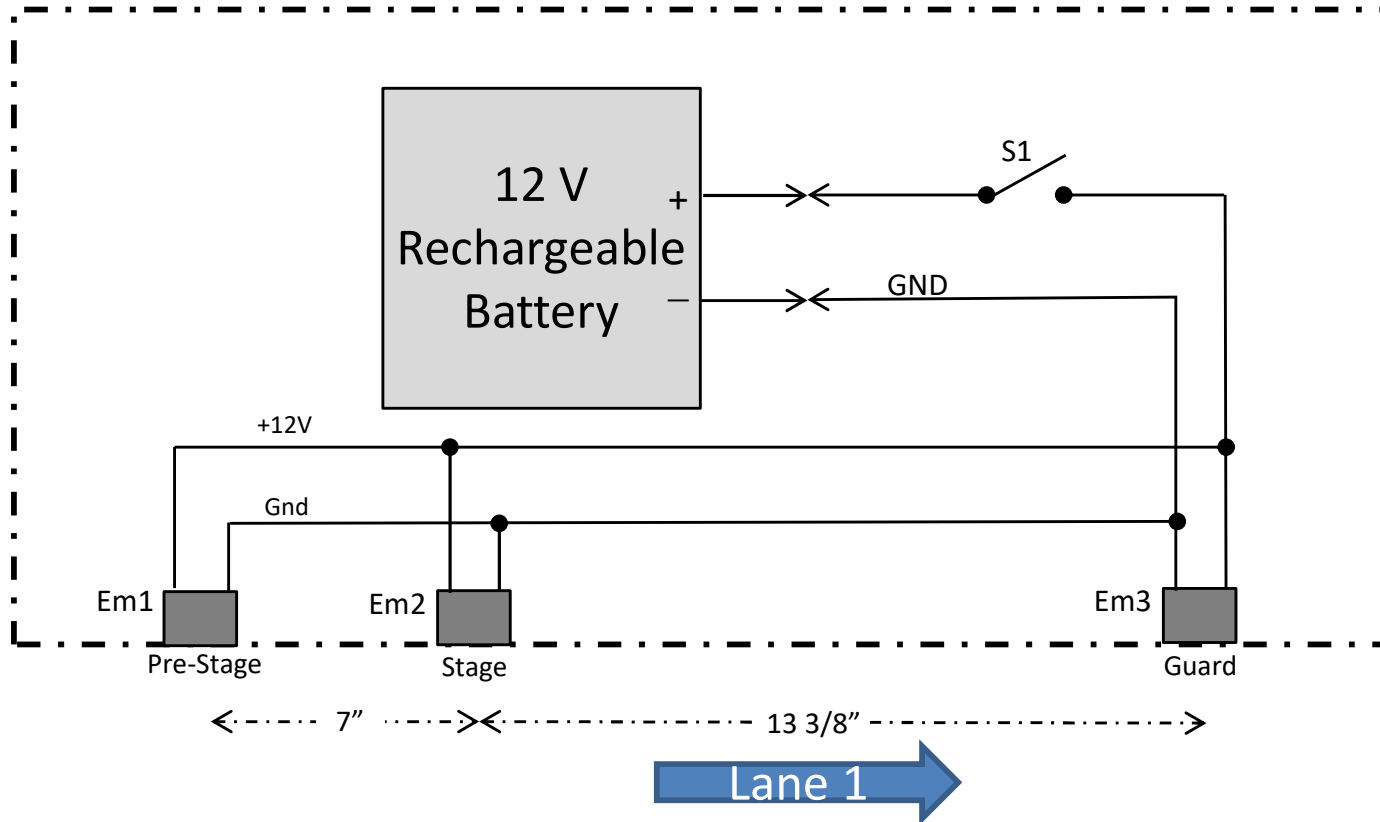
START LINE IR RECEIVER UNIT

(AUTONICS™ BJ15M-TDT IR RECEIVERS)



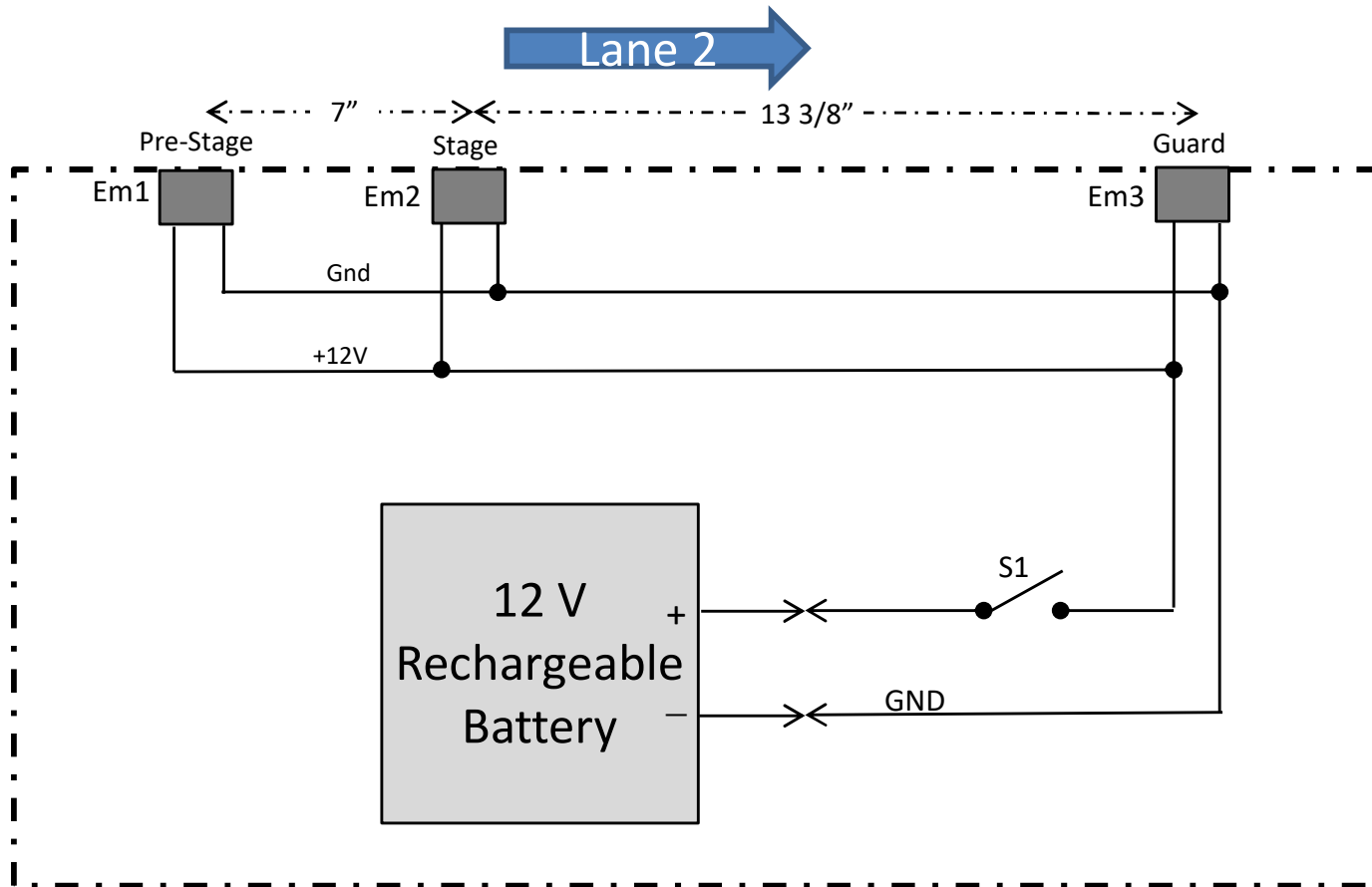
LANE 1 START LINE IR EMITTER UNIT

(AUTONICS™ BJ15M-TDT IR EMITTERS)

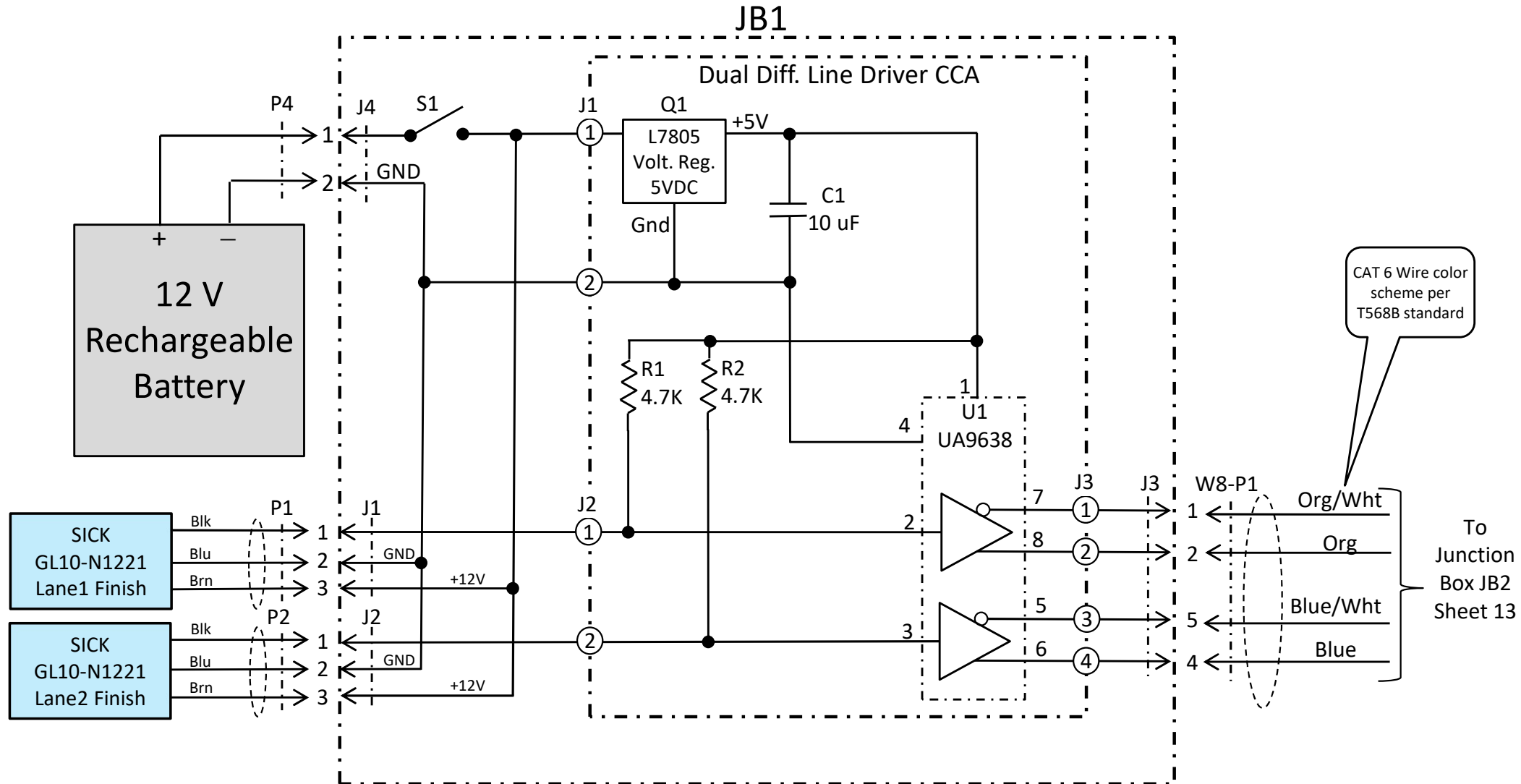


LANE 2 START LINE IR EMITTER UNIT

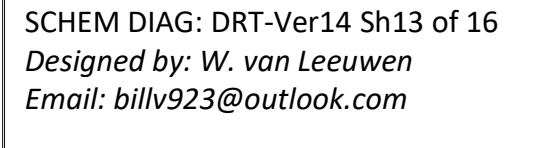
(AUTONICS™ BJ15M-TDT IR EMITTERS)



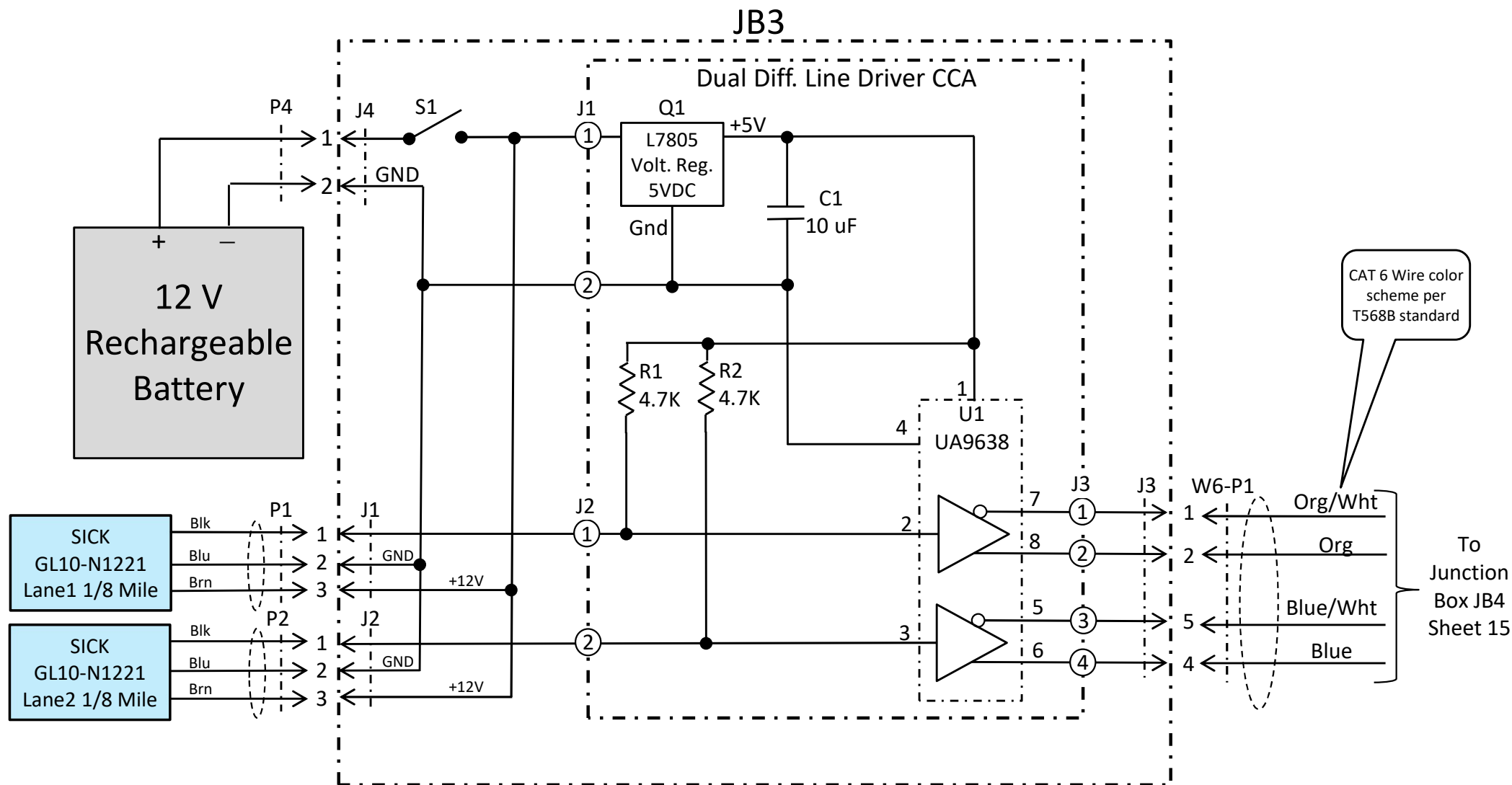
Junction Box #1 –Finish Line 1320' (402m) Sensors



JB2



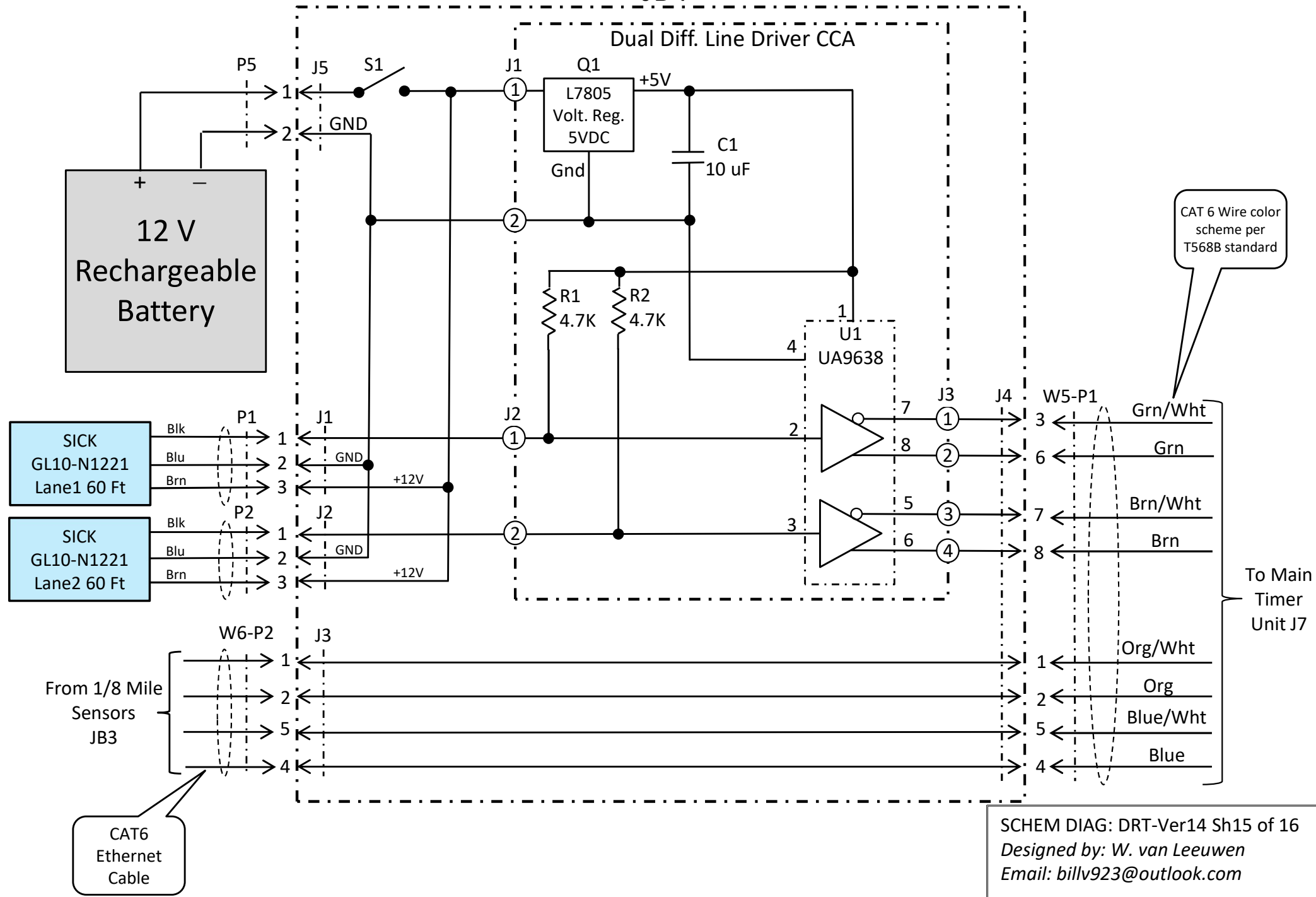
Junction Box #3 – 1/8 Mile (201m) Sensors



Junction Box #4 – 60 Ft (18.3m) Sensors

JB4

Dual Diff. Line Driver CCA



Win Indicator (Optional)

Main Timer Unit

Long 3-Conductor
Cable

Win Indicator Unit

OPTO-22-120-240 VAC, 25 Amp.
DC Control Solid State Relay (SSR)
w/ 3-32V DC CONTROL

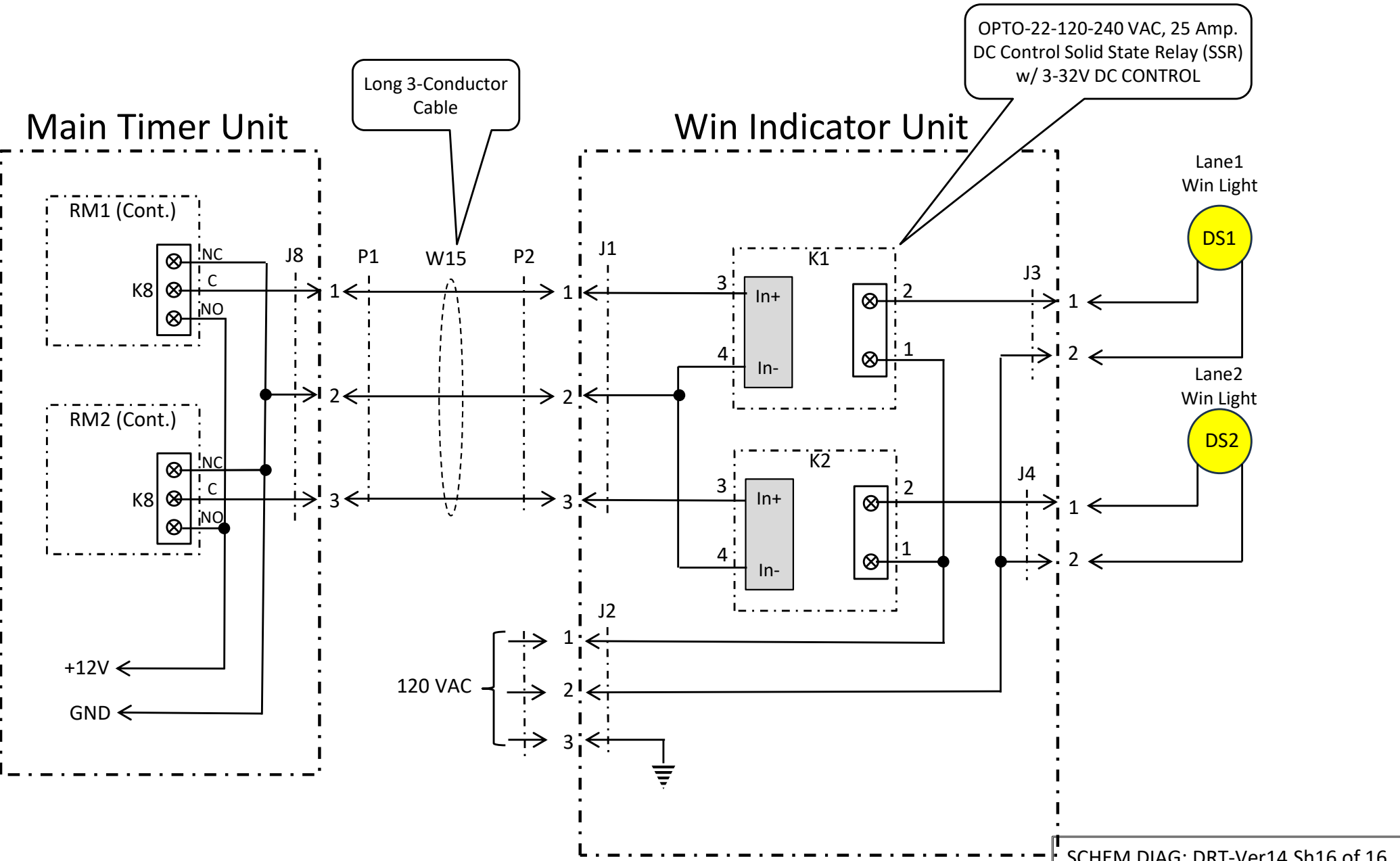
Lane1
Win Light



Lane2
Win Light



SCHEM DIAG: DRT-Ver14 Sh16 of 16
Designed by: W. van Leeuwen
Email: billv923@outlook.com



Suggested Parts List

Ref.	Qty	Description	Part No.	Manufacturer
TIMER UNIT				
---	1	Arduino MEGA or MEGA 2560 Micro-Controller	See www.Arduino.cc	Arduino
D1	1	Diode, Schotky, 1 Amp	Various	Various
PS1	1	DC-DC Buck Power Supply, 5VDC Output (2 amp minimum)	LM2596S	Various
TB1	1	Terminal Block, 3 position, #6-32 screw	Various	Various
C1	1	Capacitor, Electrolytic, 100 uF, 25V	Various	Various
S1	1	Pushbutton switch (hand held)	See EBay	
J1	1	Panel Mount 16mm Dia. Screw 8 Pin Metal Aviation Receptacle (See design notes for more info)	GX16-8	See eBay or AliExpress
J2	1	Jack, 2-cond. 1/4" (6.35mm) panel phone jack	See EBay	J2
P2	1	Plug, 2-cond. 1/4" (6.35mm) mono phone plug	See EBay	P2
Wx (J3)	1	USB Male to USB 'B' Female Socket Printer Panel Mount Extension Cable	(See EBay)	Various
R1–R7, R11	8	Resistor, 4.7 K-Ohm, ¼ Watt	Various	NTE Electronics
R8	1	Resistor, 240 Ohm, ¼ Watt	Various	NTE Electronics
R9	1	Resistor, 470 Ohm, ¼ Watt	Various	NTE Electronics
R10	1	Resistor, 2.4 K-Ohm, ¼ Watt	Various	NTE Electronics

Notes: Parts can be substituted to meet the builder's desires/needs (i.e. choice of switches or connectors).
 Parts list does not include enclosure (box) or mounting hardware (screws, circuit board standoffs, etc.).

Suggested Parts List (Cont.)

Ref.	Qty	Description	Part No.	Manufacturer
TIMER UNIT (Continued)				
RM1, RM2	2	Relay Module – 8 Channel, 5VDC EBay: “JBtek 8 Channel DC 5V Relay Module”	(See EBay Listings)	JBTEK
---	1	Circuit Card Assy – Dual Quad Differential Line Receiver	See separate parts list	
J4	1	Jack, Molex .093” 15-pin female	Various	Molex
P4	1	Plug, Molex .093” 15-pin male	Various	Molex
J5	1	Jack, Molex .093” 2-pin female	TBD	Molex
P5	1	Plug, Molex .093” 2-pin male	TBD	Molex
J6 & J7	2	RJ45 Jack, Panel Mount Connector	Various	See EBay
F1	1	Fuse Holder, Screw Cap with 10 Amp, Slo-Blow fuse	TBD	
W2	1	Cable, 50 Ft (Make from light duty 16AWG extension cord)	Various	
TIMER UNIT Miscellaneous				
---	1	Enclosure, 12x8x6, weatherproof	TBD	
---	---	Misc. hardware (screws, nuts, washers, wire, tie-wraps, etc.)		

*Notes: Parts can be substituted to meet the builder’s desires/needs (i.e. choice of switches or connectors, etc.).

Suggested Parts List (Cont.)

Ref.	Qty	Description	Part No.	Manufacturer
LIGHT TREE UNIT				
DS1 - DS4	8	Indicator, White lamp	TBD (User Defined)	
DS5 – DS10	6	Indicator, Amber lamp	TBD (User Defined)	
DS11, DS12	2	Indicator, Green lamp	TBD (User Defined)	
DS13, DS14	2	Indicator, Red lamp	TBD (User Defined)	
W1	1	Cable, 14 AWG, 15 Conductor	TBD	
P4	1	Plug, Molex .093" 15-pin male	TBD	Molex
LIGHT TREE – Miscellaneous				
---	14	Lamp Sockets	TBD (User Defined)	
---	---	Misc. hardware (screws, nuts, washers, wire, tie-wraps)		

*Notes: Parts can be substituted to meet the builder's desires/needs (i.e. choice of switches or connectors, etc.).

Suggested Parts List (Cont.)

Ref.	Qty	Description	Part No.	Manufacturer
START LINE IR RECEIVER UNIT				
Sn1 – Sn6	6	Autonics BJ15M Trough Beam Photo Electric Sensor	BJ15M-TDT2	Autonics
TB1	1	Terminal Block, 8 position, #6-32 screw	TBD	
Misc	1	Enclosure/Housing		
P1	1	16mm Dia. Screw 8 Pin Metal Aviation Plug (See design notes for more info)	GX16-8	See EBay
W1	Tbd Ft	Cable, 8 conductor, 18 AWG sprinkler system cable	54706	Southwire
LANE 1 – START-LINE IR EMITTER UNIT				
Em1 – Em3	3	Autonics BJ15M Trough Beam Photo Electric Emitter	BJ15M-TDT1	Autonics
S1	1	Miniature Switch, SPST	TBD	
B1	1	Battery, 12 Volt, Rechargeable	Various	
LANE 2 – START-LINE IR EMITTER UNIT				
Em1 – Em3	3	Autonics BJ15M Trough Beam Photo Electric Emitter	BJ15M-TDT1	Autonics
S1	1	Miniature Switch, SPST	TBD	
B1	1	Battery, 12 Volt, Rechargeable	Various	

*Notes: Parts can be substituted to meet the builder's desires/needs (i.e. choice of switches or connectors, etc.).

Suggested Parts List (Cont.)

Ref.	Qty	Description	Part No.	Manufacturer
JB1 & JB3 - FINISH LINE & 660' SENSOR JUNCTION BOX (QTY = 2)				
S1	1	Miniature Switch, SPST	Various	See EBay
CCA	1	Circuit Card Assy – Dual Differential Line Driver	See separate parts list	
J1 & J2	2	Panel Mount 16mm Dia. Screw 3 Pin Metal Aviation Receptacle (See separate sheet for more info)	GX16-3	See EBay
J3	1	RJ45 Jack, Panel Mount Connector	Various	See EBay
J4	1	Jack, Molex .093" 2-pin female	TBD	Molex
P4	1	Plug, Molex .093" 2-pin male	TBD	Molex
B1	1	Battery, 12 Volt, Rechargeable	Various	
---	1	Circuit Card Assy – Dual Differential Line Driver	See separate parts list	

*Notes: Parts can be substituted to meet the builder's desires/needs (i.e. choice of switches or connectors, etc.).

Suggested Parts List (Cont.)

Ref.	Qty	Description	Part No.	Manufacturer
JB2 & JB4 – Trap & 60' SENSOR JUNCTION BOX (QTY = 2)				
S1	1	Miniature Switch, SPST	TBD	
CCA	1	Circuit Card Assy – Dual Differential Line Driver	See separate parts list	
J1, J2	2	Panel Mount 16mm Dia. Screw 3 Pin Metal Aviation Receptacle (See design notes for more info)	GX16-3	See EBay
J3, J4	2	RJ45 Jack, Panel Mount Connector	Various	See EBay
J5	1	Jack, Molex .093" 2-pin female	TBD	Molex
P5	1	Plug, Molex .093" 2-pin male	TBD	Molex
B1	1	Battery, 12 Volt, Rechargeable	Various	
---	1	Circuit Card Assy – Dual Differential Line Driver	See separate parts list	

*Notes: Parts can be substituted to meet the builder's desires/needs (i.e. choice of switches or connectors, etc.).

Suggested Parts List (Cont.)

Ref.	Qty	Description	Part No.	Manufacturer
ETHERNET CABLES				
W5, W8	100 Ft	CAT6 Outdoor Ethernet Cable w/ RJ45 connectors		
W6	600 Ft	CAT6 Outdoor Ethernet Cable w/ RJ45 connectors		
W7	1200 Ft	CAT6 Outdoor Ethernet Cable w/ RJ45 connectors		
60 Ft, 660', Trap & Finish Line IR Sensor Units for Lanes 1 & 2				
S1 – S8	8	Retroreflective Photo Electric Sensor System	GL10-N1221 or OPT2136	SICK WENGLOR
---	8	Plug, 16mm Dia. Screw 3 Pin Metal Aviation Plug (See design notes for more info)	GX16-3	
M1 – M8	8	Retroreflective Mirror	PL80A	SICK

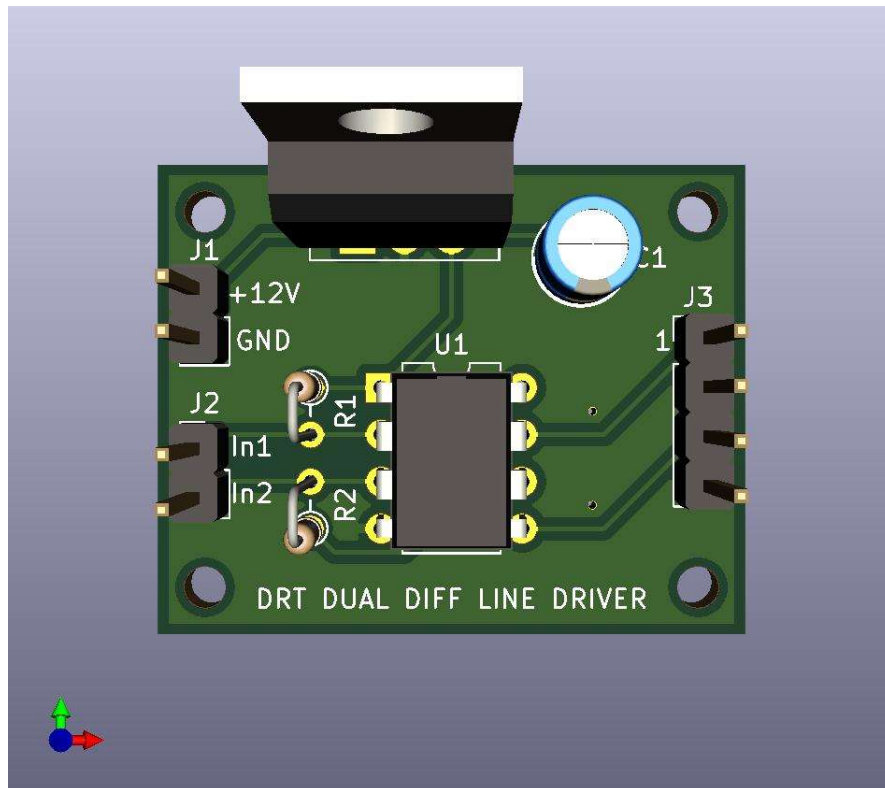
*Notes: Parts can be substituted to meet the builder's desires/needs (i.e. choice of switches or connectors, etc.).

Suggested Parts List (Cont.)

Ref.	Qty	Description	Part No.	Manufacturer
WIN INDICATOR UNIT (Optional)				
K1 & K2	2	Solid State Relay, OPTO-22-120-240 VAC, 25 Amp. DC w/ 3-32V DC CONTROL		
J1	1	Panel Mount 16mm Dia. Screw 3 Pin Metal Aviation Receptacle (See design notes for more info)	GX16-3	See eBay or AliExpress
J2 – J4	3	Connector, Panel Mount	TBD	TBD
DS1, DS2	2	Lamp, 120VAC	TBD	TBD
W15	1400'	Cable, 18AWG, 3-Conductor	Various	Various
W15-P1 & W15-P2	2	Plug, 16mm Dia. Screw 3 Pin Metal Aviation Plug (See design notes for more info)	GX16-3	See eBay or AliExpress

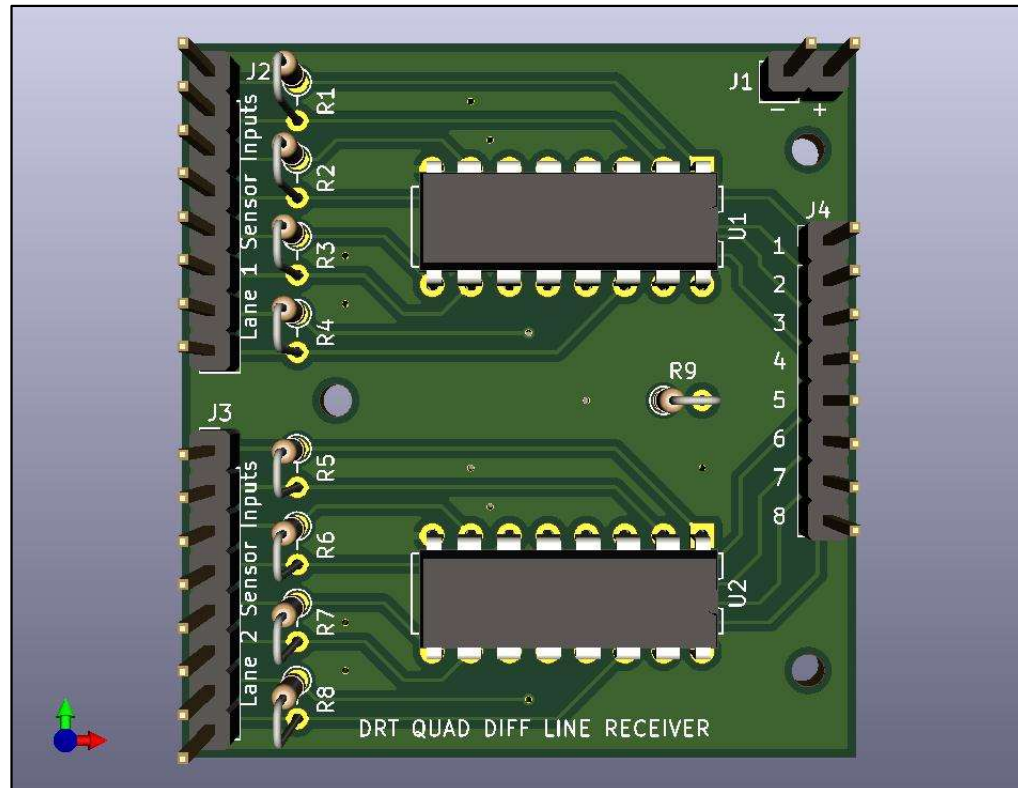
*Notes: Parts can be substituted to meet the builder's desires/needs (i.e. choice of switches or connectors, etc.).

Sensor Line Driver & Line Receiver Circuit Card Assemblies



Dual Differential Line Driver

Circuit Card Assembly (CCA). Qty=4 Required
Ref. Schem. Diag. DRT-Ver14 Sht 13, 14, 15 & 16

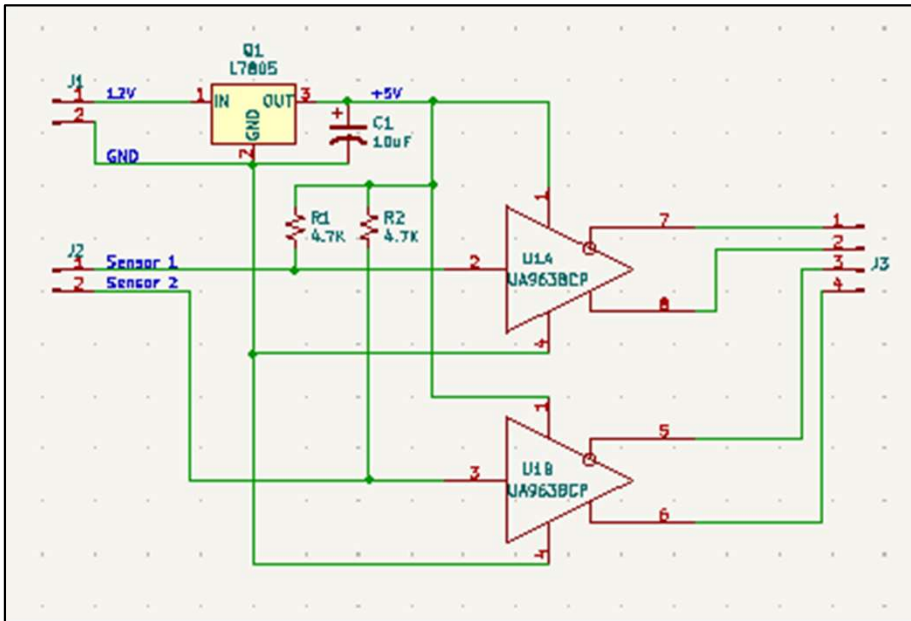


Quad Differential Line Receiver

Circuit Card Assembly (CCA). Qty=1 Required
Ref. Schem. Diag. DRT-Ver14 Sht 4 & 5

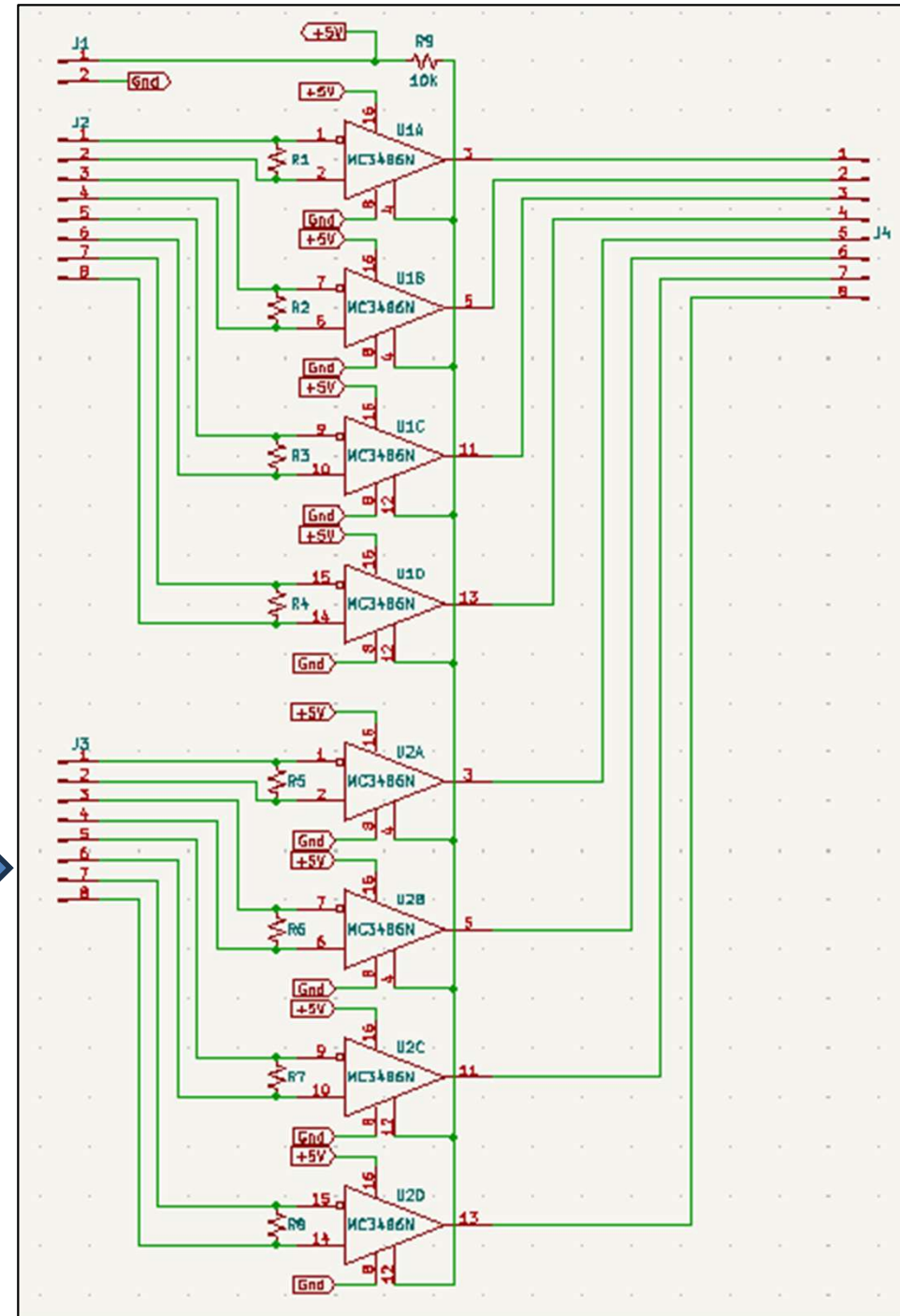
Circuit cards can be easily built using a prototyping circuit board or can be ordered from your local circuit board manufacturer using the CAD (.kicad_pcb) files provided with this design package. The circuit boards can also be ordered from the author for a fee either as a bare board or a fully populated board. Circuit boards were designed using KiCad a free software package downloadable from the Internet. Boards can be manufactured by OSH PARK (<https://oshpark.com>).

Sensor Line Driver & Line Receiver CCA's



CCA - Dual Differential Line Driver Schematic Diagram

CCA - Dual Quad Differential Line Receiver



Circuit Card Assemblies

(See Design Notes)

Ref.	Qty	Description	Part No.	Manufacturer
CIRCUIT CARD ASSY – Quad Differential Line Receiver Module (Qty Req'd=1)				
U1 & U2	2	Quad Differential Line Receiver	MC3486	Texas Instruments
R1 – R8	8	Resistor, 100 Ohm, ¼ Watt	Various	Various
R10	1	Resistor, 10 K-Ohm, ¼ Watt	Various	Various
J2 – J4	3	Male Header 8-Pin, 0.1" (2.54mm) pitch	Various	Various
J1	1	Male Header 2-Pin, 0.1" (2.54mm) pitch	Various	Various
CIRCUIT CARD ASSY – Dual Differential Line Driver Module (Qty Req'd=4)				
Q1	1	Voltage Regulator, 5V	L7805	STMicroelectronics
U1	1	Dual Differential Line Driver	UA9638	Texas Instruments
C1	1	Capacitor, Electrolytic, 10uF, 25V	Various	Various
R1 & R2	2	Resistor, 4.7K, ¼ Watt	Various	Various
J3	1	Male Header 4-Pin, 0.1" (2.54mm) pitch	Various	Various
J1 & J2	2	Male Header 2-Pin, 0.1" (2.54mm) pitch	Various	Various

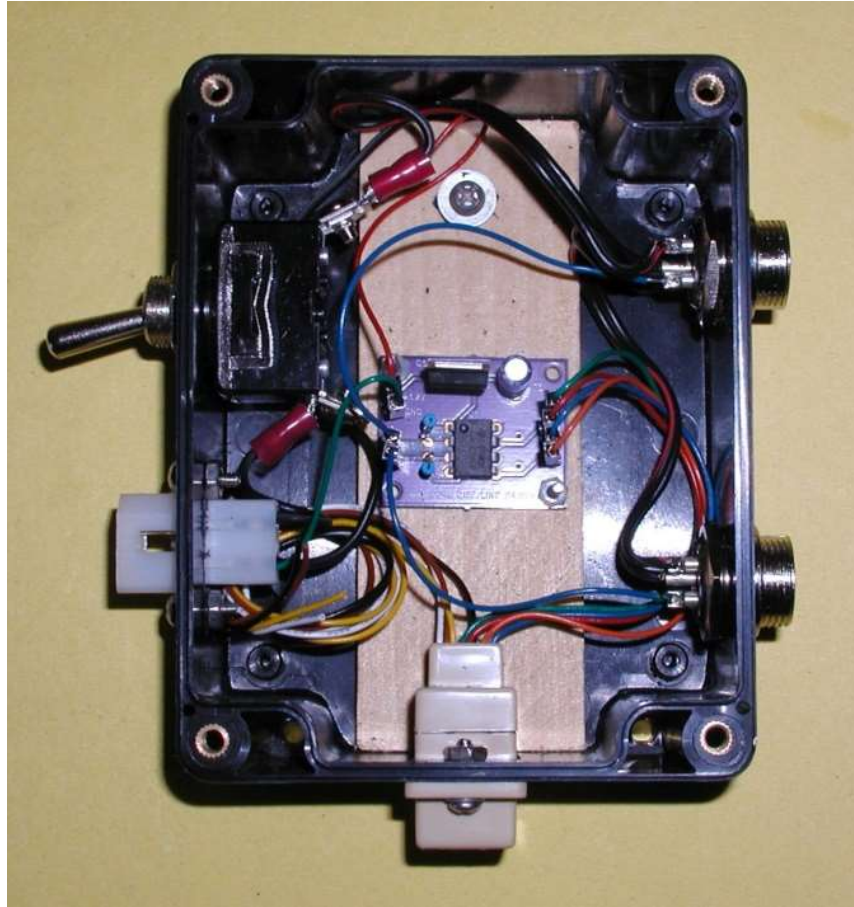
*Notes: Parts can be substituted to meet the builder's desires/needs (i.e. choice of switches or connectors, etc.).

Timer Design Notes

- The Hand-Held Start switch (S1) uses a normally open (N.O.) set of contacts.
- The Christmas tree interface provides normally open (N.O.) relay contacts rated at 10 amps that allow the user to implement almost any kind of indicator of their choice, whether they be 120/240 VAC incandescent lamps, 5 volt LEDs or something in between. It is recommended that LED equivalents be used because they use less power and have an instantaneous on/off cycle time.
- **NOTE:** The Guard Sensors are optional. If not used, wire input pins to ground to disable them. Failure to do so will prevent the timer from working.

Junction Box Build

Photo showing an example Junction Box build with Dual Differential Line Driver Circuit Board



Example Build of a Different but Similar Main Timer Unit

12 Pwr
Supply

Differential Line
Receiver Board for
down-track sensor
inputs

Arduino
Mega

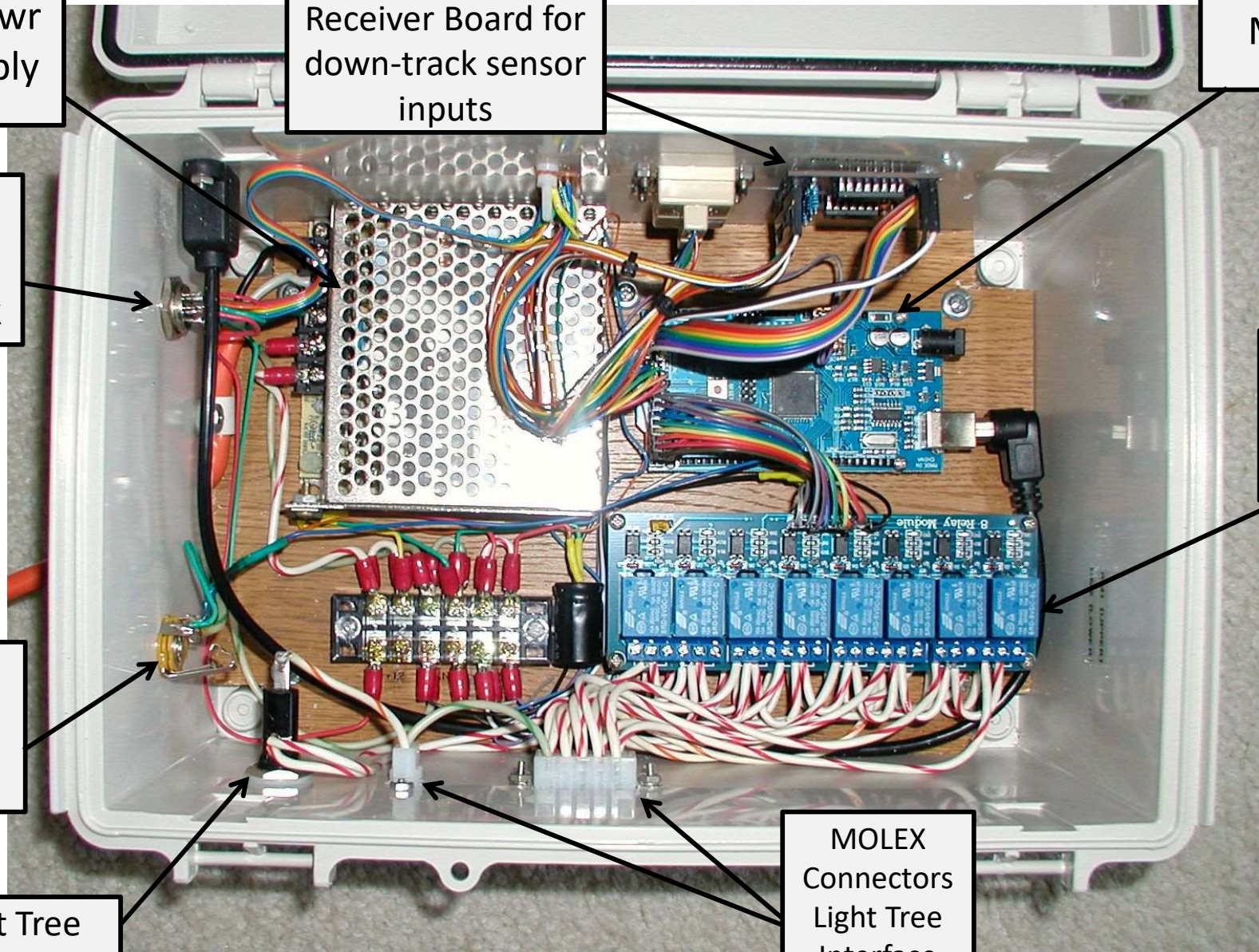
Start-Line
Sensors
Input Jack

Relay
Board
(Qty 2)

Hand-Held
Pushbutton
Input Jack

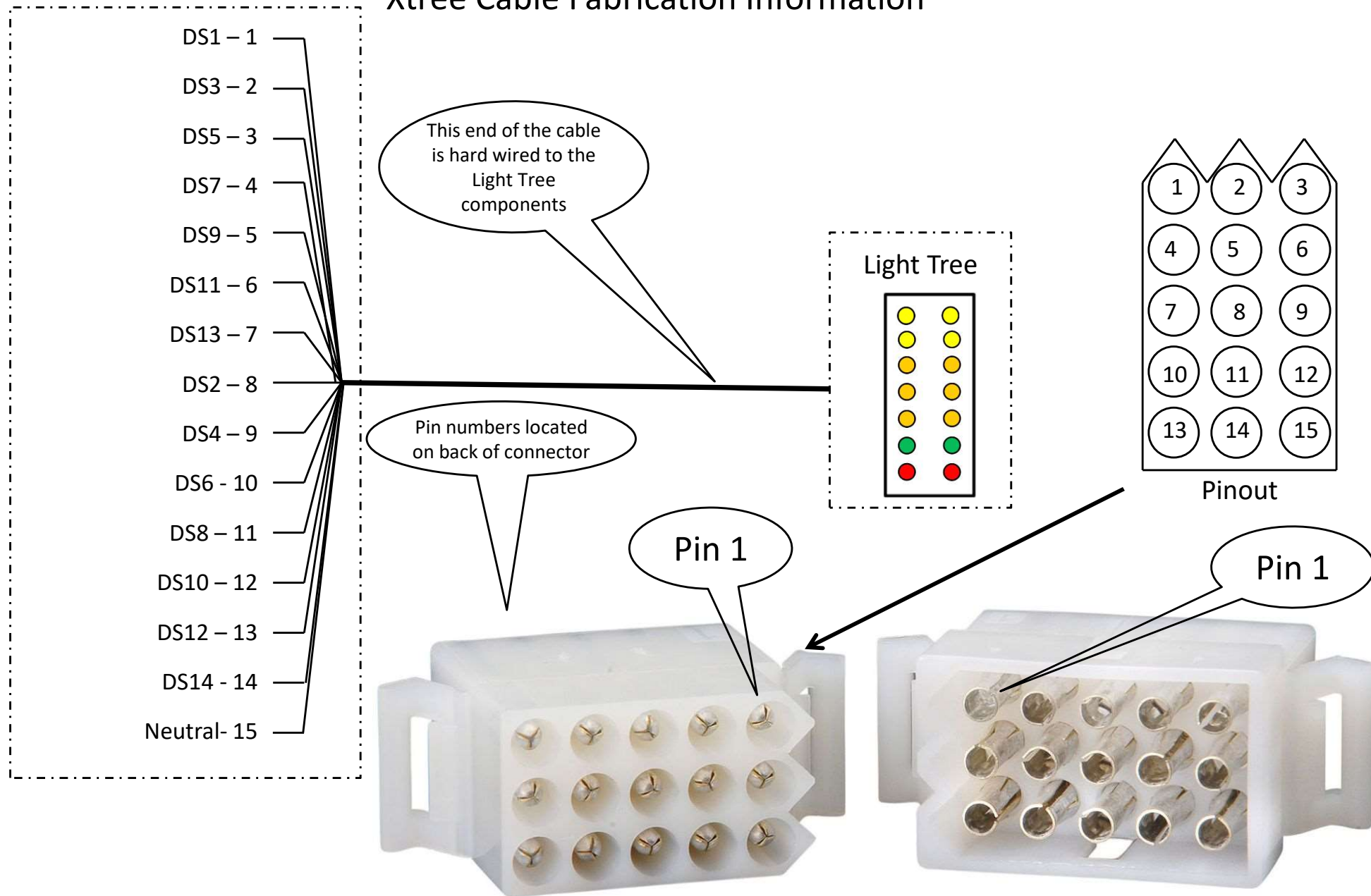
Light Tree
Power Fuse
Holder

MOLEX
Connectors
Light Tree
Interface



Xtree Timer Cable Assemblies

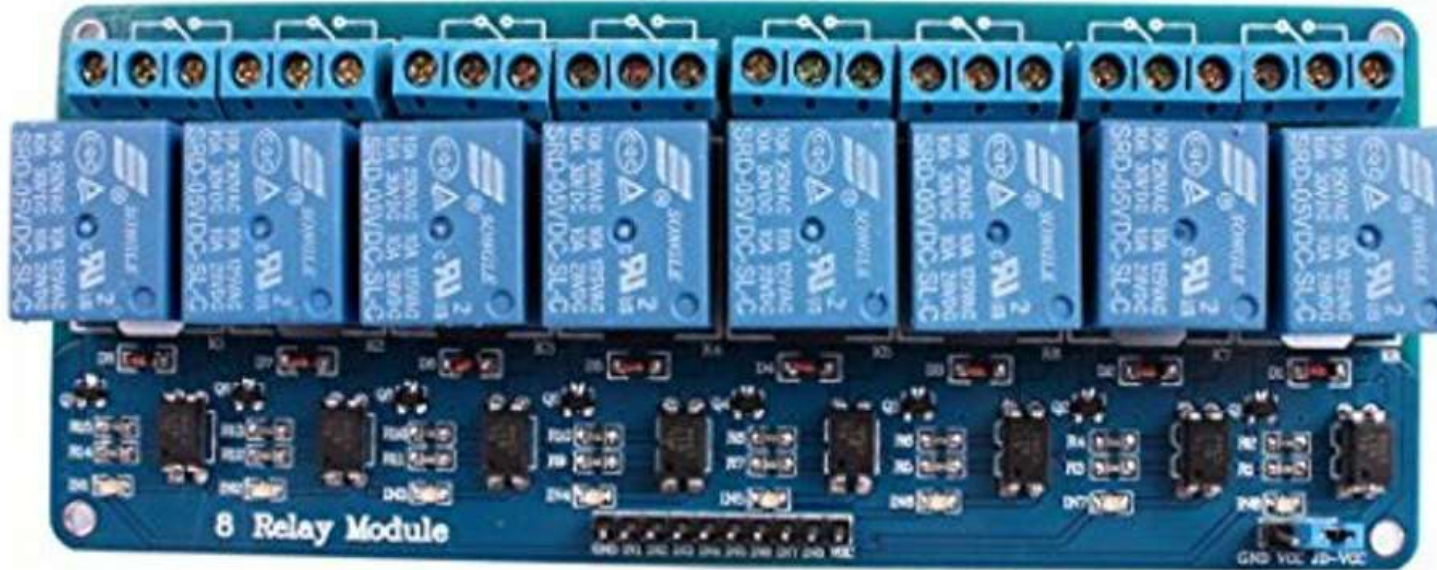
Xtree Cable Fabrication Information



Recommended connectors for Light Tree: 15-Pin Molex, .093" Pins, 18-22 AWG, Panel Mount

Timer Design Notes (Cont.)

- JBTEK 8 Channel 5 VDC Relay Module (RM1 & RM2)



- RJ45 Jack, Panel Mount



Timer Design Notes (Cont.)

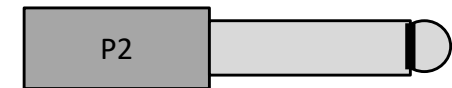
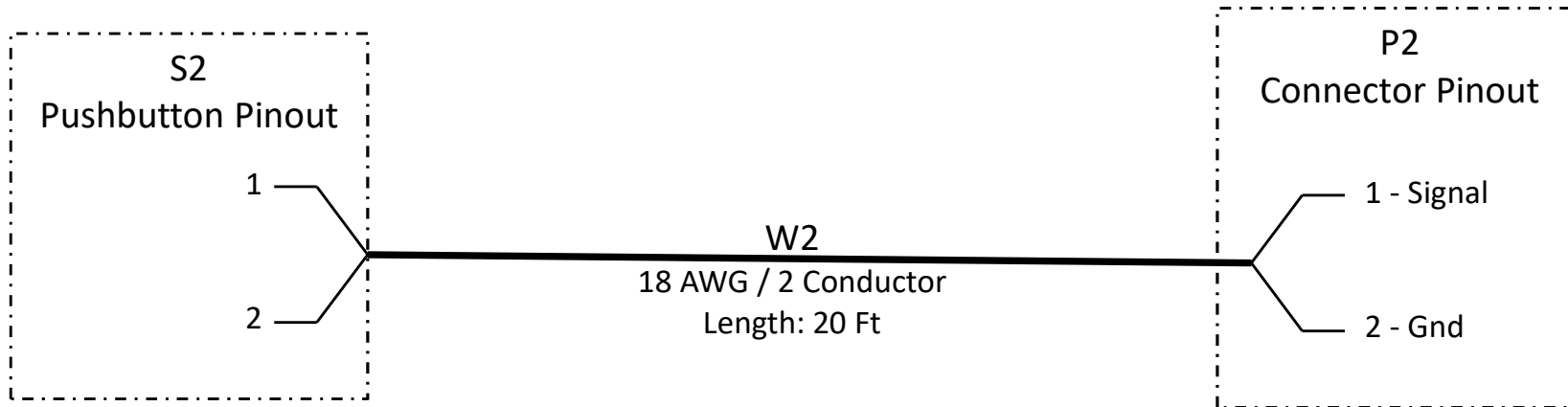
- Recommended connector for all down-track sensors: GX16 3-Pin Panel Mount 16mm Dia Screw, Metal Aviation Wire Connector Plug & Receptacle (See EBay).



- Recommended connector for W4: GX16 8-Pin Panel Mount 16mm Dia Screw, Metal Aviation Wire Connector Plug & Receptacle (See EBay).



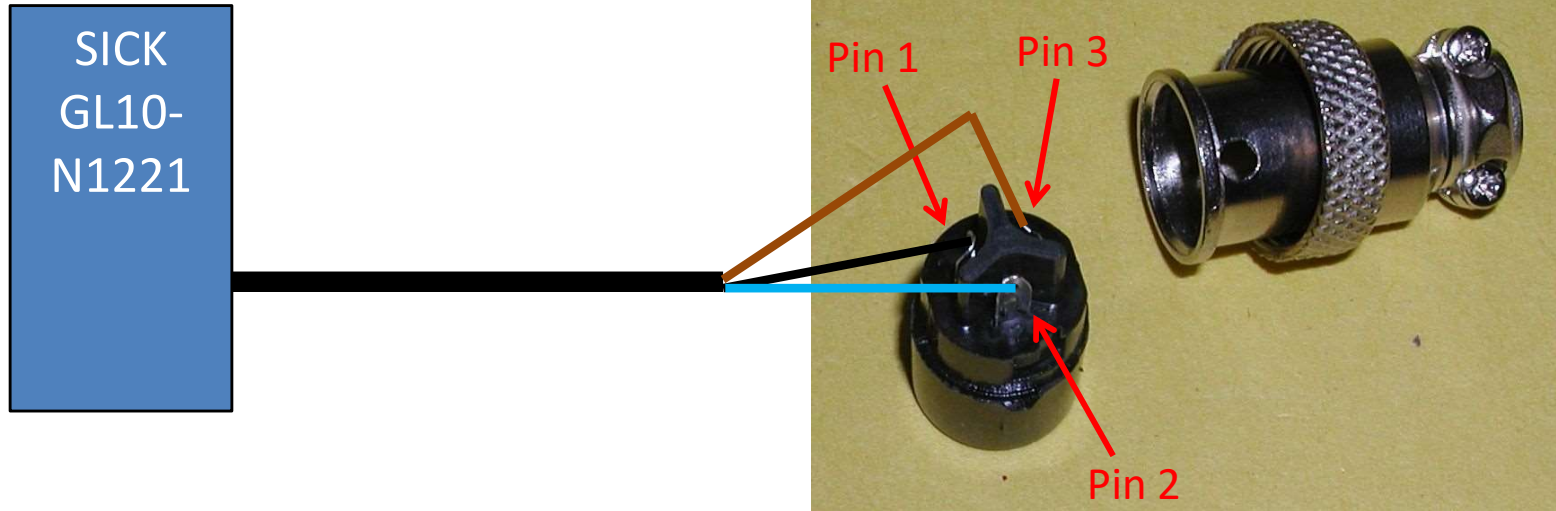
Pushbutton Cable Fabrication Information (W2)



Suggestion: Use an inexpensive 20 – 30 foot outdoor rated extension chord for the cable.

Sensor Connector Wiring

SICK GL10-N1221 Connector Wiring:




Relays used in the optional Win Light unit:



Solid State Relay, OPTO-22-120-240 VAC,
25 Amp. DC w/ 3-32V DC CONTROL

Timer Design Notes (Cont.)

- **Time Slip Printer:** There are many Point-Of-Sale (POS) thermal receipt printers available on the market. The author used an Epson ECS/POS 80mm thermal printer purchased from EBay (See picture below). Any printer can be used since the race management software issues a DOS print command to send a text file to the PC's default printer.



LOT 10 USB POS Receipt Thermal Printer 80mm w/ Paper Roll High-speed Printing BA
🔥 1 sold in last hour

Condition: **New**
LOT/PCS: LOT 1 = 1PC
Quantity: 1 4 available / 2 sold

Price: **US \$65.99**

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