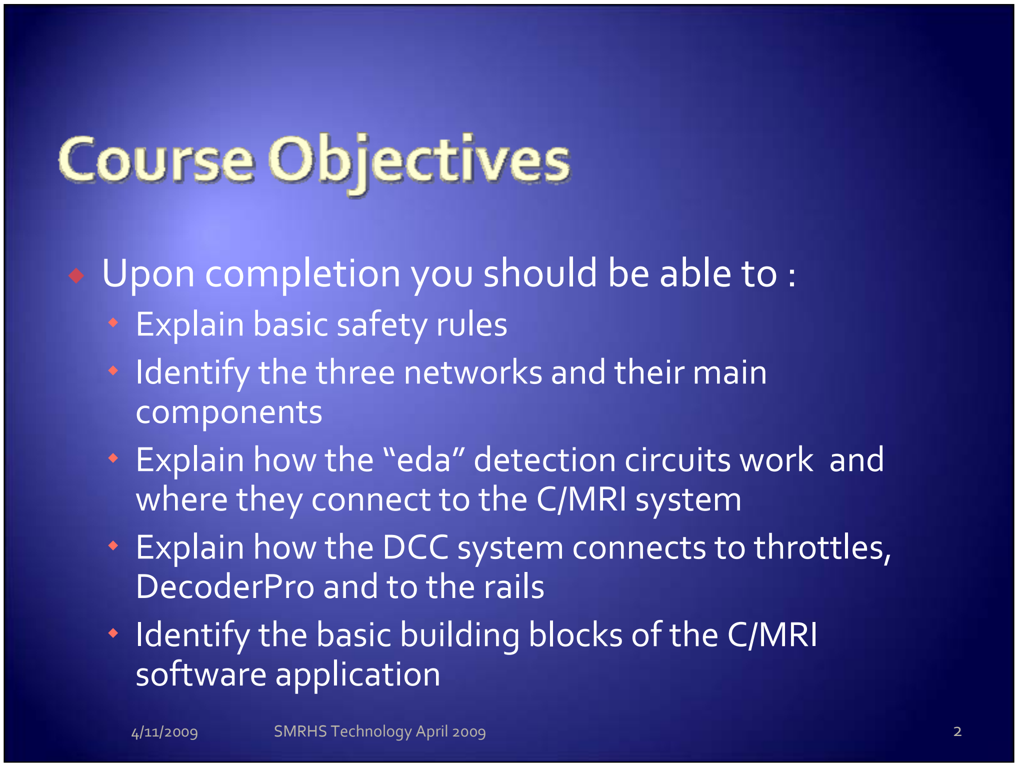
This is intended to be the first of a series of training classes that will provide both theory and practical hands-on introduction to the technologies deployed on the standard gauge layout.

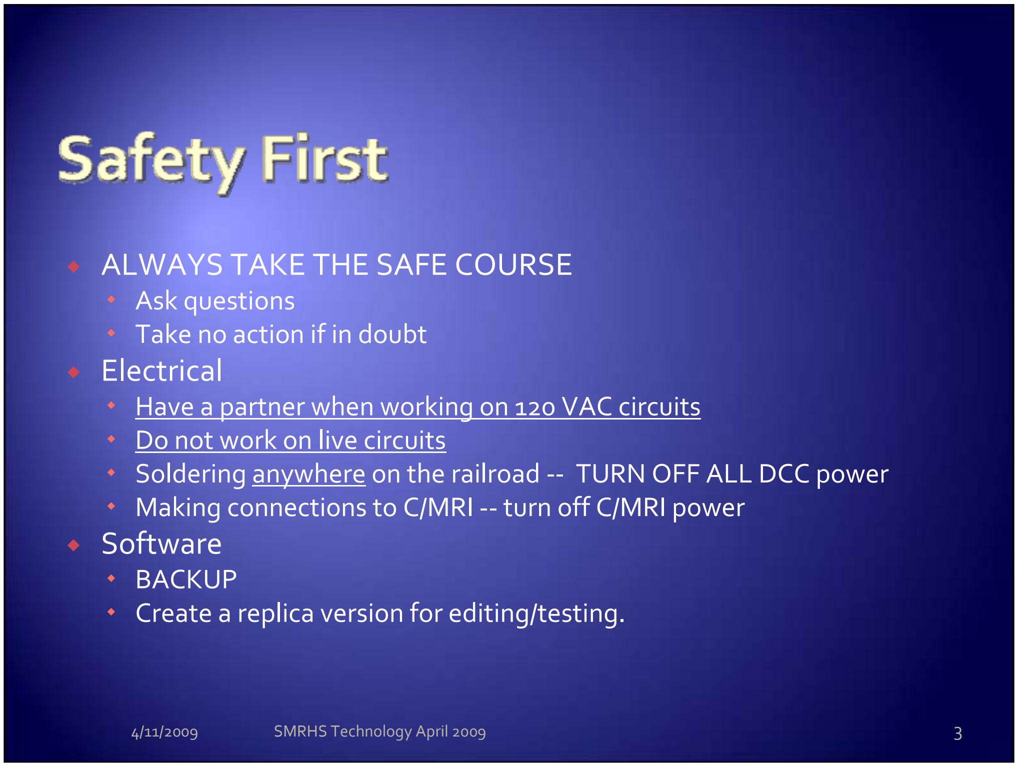
If you have any questions please ask for clarification – we really want you to understand how the stuff works.

Your facilitators: Joe Melhorn and Dave Megeath



By identifying each day's objectives we hope to stay focused – and we should close the day out by returning to this screen to discuss these points.

We will be asking for volunteers to accept certain tasks – help will be provided, don't worry!



Mistakes can lead to equipment damage and ultimately bodily harm.

When working on 120 VAC circuits, make sure you have a partner on hand;. “Blue Flag” breakers or wall switches as needed.

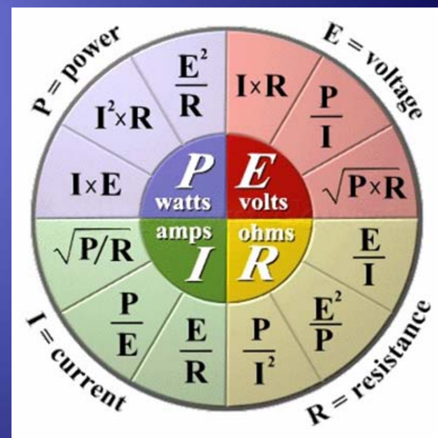
If you have to shut the layout down during open house to safely make a repair, so be it – you are responsible for your own safety and that of others in your work area.

Failure to follow these simple rules has cost the Society in the past in repairs to the Digitrax equipment. So far our worker loss rate is zero.

When working on software, BACKUP and create a replica version for editing/testing. Date-code file names (e.g., SMRHS_SIGNALS_11apr2009)

Ohm's Law – Who cares?

- It's **The Law** for DC circuits
  - E = voltage (volts DC)
    - also expressed as 'electromotive force', thus the "E" in the formulas
  - I = current (amps)
  - R = resistance (Ω , Ohms)
  - P = power (watts)



4/11/2009 SMRHS Technology April 2009 4

The Ohm's Law Wheel with Power shown above provides a graphical representation of the relationships between voltage, current, resistance and power in a direct current electrical circuit.

George (Georg) Simon Ohm (1789 -1854), a German physicist, discovered the relationship between applied voltage, current flow and various lengths of wire (resistance).
Ohm's Law expresses these relationships as follows:

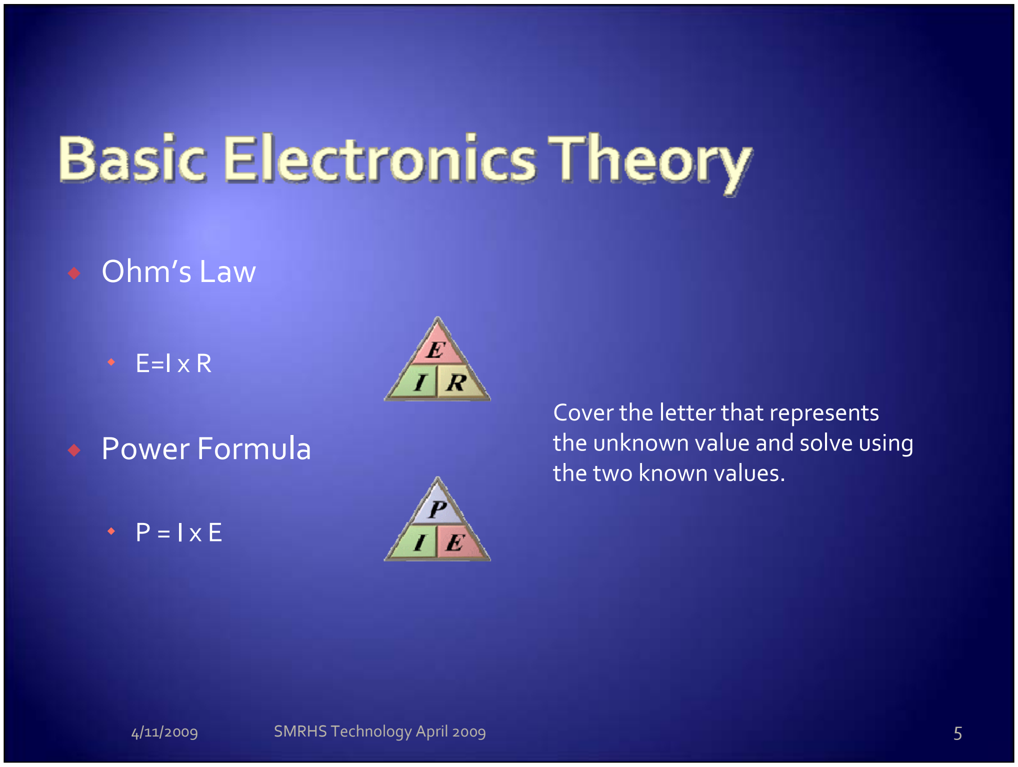
The current flowing in a circuit is directly proportional to the applied EMF and is inversely proportional to the resistance.

When expressed as an equation it takes the form: I = E/R (I = E divided by R).
Where:
I = current in amperes
E = EMF (Electromotive Force) in volts
R = resistance in ohms

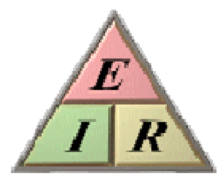
The equation above solves for the value of current flowing in a circuit when voltage and resistance values are known. This equation can be transposed allowing any of the three quantities to be determined if the remaining two are known:

E = IR (E = I times R) solves for the value of the voltage applied to a circuit when the current and resistance values are known.

R = E/I (R = E divided by I) solves for circuit resistance when applied voltage and current flow are known.
It is important to remember that the units of measurement used in the expression are amperes, volts and ohms. Other units such as milliamperes (1/1000th of an ampere), kilohms (K ohms) or kilovolts (1000 volts) must be converted before using the equation.

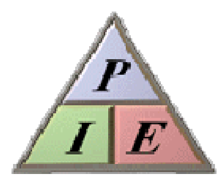


Using the icons, cover the letter of the unknown and solve.



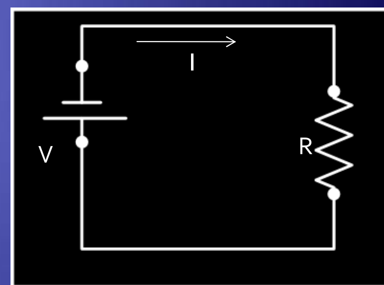
Example:
R is unknown
R = E / I

P is unknown
P= I x E



DC CIRCUIT BASICS

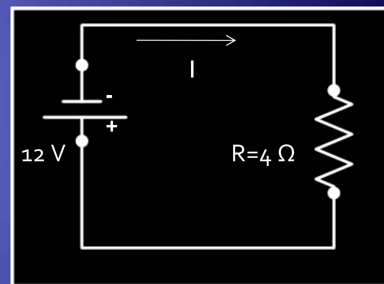
- Battery, potential is V (volts)
- Current flow, I (amps)
- Resistor, R (Ω, Ohms)



Basic symbols used in circuit diagram above: battery cell, resistor.

DC CIRCUIT EXAMPLE 1 a

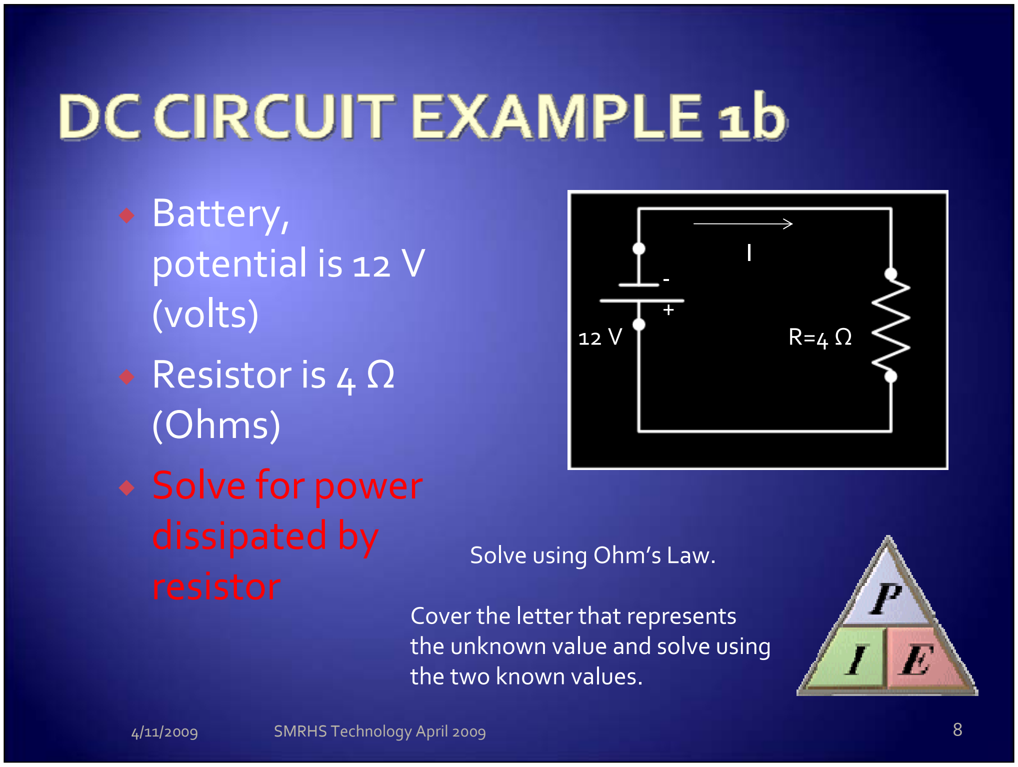
- Battery, potential is 12 V (volts)
- Resistor is 4 Ω (Ohms)
- Solve for Current flow, I (amps)



Solve using Ohm's Law.

Cover the letter that represents the unknown value and solve using the two known values.

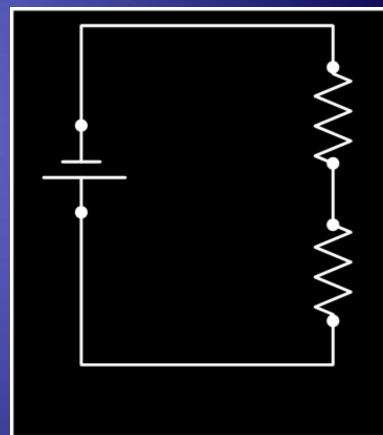
4/11/2009 SMRHS Technology April 2009 7



You will need information from example 1a to solve this.

Series Circuit

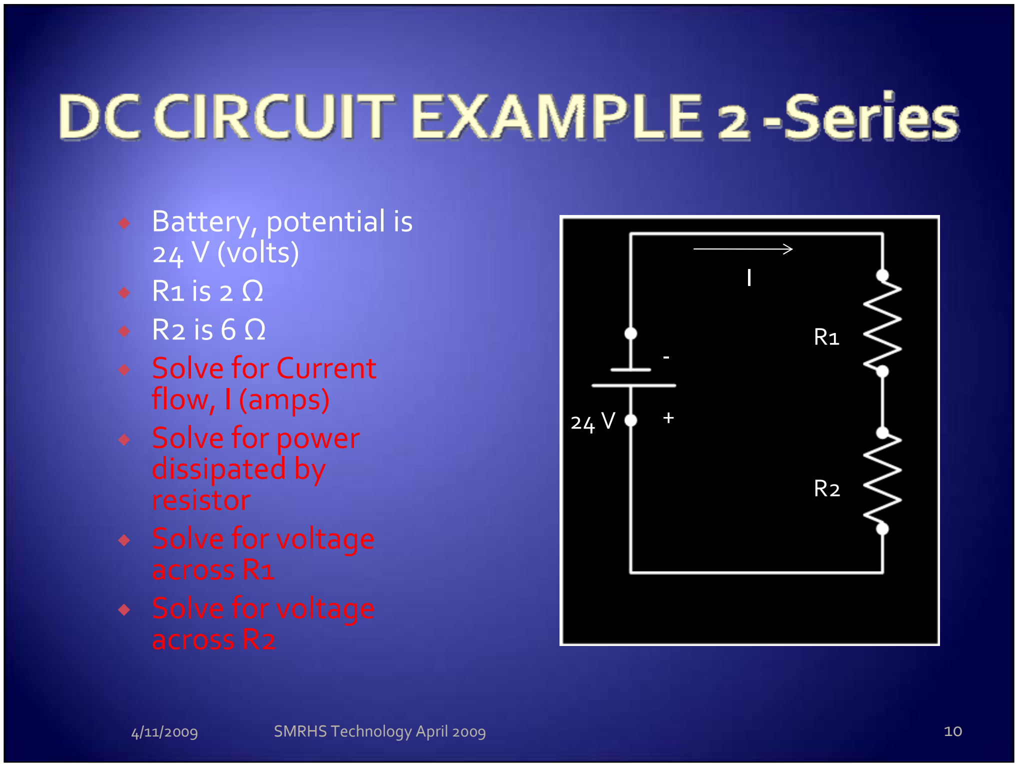
- Resistors in series
  - Current is common in a series circuit
  - Total Voltage across the circuit = sum of voltages across each component
  - In a series circuit, every device must function for the circuit to be complete



4/11/2009 SMRHS Technology April 2009 9

The voltage drop across each resistor can be used to drive other circuits – this is called a voltage divider.

The voltage dropped will be a function of what two variables in the E=I x R equation?

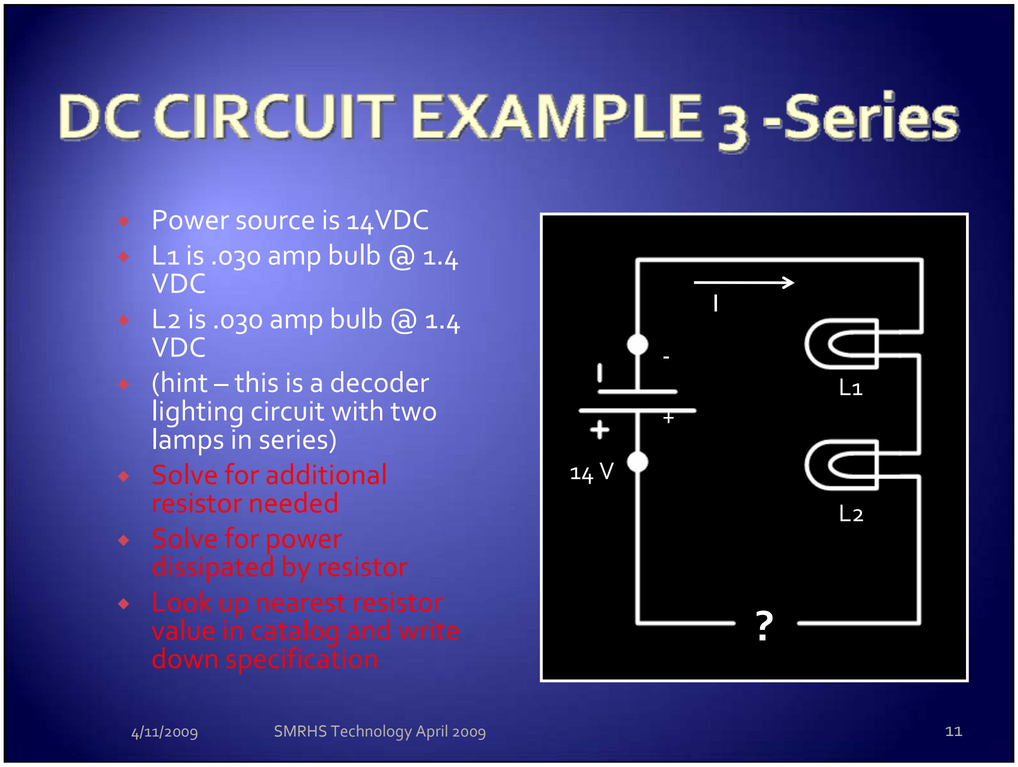


Resistors in series

Same current flows through all resistors

Total Voltage across the circuit = sum of voltages across each component

In a series circuit, every device must function for the circuit to be complete



Resistors in series

Same current flows through all resistors

Total Voltage across the circuit = sum of voltages across each component

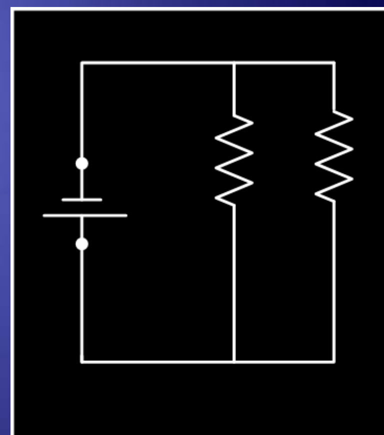
In a series circuit, every device must function for the circuit to be complete

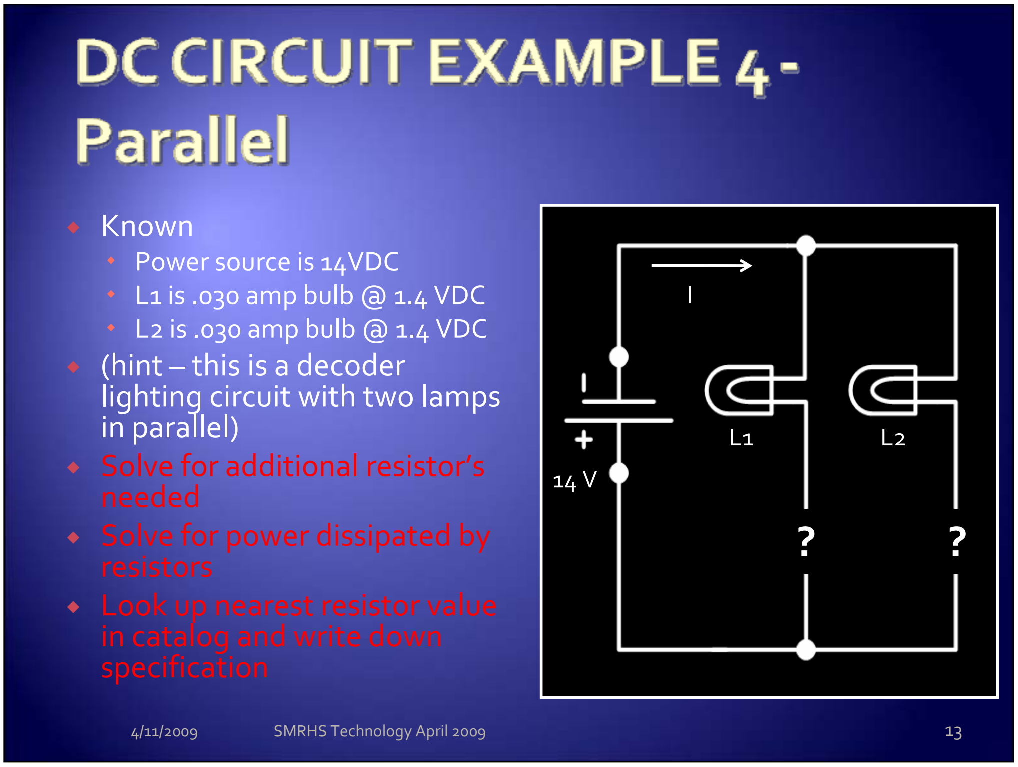
This could be a diagram for a two-lamps-in-series diagram for a locomotive. **Bonus exercise!**

- Source voltage from decoder is 14 VDC
- R1 and R2 are actually 0.030 amp (30 milliamp) bulbs
- bulbs are to operate at 1.4 VDC
- You need to add one resistor in series so the bulbs don't burn out – what is the resistance value and the power rating of the resistor?
- Grab an electronics catalog and specify the resistor

Parallel Circuit

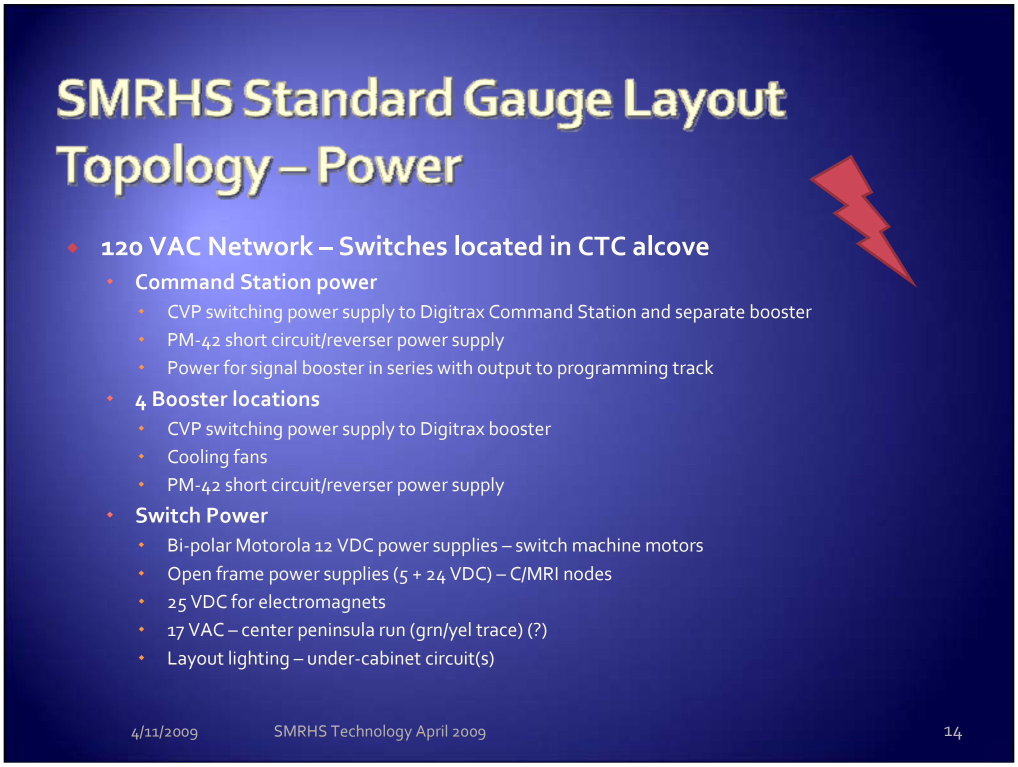
- Resistors in parallel
  - Voltage is common in a parallel circuit
  - Total Current of the circuit = sum of currents across each component
  - In parallel circuits, each device has its own circuit, so all but one device could be burned out, and the last one will still function





Voltage is common in a parallel circuit
Total Current of the circuit = sum of currents across each component

In parallel circuits, each device has its own circuit, so all but one device could be burned out, and the last one will still function; corollary question: **why do we put the added resistor in each path instead of one in common?**

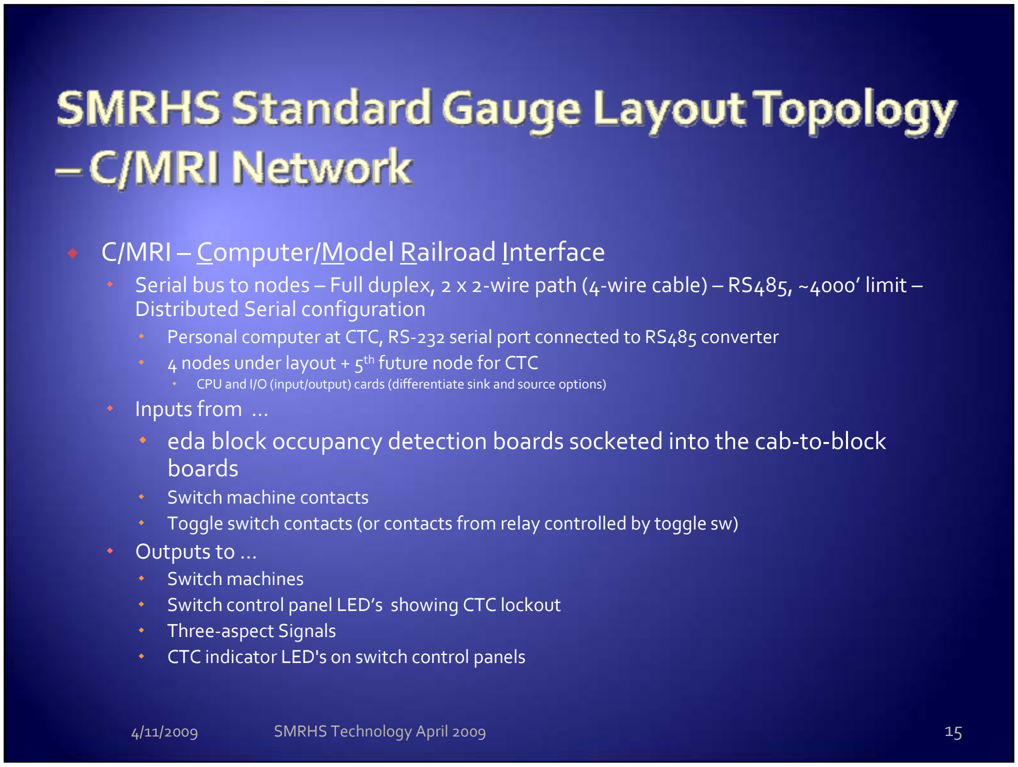


Topology refers to the shape of a network , or the network's layout. How different nodes in a network are connected to each other and how they communicate are determined by the network's topology. Topologies are either physical or logical.

These three high voltage circuits were all run from new breakers in the panel through metal conduit and include a ground wire. The existing building circuits were not run with a ground, instead they relied on the metal conduit as the ground path.

We will stop and locate the breaker panel in the tool room and the SPST (single pole single throw) toggle switches in the CTC alcove; also will show the quad-box terminations under the layout.

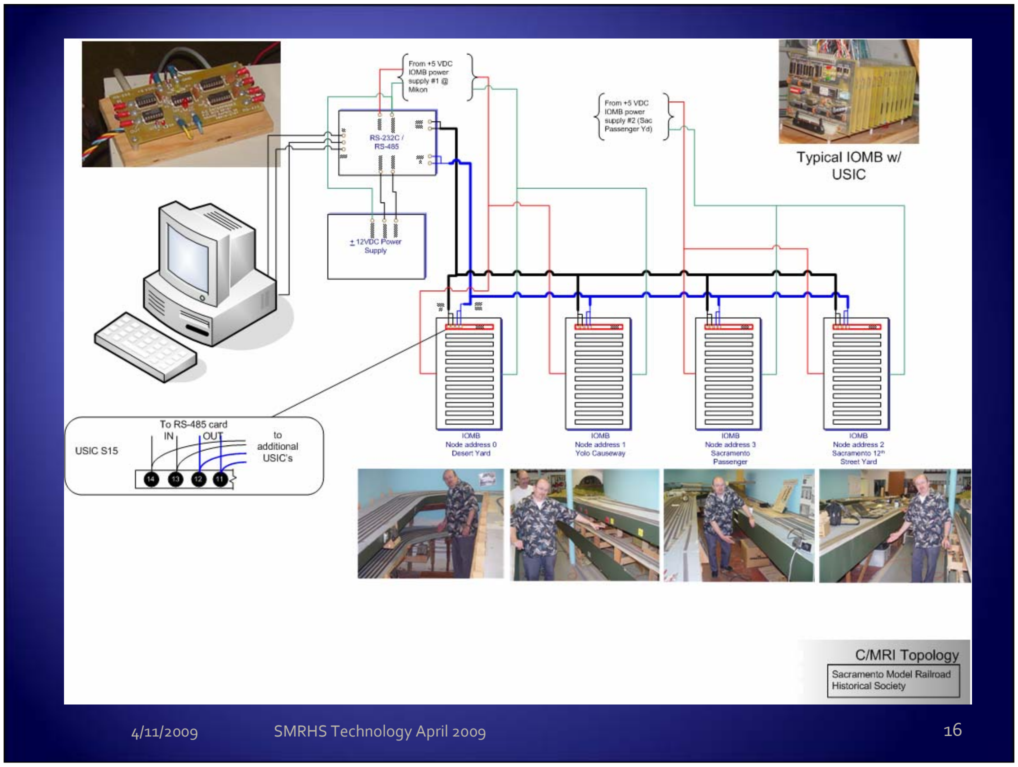
We need a volunteer to map out the 120 VAC network; also need to discuss the feasibility of extending the Booster 120VAC network over to the Command Station location.



C/MRI is comprised of hardware and software – think of how a mouse works on a computer:

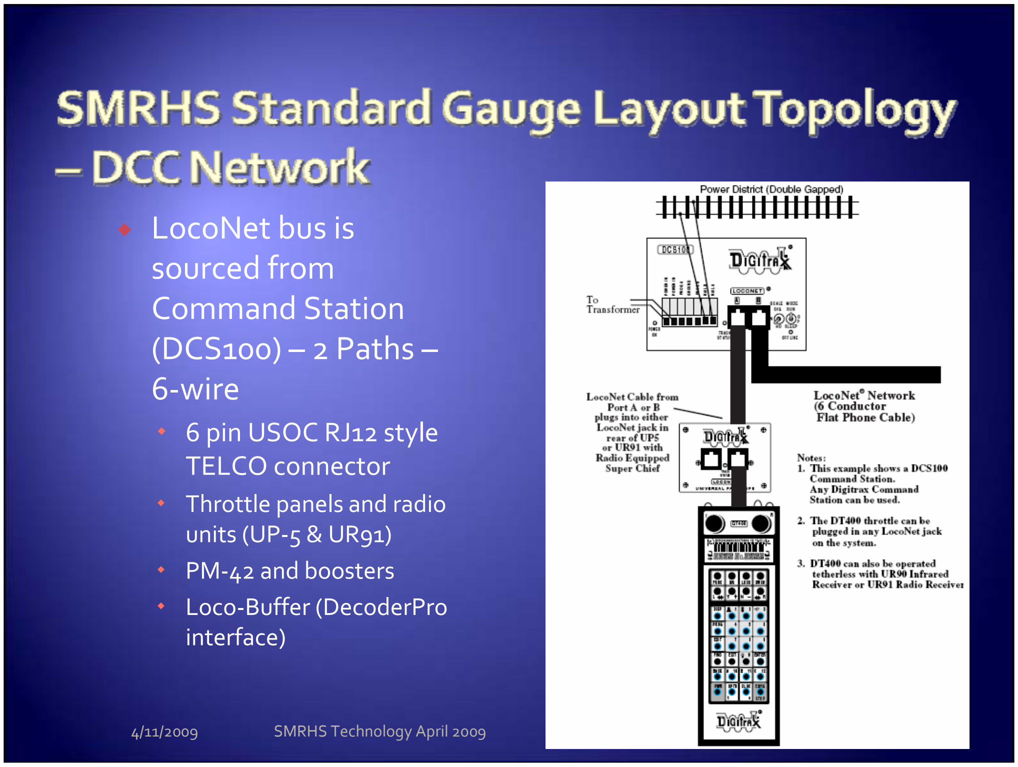
> Mouse is connected to the computer and provides input in terms of tracking movement in a 2-dimension grid – think in terms of an X-Y coordinate system, where X is the horizontal axis, Y the vertical axis. When you move the mouse "up" it is actually counting how many pixels you are moving … e.g., mouse moved 100 pixels "up" = +100 pixels location. So the input to the computer is + 100 pixels. In the case of the mouse, this will actually be 100 individual input messages to the computer, 1 pixel at a time.
>
> Next the computer needs to do something with the input information. In this case we want the computer do display the mouse icon in a new position – moving it up 100 pixels on the display. We'll call this the calculation or processing function followed by an output function (icon moves on the display).

C/MRI in a model railroad is essentially doing the same thing – it is an extension of the computer's input/output capabilities with a custom software application that we teach how to handle the inputs and how to drive the outputs based on the calculations and processing that the application performs.



This is the diagram of the C/MRI physical network that is currently installed on the standard gauge layout. At this point we will go out to the layout and have you identify each location.

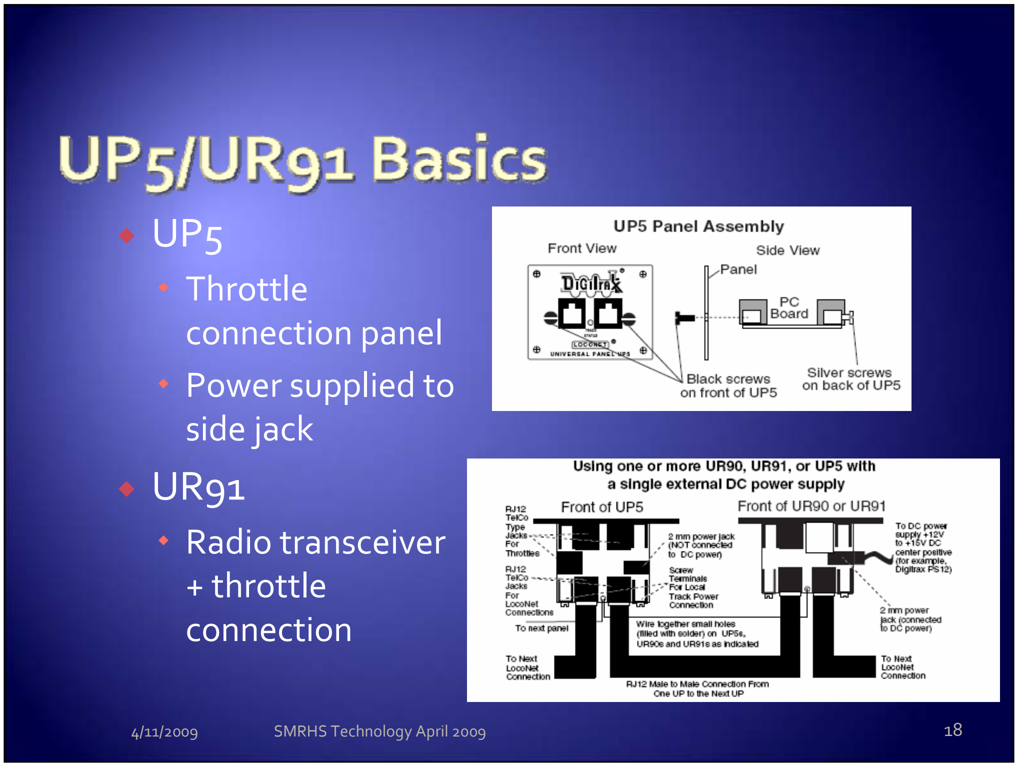
Note that this hardware is a few years old and has been superseded by newer generation hardware that can be mixed into our configuration. More info can be found at this web site maintained by Bruce Chubb:
http://www.jlcenterprises.net/index.htm



This is the DIGITRAX DCC system. http://www.digitrax.com/ is the main web site link – specific manuals that you may want to download for your own reference is the CHIEF manual, the PM42 manual, and information on LocoNet.

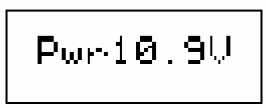
We use 6-conductor satin flat cable and have created two different pathways that run serially around the layout. There are no branches on either pathway.

Need a volunteer to document the voltage levels at each UP5, PM42, booster and UR91 as a baseline. Troubleshooting problems will be greatly improved when we have measurements of the LocoNet during a ‘healthy’ mode.



Layout has two UR91 panels – one by the command station the other by the Sacramento passenger yard. We had a failure in the past where the UR91 shorted out pulling down the LocoNet voltage.

From the DT400 manual:
This screen indicates the power available to the throttle. When you are plugged in to LocoNet, this value will be between 9 & 15 volts. when you insert a battery or unplug from LocoNet, the value displayed will be the battery power available. When this number is less than 6.2 volts it's time to consider replacing or recharging your battery.



The laptop station located by the Desert Yard area is connected to the layout's LocoNet. Utilities are available in the DecoderPro software that support monitoring of the LocoNet traffic, programming of the PM42 boards and the Command Station.

Suggest you spend time looking at the various menu items in DecoderPro.

Need a volunteer to document the PM42 settings and the Command Station op-switch settings. You will use the laptop to view the information.

DCC Track Power Districts

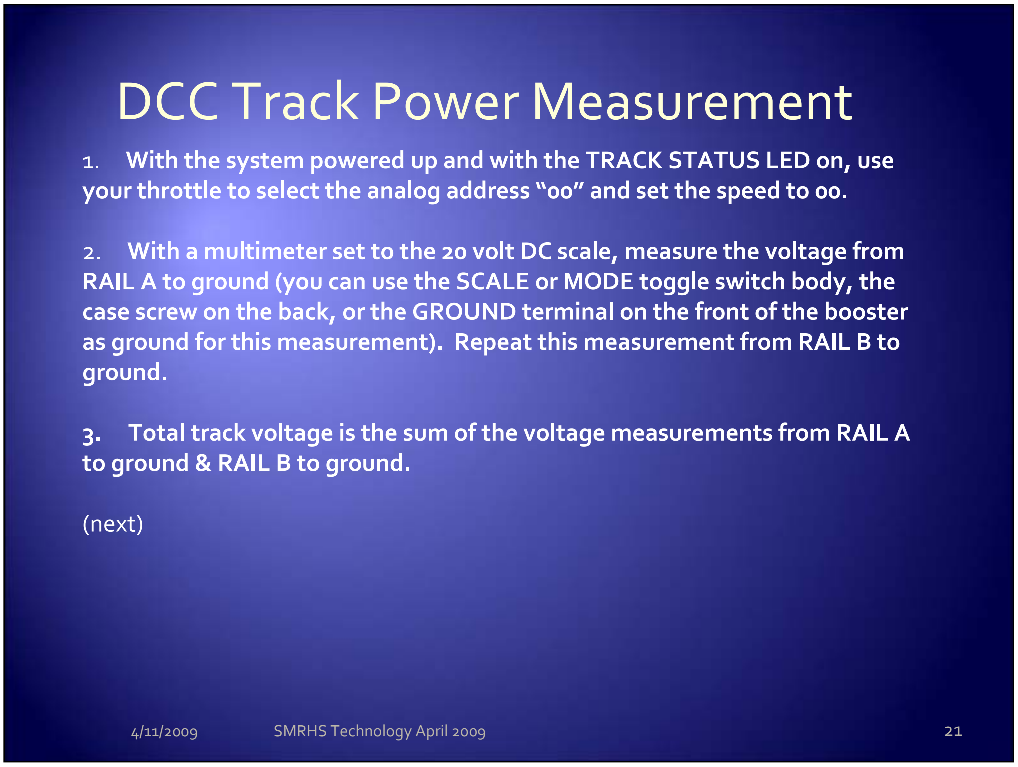
- Power districts are isolated from each other
  - Booster(s) do not cross power districts
  - Booster power supplies do not cross power districts
  - Rails double-gapped to isolate districts
- Phasing between booster districts
  - Rail A should not cross to Rail B between power districts
- Protecting against short circuits-built into booster
  - PM42 used to create sub districts and control auto-reverse where needed

4/11/2009 SMRHS Technology April 2009 20

This can be an important starting point when trouble-shooting layout DCC power problems. Start at the Booster district level and validate rail-gaps.

Note we also have installed incandescent automotive bulbs in parallel with each PM42 output – this provides a sneak-path around the PM42 short circuit protection that supports an initial in-rush of high current track power to allow sound decoders time to boot up in the event of a power restart. The filament acts as a variable resistor – for a brief period of time (fraction of a second) the filament is cold and passes current, then it warms up and presents a higher resistance, halting flow of current through this sneak-path and the PM42 circuits provide the path of least resistance for flow of power to the rails.

If you have a failure on the rails first thing is to check the state of 1) the PM42 and the incandescent bulbs – you may see a pair of bulbs cycling on and off – indicating you have a hard short.



How to Measure Track Voltage on DCC Layouts with Direct Home Wiring

Track voltage on DC (analog) layouts can be measured from rail to rail. With DCC layouts that use direct home wiring as recommended by Digitrax, this method of measurement does not work with most voltmeters.
Track voltage (output from the booster to the rail) on DCC layouts with direct home wiring can be measured as follows:
1. **With the system powered up and with the TRACK STATUS LED on, use your throttle to select the analog address "00" and set the speed to 00.**
2. **With a multimeter set to the 20 volt DC scale, measure the voltage from RAIL A to ground (you can use the SCALE or MODE toggle switch body, the case screw on the back, or the GROUND terminal on the front of the booster as ground for this measurement). Repeat this measurement from RAIL B to ground.**
3. **Total track voltage is the sum of the voltage measurements from RAIL A to ground & RAIL B to ground.**
4. **The difference between the RAIL A & RAIL B voltages should not exceed 0.2 volts. Satisfactory operation will still occur if the difference is as much as 0.5 volts.**
5. **Track voltage can be adjusted by using the trim pot inside the booster located between the LOCONET B port and the SCALE switch. This is useful for balancing the track voltage between power districts.**
6. **If you find that the track voltage on one of your boosters falls outside these ranges, be sure that there are no analog addresses running in the system by using your throttle to select the analog address "00" and setting the speed to 00. Once you have done this, re-measure the voltages. If you find that there is still a problem, contact Digitrax customer support (770) 441-7992 (M-F 9am-5pm eastern time) or e-mail techsupport@digitrax.com**

Track Voltages should be approximately (depending on trim pot adjustments you have made):
SCALE Switch setting
RAIL A to ground voltage
RAIL B to ground voltage
Total track voltage
N
6.2 (+/-0.25v)
6.2 (+/-0.25v)
12.4 (+/-0.5v)
HO
7.5 (+/-0.3v)
7.5 (+/-0.3v)
15.0 (+/-0.6v)
O/G
10.0 (+/-0.5v)
10.0 (+/-0.5v)
20.0 (+/-1.0v)

When the layout is returned to operation we need someone to accept the task of checking each booster district's voltage; document the readings and then we can look at any boosters that we may need to adjust.

DCC Track Power Districts

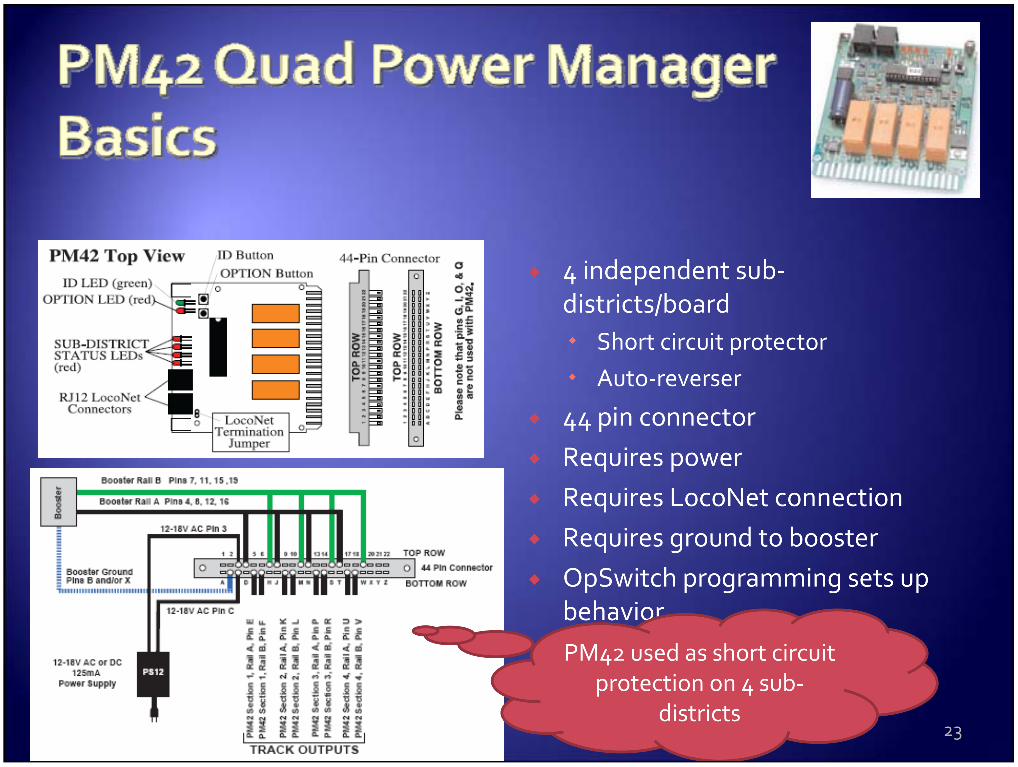
4. The difference between the RAIL A & RAIL B voltages should not exceed 0.2 volts. Satisfactory operation will still occur if the difference is as much as 0.5 volts.

5. Track voltage can be adjusted by using the trim pot inside the booster located between the LOCONET B port and the SCALE switch. This is useful for balancing the track voltage between power districts.

Track Voltages should be approximately (depending on trim pot adjustments you have made) as shown in the table below:

SCALE Switch setting	RAIL A to ground voltage	RAIL B to ground voltage	Total track voltage
N	6.2 (+/-0.25v)	6.2 (+/-0.25v)	12.4 (+/-0.5v)
HO	7.5 (+/-0.3v)	7.5 (+/-0.3v)	15.0 (+/-0.6v)
O/G	10.0 (+/-0.5v)	10.0 (+/-0.5v)	20.0 (+/-1.0v)

Record the Zephyr command station's track voltage.



The PM42 OpSw settings are used to set up the PM42 for setting up the trip current, short circuit management (including sensitivity), and/or auto-reversing. Follow the steps outlined below to set up OpSws according to the **TABLES** contained in the manual.

Connect a DT series throttle (with battery installed) to the LocoNet connector on your powered PM42 to read back and make changes to the PM42's option switches (OpSws).

The factory default setting on all PM42 OpSws is "thrown" or "t". This setting will operate each section of the PM42 as a short circuit manager.

To Change PM42 OpSw settings:

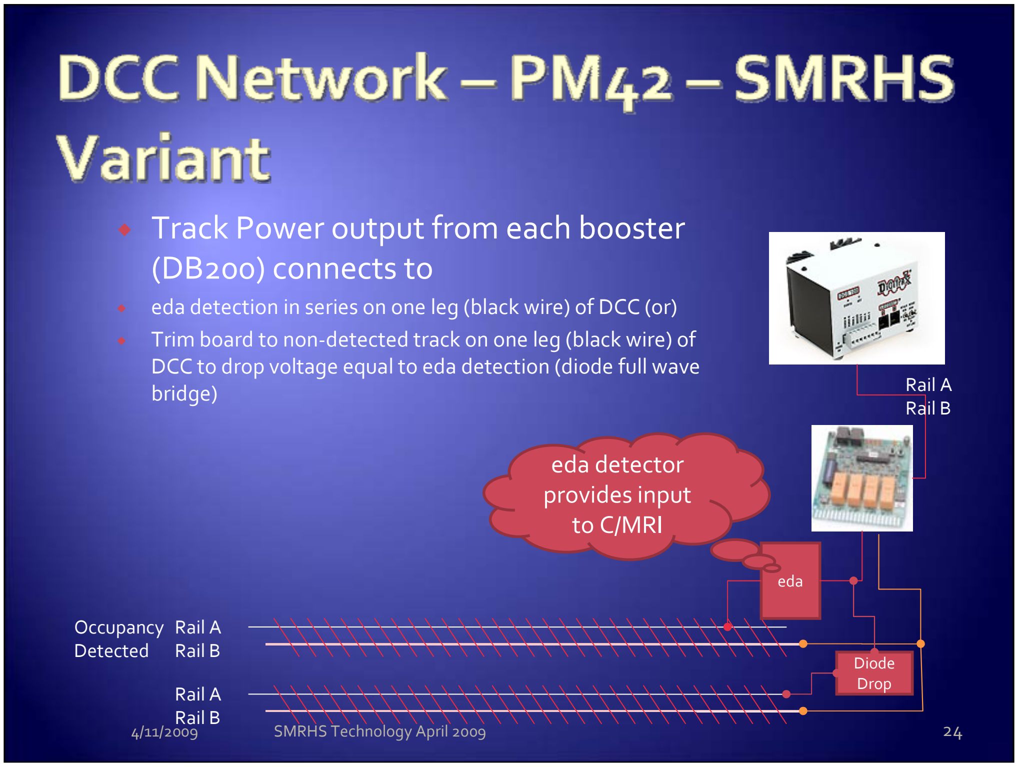
1.Enter option switch mode by pressing the "OPTION" button on the PM42 for about 1 second and then releasing it. The green "ID“ LED and red "OPTION" LED will flash alternately to indicate that you have entered option switch mode.

2. Connect any Digitrax DT series throttle to the PM42's LocoNet connector. Note that because the throttle’s switch control mode is used to change the PM42's OpSw settings, each time you change the PM42's option switch settings you will also send switch commands to the layout any time you are connected to LocoNet and the layout.

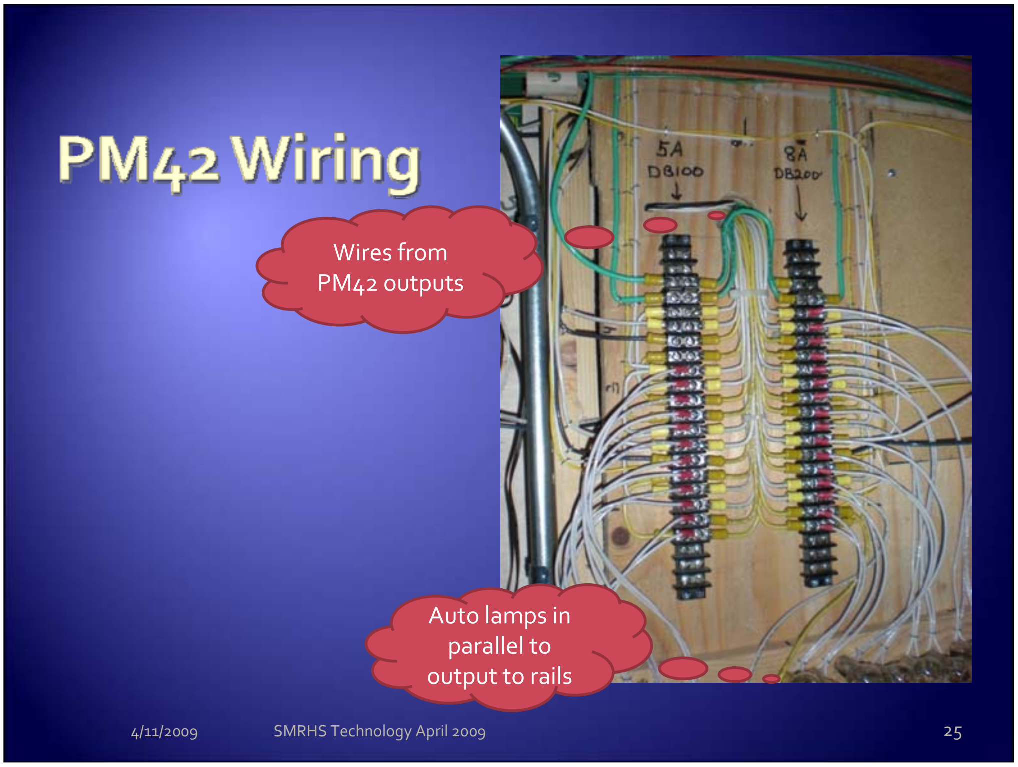
3. If the PM42 is connected to a working LocoNet (via a 6 conductor LocoNet cable), skip to step D since the LocoNet termination jumper is not needed. If the PM42 is not connected to a working LocoNet, move the LocoNet termination jumper so that it is across both pins. The LocoNet termination jumper is, located behind the RJ12 sockets on the PM42 board.

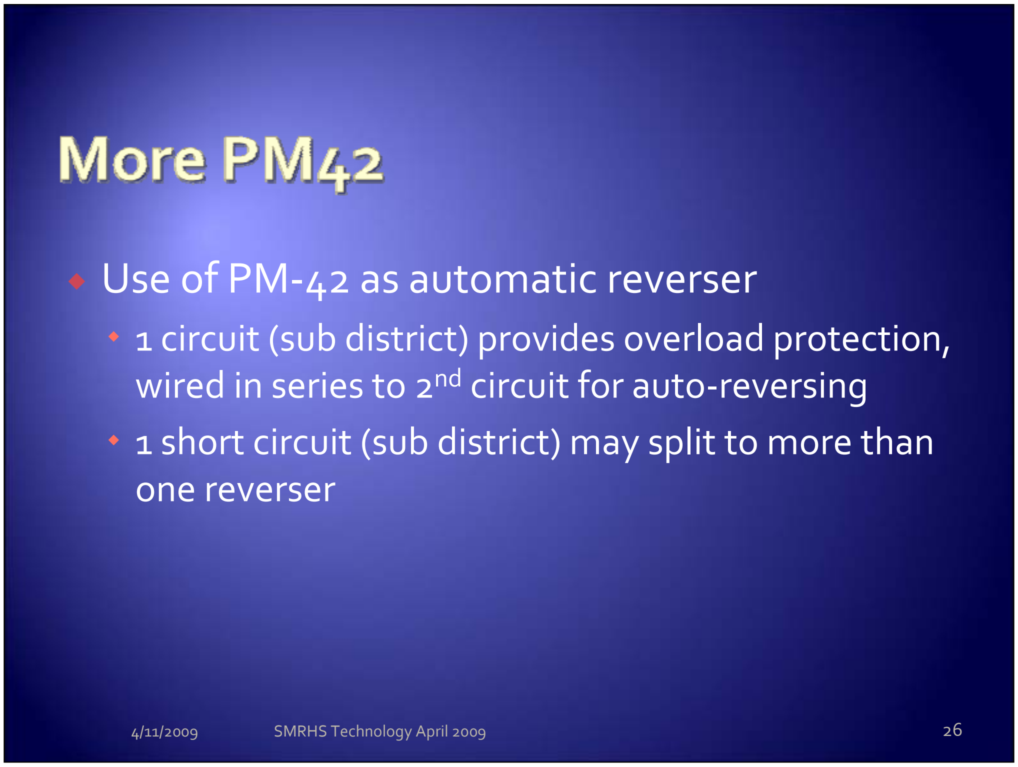
4.. Follow the instructions for the throttle you are using to enter switch control mode on the throttle. Select the switch address that corresponds to the OpSw number you want to change. Press the "c" or "t" button to change the OpSw setting as desired.

5. When OpSw set up is complete, press the PM42’s "OPTION" button and the unit will exit option switch mode. If you moved the LocoNet termination jumper in step C above, return it to its original position (leave it attached to one pin so that you don't lose the jumper).



The "eda" detectors are presenting a 5 volts DC current-limited signal to the C/MRI system inputs.


PM42 Wiring
Wires from PM42 outputs
Auto lamps in parallel to output to rails
5A DB100
8A DB200
4/11/2009
SMRHS Technology April 2009
25

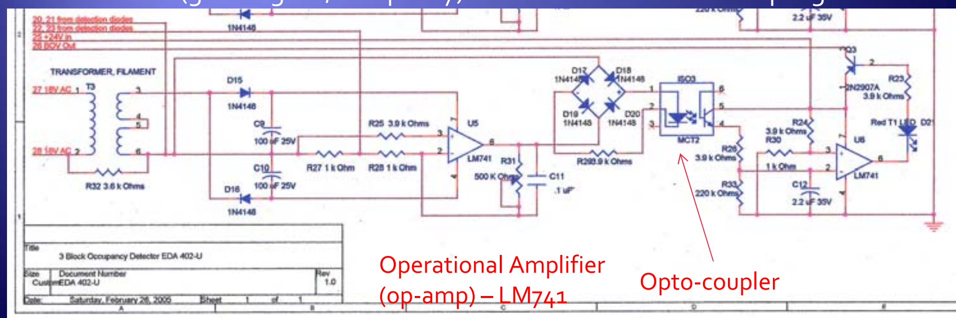


Examples can be found at the PM42 cards located by the command station – both the upper and lower level loops have reversing sections. Go to the layout and identify where these are located.

Important that no train extends in length over both ends of a reversing section.

Hardware – *eda* Detection Cards

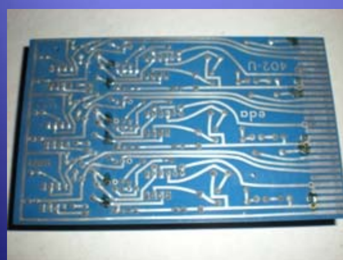
- Handout
- Graphic shows 1 of 3 parallel circuits on each detector card
- BOV Out (goes high w/occupancy) feeds to hex-inverter to flip logic state



4/11/2009 SMRHS Technology April 2009 27

eda detector card

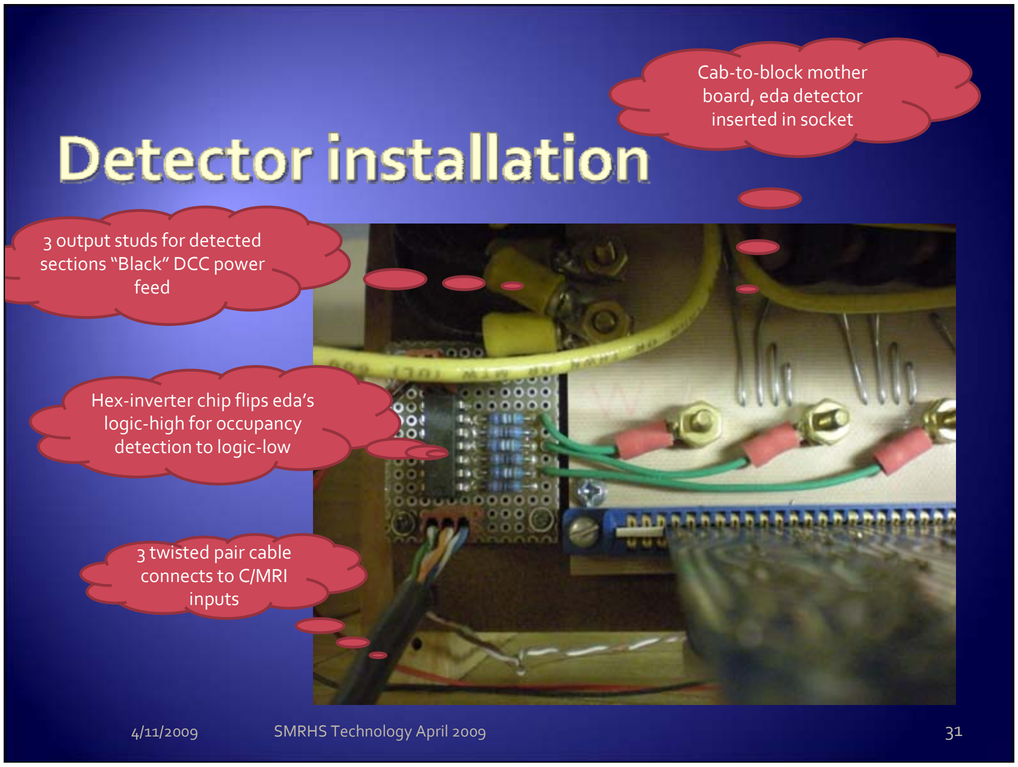
- Top of board, back side has edge connectors



Detector installation

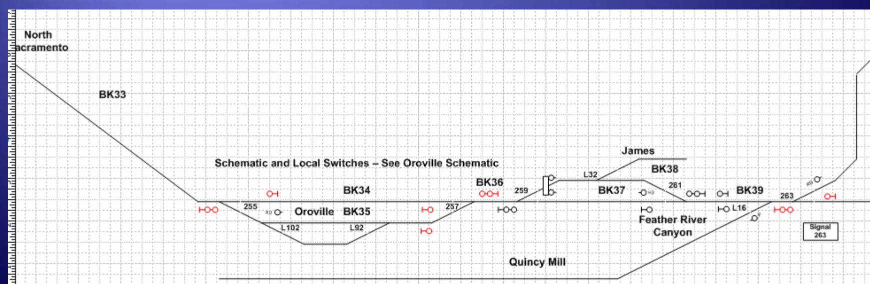
- Each eda detector is connected to a cab-to-block board (CBB); view of back side of two CBB's shown

Encased white relays were intended for integration of the eda progressive cab control (analog throttles); never implemented in the layout.


Detector installation
Cab-to-block mother board, eda detector inserted in socket
3 output studs for detected sections "Black" DCC power feed
Hex-inverter chip flips eda's logic-high for occupancy detection to logic-low
3 twisted pair cable connects to C/MRI inputs
4/11/2009
SMRHS Technology April 2009
31

C/MRI – Steps To Get Started

- Make functional schematic line drawings of track plan
  - Refer to diagram done by Don Butler, displayed in CTC
    - Divide mainline into signal blocks
    - Show signals and switches that will be controlled
    - Show push buttons, panel switches & indicator LED's that will be interfaced

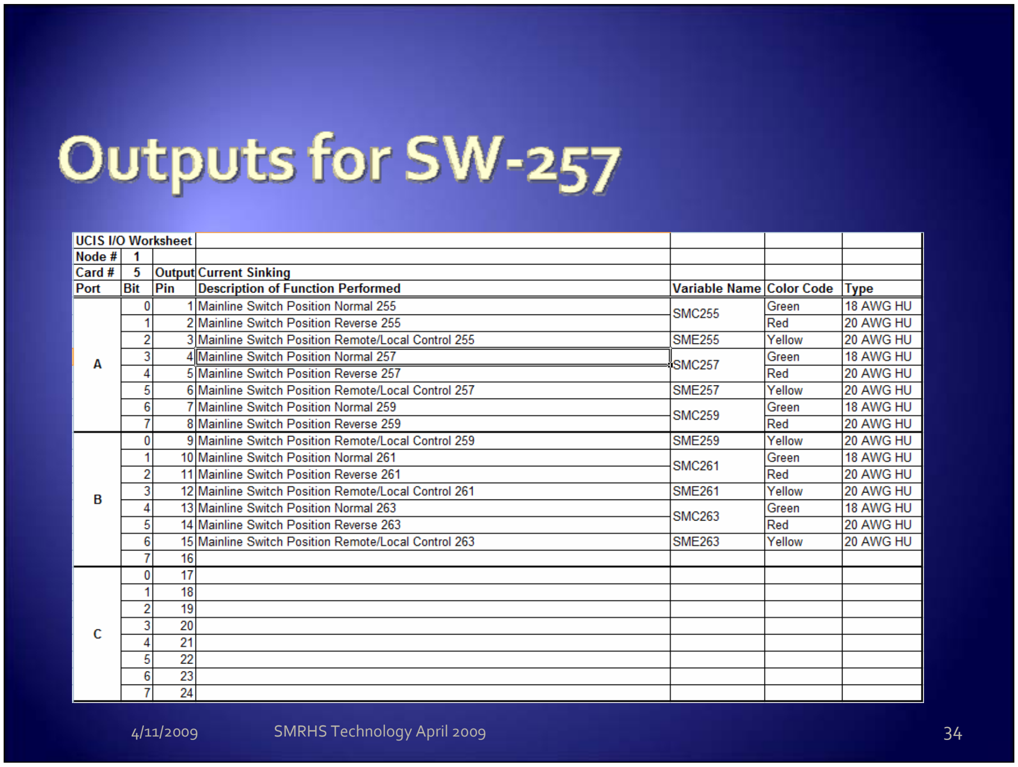


4/11/2009 SMRHS Technology April 2009 32

This is a VISIO-2003 drawing – volunteer needed with access to this software to maintain this document. This is the same drawing you can see in the CTC area above the panels.

CIS I/O Worksheet						
Node #	1					
Card #	9	Output	Current Sourcing			
Port	Bit	Pin	Description of Function Performed	Variable Name	Color Code	Type
A	0	1	Signal 221 West Main Facing point Green LED	SIG221WMF		
	1	2	Signal 221 West Main Facing point Red LED			
	2	3	Signal 221 West Diverging Facing point Green LED	SIG221WDF		
	3	4	Signal 221 West Diverging Facing point Red LED			
	4	5	Signal 221 West Main Trailing point Green LED	SIG221WMT		
	5	6	Signal 221 West Main Trailing point Red LED			
	6	7	Signal 221 West Diverging Trailing point Green LED	SIG221WDT		
	7	8	Signal 221 West Diverging Trailing point Red LED			
B	0	9	Signal 255 West Main Facing point Green LED	SIG255WMF		
	1	10	Signal 255 West Main Facing point Red LED			
	2	11	Signal 255 West Diverging Facing point Green LED	SIG255WDF		
	3	12	Signal 255 West Diverging Facing point Red LED			
	4	13	Signal 255 East Main Trailing point Green LED	SIG255EMT		
	5	14	Signal 255 East Main Trailing point Red LED			
	6	15	Signal 255 East Diverging Trailing point Green LED	SIG255EDT		
	7	16	Signal 255 East Diverging Trailing point Red LED			
C	0	17	Signal 257 West Main Trailing point Green LED	SIG257WMT	Blue	CAT5
	1	18	Signal 257 West Main Trailing point Red LED		Blue/White	CAT5
	2	19	Signal 257 West Diverging Trailing point Green LED	SIG257WDT	Brown	CAT5
	3	20	Signal 257 West Diverging Trailing point Red LED		Brown/White	CAT5
	4	21	Signal 257 East Main Facing point Green LED	SIG257EMF	Green	CAT5
	5	22	Signal 257 East Main Facing point Red LED		Green/White	CAT5
	6	23	Signal 257 East Diverging Facing point Green LED	SIG257EDF	Orange	CAT5
	7	24	Signal 257 East Diverging Facing point Red LED		Orange/White	CAT5

Hunt down switch 257, East Oroville.
Note this is a current-sourcing board used for LED based signals.



UCIS I/O Worksheet						
Node #	1					
Card #	5	Output	Current Sinking			
Port	Bit	Pin	Description of Function Performed	Variable Name	Color Code	Type
A	0	1	Mainline Switch Position Normal 255	SMC255	Green	18 AWG HU
	1	2	Mainline Switch Position Reverse 255		Red	20 AWG HU
	2	3	Mainline Switch Position Remote/Local Control 255	SME255	Yellow	20 AWG HU
	3	4	Mainline Switch Position Normal 257	SMC257	Green	18 AWG HU
	4	5	Mainline Switch Position Reverse 257		Red	20 AWG HU
	5	6	Mainline Switch Position Remote/Local Control 257	SME257	Yellow	20 AWG HU
	6	7	Mainline Switch Position Normal 259	SMC259	Green	18 AWG HU
	7	8	Mainline Switch Position Reverse 259		Red	20 AWG HU
B	0	9	Mainline Switch Position Remote/Local Control 259	SME259	Yellow	20 AWG HU
	1	10	Mainline Switch Position Normal 261	SMC261	Green	18 AWG HU
	2	11	Mainline Switch Position Reverse 261		Red	20 AWG HU
	3	12	Mainline Switch Position Remote/Local Control 261	SME261	Yellow	20 AWG HU
	4	13	Mainline Switch Position Normal 263	SMC263	Green	18 AWG HU
	5	14	Mainline Switch Position Reverse 263		Red	20 AWG HU
	6	15	Mainline Switch Position Remote/Local Control 263	SME263	Yellow	20 AWG HU
	7	16				
C	0	17				
	1	18				
	2	19				
	3	20				
	4	21				
	5	22				
	6	23				
	7	24				

Hunt down switch 257, East Oroville

Notice this card is current-sinking

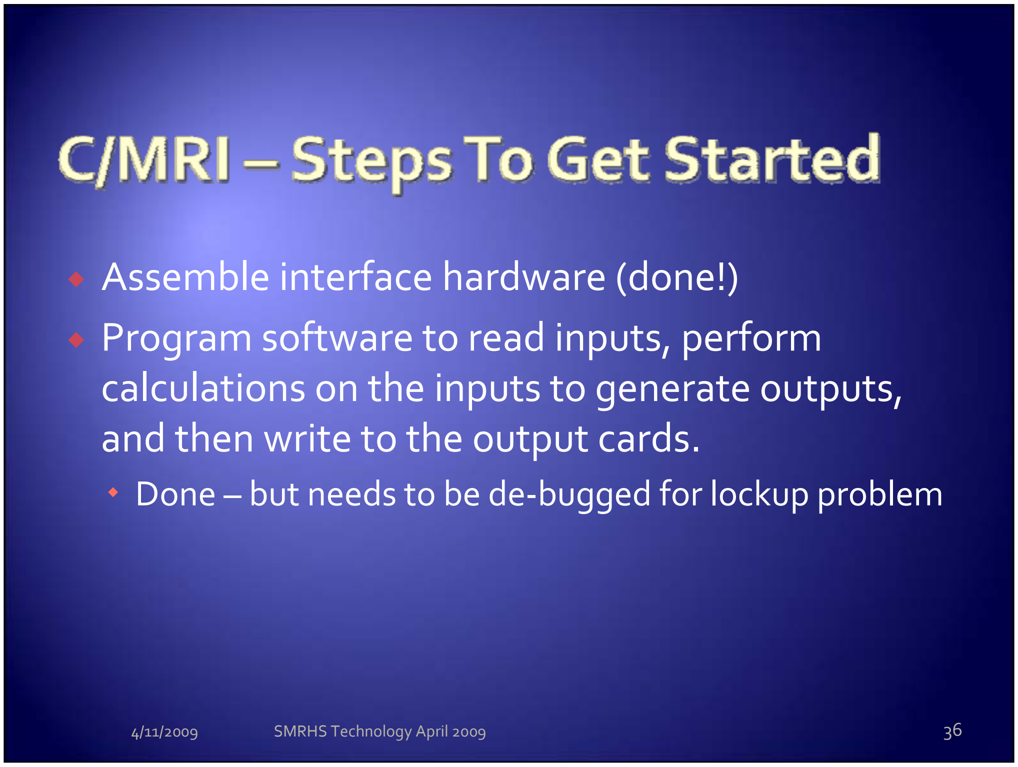
Block Detection Inputs

UCIS I/O Worksheet						
Node #	1					
Card #	1	Input				
Port	Bit	Pin	Description of Function Performed	Variable Name	Color Code	Type
A	0	1	Oroville Main West (BK35)	BKW(35)	White/Brown	CAT5
	1	2	Oroville Main East (BK35)	BKE(35)	Brown/White	CAT5
	2	3	Spur Switch Occupancy L92 (BK36)	BKA(36)		
	3	4	Oroville Siding East (BK36)	BKE(36)	Green/White	CAT5
	4	5	Oroville Siding Body (BK36)	BKB(36)	White/Blue	CAT5
	5	6	Oroville Siding West (Spur Switch Occupancy L102) (BK36)	BKW(36)	Blue/White	CAT5
	6	7				
	7	8				
B	0	9	East Oroville/James West (Mainline Switch Occupancy 249) (BK37)	BKW(37)	Black/Blue	Telco cable
	1	10	East Oroville/James Body (BK37)	BKB(37)	Blue/Black	Telco cable
	2	11	East Oroville/James East (Mainline Switch Occupancy 251) (BK37)	BKE(37)	White/Green	Telco cable
	3	12	James Main West (BK38)	BKW(38)	Blue/Red	Telco cable
	4	13	James Main East (BK38)	BKE(38)	Red/Blue	Telco cable
	5	14	James Siding West (BK39)	BKW(39)	Slate/Red	Telco cable
	6	15	James Siding Body (Spur Switch Occupancy L32) (BK39)	BKB(39)	Orange/Red	Telco cable
	7	16	James Siding East (BK39)	BKE(39)	Red/Orange	Telco cable
C	0	17	Spur Switch Occupancy L16 (BK40)	BKA(40)		
	1	18	Feather River West (Mainline Switch Occupancy 261) (BK40)	BKW(40)	White/Orange	CAT5
	2	19	Feather River Body (BK40)	BKB(40)	Orange/White	CAT5
	3	20	Feather River East (Mainline Switch Occupancy 263) (BK40)	BKE(40)	White/Green	CAT5
	4	21				
	5	22				
	6	23				
	7	24				

4/11/2009 SMRHS Technology April 2009 35

Hunt down switch 257 on the track diagram, East Oroville, and look for blocks immediately east and west.

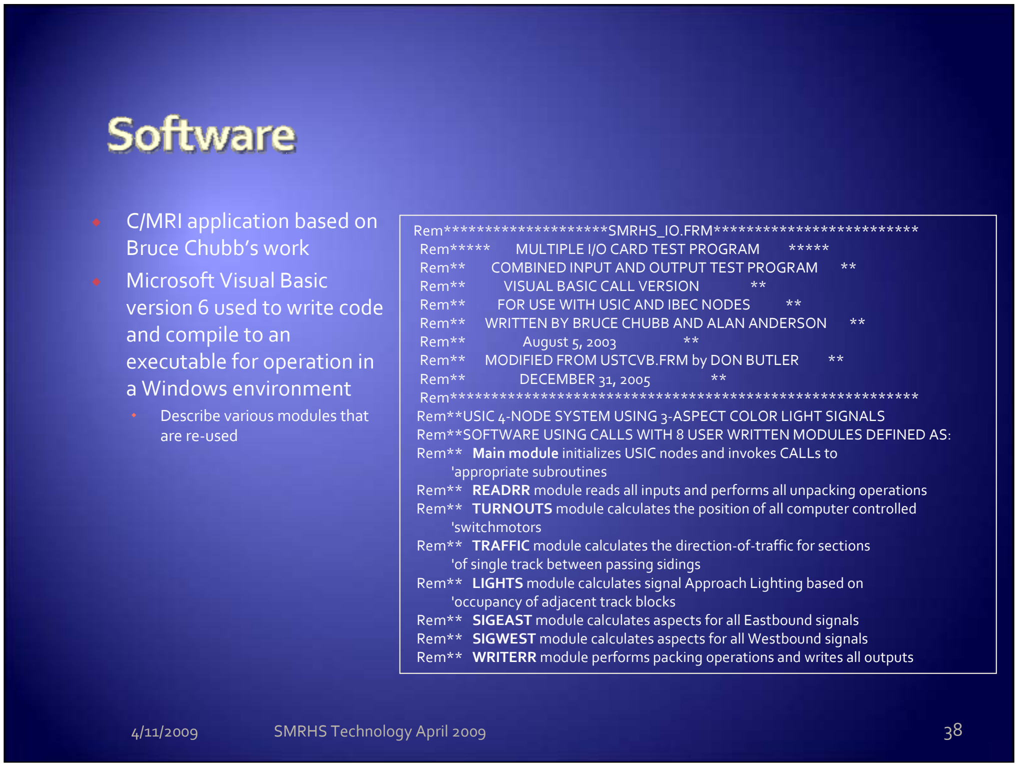
This is an input board.


C/MRI – Steps To Get Started
Assemble interface hardware (done!)
Program software to read inputs, perform calculations on the inputs to generate outputs, and then write to the output cards.
Done – but needs to be de-bugged for lockup problem
4/11/2009
SMRHS Technology April 2009
36

C/MRI – Steps To Get Started

- Connect devices to i/o cards
  - Done, more to be added as we expand detection and signaling
- Test and debug
  - We have some work to do here!
- Operate your railroad!
- Dream up new applications
  - Replace Oakland Desert Yard discrete IC panels w/C/MRI
  - Control layout lighting

4/11/2009 SMRHS Technology April 2009 37


Software
C/MRI application based on Bruce Chubb's work
Microsoft Visual Basic version 6 used to write code and compile to an executable for operation in a Windows environment
Describe various modules that are re-used
Rem*******************SMRHS_IO.FRM************************
Rem*****   MULTIPLE I/O CARD TEST PROGRAM   *****
Rem**   COMBINED INPUT AND OUTPUT TEST PROGRAM   **
Rem**   VISUAL BASIC CALL VERSION   **
Rem**   FOR USE WITH USIC AND IBEC NODES   **
Rem**   WRITTEN BY BRUCE CHUBB AND ALAN ANDERSON   **
Rem**   August 5, 2003   **
Rem**   MODIFIED FROM USTCVB.FRM by DON BUTLER   **
Rem**   DECEMBER 31, 2005   **
Rem**
Rem**USIC 4-NODE SYSTEM USING 3-ASPECT COLOR LIGHT SIGNALS
Rem**SOFTWARE USING CALLS WITH 8 USER WRITTEN MODULES DEFINED AS:
Rem**   Main module initializes USIC nodes and invokes CALLs to
'appropriate subroutines
Rem**   READRR module reads all inputs and performs all unpacking operations
Rem**   TURNOUTS module calculates the position of all computer controlled
'switchmotors
Rem**   TRAFFIC module calculates the direction-of-traffic for sections
'of single track between passing sidings
Rem**   LIGHTS module calculates signal Approach Lighting based on
'occupancy of adjacent track blocks
Rem**   SIGEAST module calculates aspects for all Eastbound signals
Rem**   SIGWEST module calculates aspects for all Westbound signals
Rem**   WRITERR module performs packing operations and writes all outputs
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SMRHS Technology April 2009
38

Course Objectives-Check Point

- Upon completion you should be able to :
  - Explain the basic safety rules
  - Identify the three networks and their main components
  - Explain how the "eda" detection circuits work and where they connect to the C/MRI system
  - Explain how the DCC system connects to throttles, DecoderPro and to the rails
  - Identify the basic building blocks of the C/MRI software application

4/11/2009 SMRHS Technology April 2009 39

By identifying each day's objectives we hope to stay focused – and we should close the day out by returning to this screen to discuss these points.

Next Class … April 25th

- C/MRI
  - Mapping of inputs/outputs
  - Connection of inputs/outputs
  - Review the coding for the application
    - Program Variables – review the definitions
    - Program flow
      - If-Then
      - If-Then-Else
      - Go To, Go Sub
    - Binary number system
      - Packing/Unpacking Bytes
  - Review how detection is installed
    - OS, body block, intermediate block

4/11/2009 SMRHS Technology April 2009 40