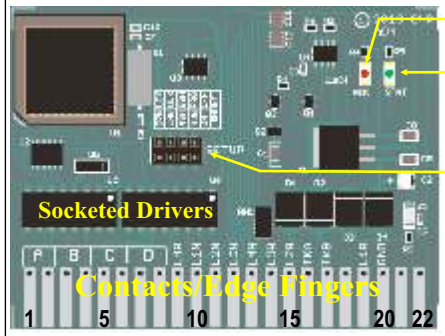
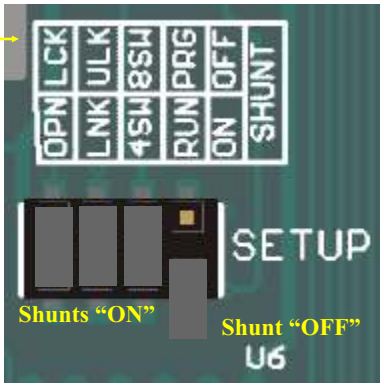
AD4 Familiarization



LED Indicators show the status of the decoder. The green STAT indicator glows green whenever valid DCC packets are being received. The red ACK indicator turns on to indicate a valid programming action has occurred.

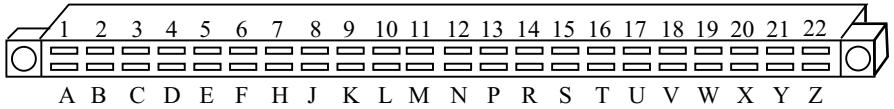
Setup Shunts are a group of 4 small plugs used to select different decoder options. A small plug is placed ON the posts to join them together or it is removed, leaving the posts open. Next to each post is an abbreviated description of what the plug does if it is ON the posts or OFF the posts.

Optional 22/44 pin Edge Connector



Socketed Output Drivers are what power the switch machine motor. The chip is in a socket for easy removal if it must be replaced.

Contacts and Edge Fingers can have wires soldered directly to them. But, all AD4 programming must be complete before soldering wires directly to the AD4. A much better method is to use the matching 22 pin edge card connector. The edge connector offers a convenient point for all wire connections without having to solder wires to the AD4 decoder. All soldering is done to it leaving the AD4 untouched.



Although a 44 pin connector is shown, only the top pins are used, numbered from 1 to 22. All soldering should be done to just the top row of pins.

Pin	Function	Pin	Function
1	A Output, Normal	12	C Local Input, Normal
2	A Output, Reverse	13	D Local Input, Normal
3	B Output, Normal	14	C Local Input, Reverse
4	B Output, Reverse	15	B Local Input, Reverse
5	C Output, Normal	16	Track Input
6	C Output, Reverse	17	Track Input
7	D Output, Normal	18	not used
8	D Output, Reverse	19	A Local Input, Reverse
9	D Local Input, Reverse	20	Ground
10	A Local Input, Normal	21	not used
11	B Local Input, Normal	22	not used

AD4 Accessory Decoder User Guide

AD4 Configuration Variable (CV) Summary

CV Number	*Alternate CV Number	Factory Value	Function	Factory Value Meaning
513	1	1	Decoder Card Number LSB	LSB = 1 = Card 01
514	2	85	Local Input Control	All inputs active
515	3	2	A Output On-Time	0.2 second pulse
516	4	2	B Output On-Time	0.2 second pulse
517	5	2	C Output On-Time	0.2 second pulse
518	6	2	D Output On-Time	0.2 second pulse
519	7	n	Software version number	n=version number
520	8	135	Manufacturer's ID number	CVP ID number
521	9	0	Decoder Card Number MSB	MSB = 0

* For DCC systems that can't program CV numbers above 255 use the alternate CV number

AD4 Setup Shunt Explanation

Shunt #1: RUN - PRG ["ON" = Run; "OFF" = Program] - Remove this shunt when programming the decoder with the programming track. Don't forget to put the shunt back across the posts when programming is completed. If not removed, the command station may not be able to detect that the AD4 decoder is a "Type-3."

Shunt #2: 4SW - 8SW ["ON" = 4; "OFF" = 8 Pushbuttons] Sets the decoder to use either one local input button to control a turnout or two separate buttons. If across the posts, one push button toggles the turnout. If off the posts, two buttons can be used for throwing normal or reverse. **CV514 must be set to 255 when 8 buttons are used.**

Shunt #3: LNK - UNL ["ON" = Linked; "OFF" = Unlinked Output Pairs] Allows each half of and AD4 output to be linked (SHUNT = ON) for use with switch machines or unlinked to create two individual and separately controlled outputs. When unlinked, the AD4 provides 8 on/off outputs.

Shunt #4: OPN - LCK ["ON" = Unlocked; "OFF" = Locked] To prevent further programming of the AD4 decoder, remove this shunt. When removed, the AD4 is locked against any programming including SERVICE and MAINLINE OPS programming.

EASYDCC™

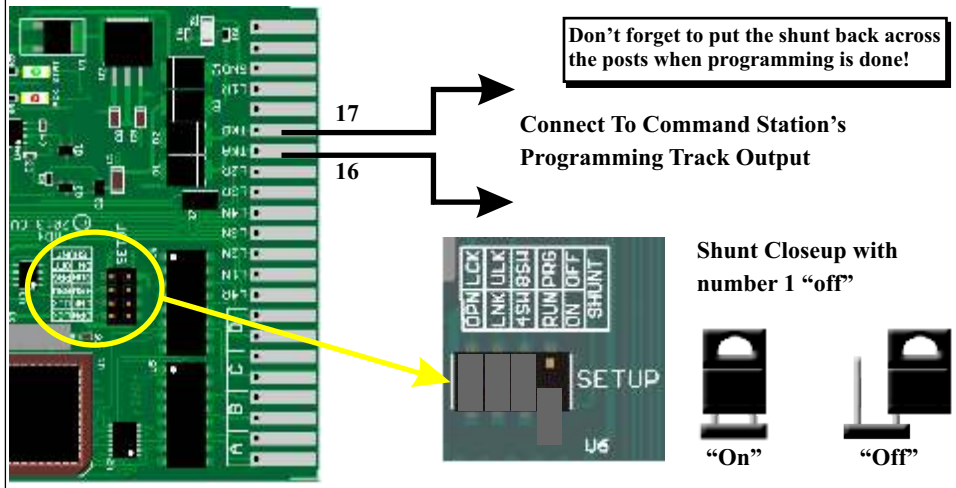
Programming The AD4

Before using the AD4, it needs to be programmed. This is done using your Command Station's programming track outputs. It is programmed just like a locomotive decoder although it uses different configuration variables (CV) than a locomotive decoder.

1. Remove the number 1 shunt [RUN/PRG] from across the posts. With the shunt removed, power is disconnected from the output drivers. This is required anytime the AD4 is programmed from the programming track. Don't forget to put the shunt back across the posts when programming is completed. If you forget to remove the shunt, the command station may not be able to detect that the decoder is a "Type-3" and you will have to enter the type manually.

Shunt Removed

2. Hookup AD4 to the programming track. Temporarily connect the AD4's two pins labeled TKA and TKB to the programming track or programming output of your Command Station. Light duty wire is fine.



Programming The AD4 Card Number (Address)

CV513 - AD4 Decoder Card Number And Output Addresses Explanation

The AD4 "card number" and accessory decoder "address" range are distinct and separate from locomotive addresses. There are a total of 511 unique AD4 "card numbers" with each number having four sequential "addresses." The card number is programmed into CV #513.

Address 00 is not a valid address

For easier remembering, think of the decoder ***card number*** as the number assigned to the specific AD4 circuit board or card. Then, each of the decoder's 4 outputs will automatically have the appropriate 4 address numbers associated with that number. For example, as delivered from the factory, the AD4 is set for card #1 with the first address on the A output being 1 and the last address on the D outputs being 4. For a card programmed as #2, its first address is 5 and its last address is 8. The table below shows the first 5 decoder numbers and their sequential addresses for their A thru D outputs.

The asterisk on card 1 is the original factory setting and can be restored by issuing a reset programming command to the AD4.

Card Number	A Output Address	B Output Address	C Output Address	D Output Address
1*	1	2	3	4
2	5	6	7	8
3	9	10	11	12
4	13	14	15	16
5	17	18	19	20 etc

Unlinking Output Pairs - Creating 8 Outputs

Each AD4 output, A-D, is actually a pair of linked outputs. For a switch machine, it takes one pair of outputs to control it. Thus, the AD4 can control 4 turnouts. However, if the AD4 is controlling devices such as lamps, relays or LEDs, that simply turn on and off, the 4 output pairs can be unlinked and 8 separate items can be turned on or off by a remote throttle or a local push button. Unlinking the output pairs is done with shunt #3.

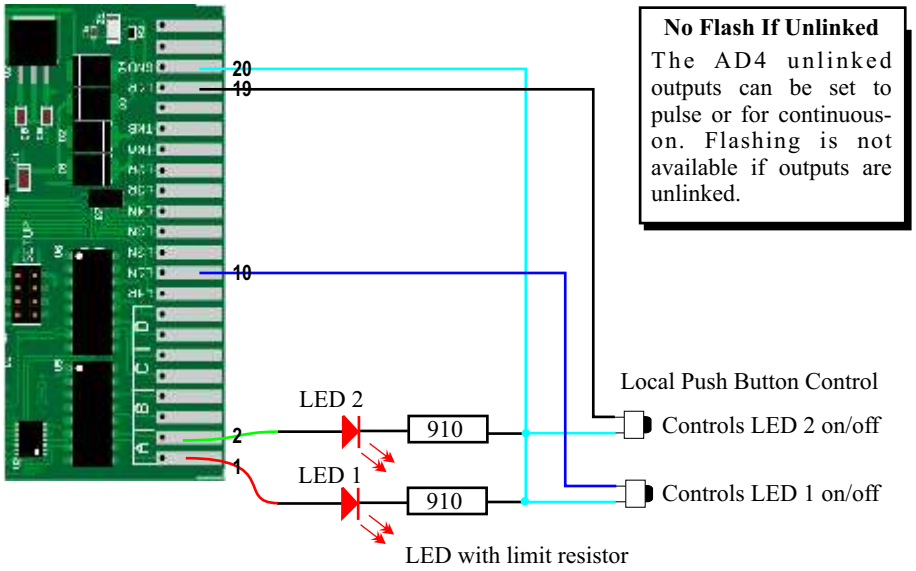
Shunt #3 "OFF" For Unlinking Output Pairs. When unlinked, each individual output only responds to its associated local input or the appropriate ON/OFF button on the remote throttle. When unlinked, the "on-time" CV for an output applies to each half of the pair.

When 8 individual outputs are used, connect the load between the Output and the GND pin of the edge connector. The illustration shows the wiring of the unlinked A output is connected to two indicator LEDs.

The table below shows the relationship between the AD4's outputs, the remote throttle's activation and the local control inputs.

Connector Pin	Output	Controlled By Local Input	Connector Pin	Remote Throttle Control
1	A, Normal	L1N	10	#, N-ON
2	A, Reverse	L1R	19	#, R-OFF
3	B, Normal	L2N	11	#, N-ON
4	B, Reverse	L2R	15	#, R-OFF
5	C, Normal	L3N	12	#, N-ON
6	C, Reverse	L3R	14	#, R-OFF
7	D, Normal	L4N	13	#, N-ON
8	D, Reverse	L4R	9	#, R-OFF

= Accessory Address followed by either N-ON or R-OFF



No Flash If Unlinked

The AD4 unlinked outputs can be set to pulse or for continuous-on. Flashing is not available if outputs are unlinked.

Enabling And Disabling Local Inputs

As received from the factory, the AD4's local inputs are all enabled. If you don't use local inputs, or if you wish to enable or disable some of the local inputs, CV514 is used to setup how the local inputs are used.

The value programmed into CV514, selectively enables or disables the local inputs. When disabled, the local inputs can't control the AD4. The original factory value setting for CV514 is 85. The value of 85 enables all local inputs. The table below shows other values for CV514 and the local inputs the value controls.

CV 514 Value	Result or Action
85	*Unlock or Enable All local inputs
0	Lock or Disable All Local Inputs
1	Unlock only local input for A
4	Unlock only local input for B
16	Unlock only local input for C
64	Unlock only local input for D
255	Enable two pushbuttons per turnout
* Original Factory Setting or after a reset	

Resetting The Decoder

There may come a time when the decoder has been accidentally, or on purpose, programmed but no longer works. If this happens, the best thing to do is to reset the decoder back to the original factory settings. The table shows the original factory settings for each of the AD4 CV configuration variables (CV). This is a two step process. Be sure to follow the instructions.

Step 1: Connect AD4 to the programming track. Remove shunt #1. Use SERVICE programming to set CV520 or its alternate, CV #8, to a value of 0.

Step 2: Disconnect the AD4 decoder from the programming track. Place shunt #1 back on the AD4 decoder. Reconnect booster power and turn it on. Watch the AD4's two LED indicators. The moment that booster power is turned on, the red ACK flashes once, followed by the steady green STAT indicator. If you do not see the red ACK flash, repeat step 1 and step 2.

This two step process guarantees the decoder can finish the task of writing all of the CVs with their original factory values.

CV Number	Factory Reset Value	Function	Factory Value Meaning
513	1	Decoder Card Number LSB	Card 01: Addresses 1-4
514	85	Local Input Control	All inputs active
515	2	A Output On-Time	0.2 second pulse
516	2	B Output On-Time	0.2 second pulse
517	2	C Output On-Time	0.2 second pulse
518	2	D Output On-Time	0.2 second pulse
519	Read Only - Unchanged		
520			
521	0	Decoder Card Number MSB	MSB = 0

Programming The AD4 Card Number (Address) *continued*

For AD4 card numbers between 1 and 63: With the AD4 connected to the programming track, the #1 shunt removed, and the desired card number determined, you are ready to program. In this example, an EasyDCC Command Station is used. This procedure is also shown on page 107 of your orange user guide. For other systems, consult the appropriate user manual.

CV Number 513 will be programmed with the desired number between 1 and 63 which for this example will be card number 2. By programming a card number of 2 int CV513, the AD4 automatically assigns addresses 1 through 4 to the 4 outputs, A through D.

The symbol ❍ means to push and release the Command Station's key. The displayed messages will be shown and explained at each step.

❍**SVC PRGM,** if the first message is not as shown then press the 3 key to advance to the first message at the left.

Program Track
Program What?

❍**CV,** *the 3 key*

Program Track
Config Var#___?

❍**5,** ❍**1,** ❍**3,**

Program Track
Config Var#513_?

❍**ENT**

Program Track
Config Var#513_?

This method of programming writes the desired card number directly to the CV.

Config Var 0513:
1=Rite,2=Verify?

❍**1** for (w)rite

CV 0513 Write:
1=Valu or 2=Bit?

❍**1** for valu(e)

CV 0513 Write:
Valu ___?

❍**2** the new card number - remember the limit - no higher than 63 in CV513!

CV 0513 Write:
Valu 2__?

CV#0513 Write OK
Config Var#____?

❍**ENT** to send the new card number to the AD4. The STAT indicator will flash when the decoder is programmed. When the "write OK message appears, you can select another CV to program or push ESC to return to the home page.

❍**ESC** to return to the home page

Note: For card numbers above 63, it is easier to use a built-in Command Station program macro that simplifies the loading of the two CVs that make up a long address and all you need to give it is the desired output address for one of the 4 outputs. The Command Station will convert the desired output address to a card number and program the AD4 with the appropriate card number. which then sets all 4 output addresses with the desired one . See page 108 in the EasyDCC Command Station's user guide for the step-by-step instructions.

Don't forget to put the shunt back across the posts when programming is done!

Each card number has 4 output addresses that are automatically generated when the number is programmed into the AD4. CV513 allows card numbers from 1 to 63. This provides output addresses from 1 to 252. Rarely will card numbers hight than 63 be needed.

Programming The AD4 Outputs For Tortoise Machines

Programming Outputs For Tortoise Machines

As received from the factory, the AD4 outputs are all set to momentarily turn on the output for about 0.2 seconds and then turn off. This is called a momentary "pulse." The "on-time" for the pulse may be changed by programming the AD4. The tortoise machine requires the output to be on continuously instead of a pulse. Thus the "on-time" needs to be set to a value of 0 which is done by programming the on-time CVs associated with each of the 4 AD4 outputs.

There are 4 "on-time" CVs: CV# 515 through CV#518, one for each of the 4 outputs. A value of 0 needs to be programmed into these 4 CVs in order for the AD4 to drive Tortoise Machines. Once again, the programming track will be used for programming these CVs. The table below summarizes the CVs, their original factory setting and the CV value needed for Tortoise machines.

CV#	Purpose	Factory Value	New Value For Tortoise Machine
515	A Output On-Time	2 Pulse @ 0.2s	0 Continuous-on
516	B Output On-Time	2 Pulse @ 0.2s	0 Continuous-on
517	C Output On-Time	2 Pulse @ 0.2s	0 Continuous-on
518	D Output On-Time	2 Pulse @ 0.2s	0 Continuous-on

Step by Step Programming With Command Station

With the AD4 connected to the programming track, and the #1 shunt removed, your are ready to program the AD4 to use Tortoise switch machines. The step-by-step instructions below cover the entire sequence for the first "on-time" of CV# 515. But rather than escape and do it all over again for the remaining 3 CVs, a short cut shows how to sequentially program the remaining CVs.

- ❍**SVC PRGM,**
- ❍**CV,** *the 3 key*
- ❍**5,** ❍**1,** ❍**5,** *"On-Time" for A Output*
- ❍**ENT**
- ❍**1** for (w)rite
- ❍**1** for valu(e)
- ❍**0** sets the output for continuos on for Tortoise machines
- ❍**ENT** to set CV 515 to a value of 0. When the "write OK message appears, the second line shows it is waiting for another CV. Enter in the next CV, 516, and repeat the same sequence which is the meaning of the arrow. Just enter in the new number and repeat the same key sequence.

Once all 4 CVs are set to 0, push ESC to return to the home page.

❍**ESC**

With the card number set and the outputs set for Tortoise machines, the AD4 should be checked before permanently mounting it on the layout.

Other Settings For AD4 Output CV# 515-518

PULSED ON-OFF with specified duration: Kato and LGB snap action turnout motors use a pulse to throw the switch. The pulse is on for the duration value set into the CV. Pulse duration ranges from 0.1s with CV value of 1 to 12.7s with a CV value of 127.

ALTERNATING FLASH at varying rates: A grade crossing flasher is a good example of where this setting is used. When activated, the two outputs will alternately flash (sometimes called flip-flop) with the flash rate set by the the CV value. A value of 138 is about a 1 second rate. Use N-ON to activate. When the R-OFF command is invoked, both outputs turn off.

Each AD4 output is unique and can have a different "on-time" setting. Pulse, flash and continuous-on can mixed.

Local Input Control - Using External Push Buttons

In addition to remote control via a throttle or the Command Station, the AD4 also allows the use of push buttons to control the turnouts or other devices. The push buttons cannot be mounted too far away from the AD4, hence the name local inputs. Limit the wiring distance to no more than 10 feet.

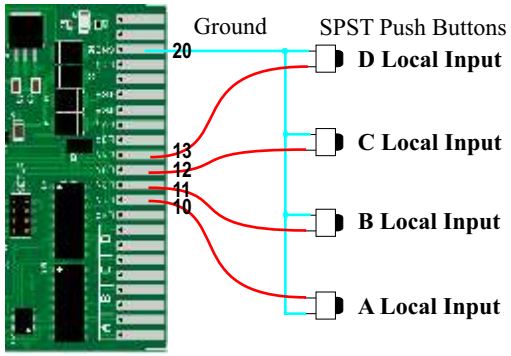
The AD4 can be setup to use a single push-button, two push-buttons or a center-off toggle switch. Shunt #2 is used to set the type of local input control is used.

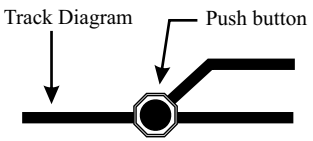
Shunt #2 "ON" For Using One Push Button Per Turnout. With shunt #2 "ON" or across the two posts, a single push button is used to throw the turnout normal or reverse. Push the button to throw the turnout from normal to reverse. Push the button again to throw the turnout back to normal. Use a normally open, SPST push button. All buttons connect to the appropriate "Local Input Normal" pin on the connector.

Hooking up the push button is easy. For example, for Output A, the button connects to Local Input A, normal. The button connects to the appropriate Local Input for the desired turnout. If all 4 turnouts will be controlled buttons, the common ground wire can be shared by all buttons. The drawing shows the hookup of all 4 buttons.

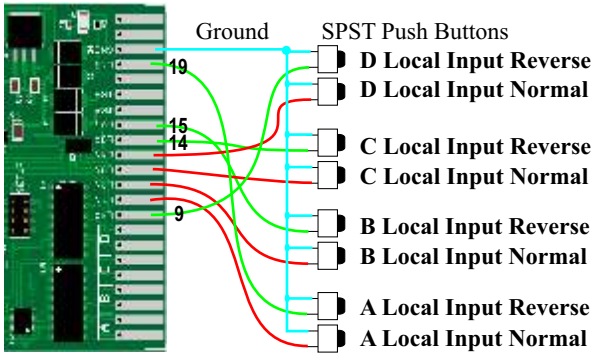
Shunt #2 "OFF" To Use a Pair Of Push Buttons Per Turnout. Two pushbuttons are needed for each turnout, one labeled normal, and the other labeled reverse. The NORMAL pushbutton will always throw the turnout to its NORMAL position, independent of its current position. Turnout control panels typically mount the NORMAL pushbutton in alignment with the main line and the REVERSE pushbutton in alignment with the diverging route as shown in the panel picture.

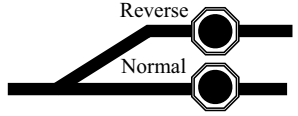
CV514 must be set to 255 when 4-pairs (8) buttons are used.



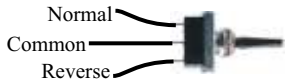


Typical track diagram and control panel arrangement for single push button

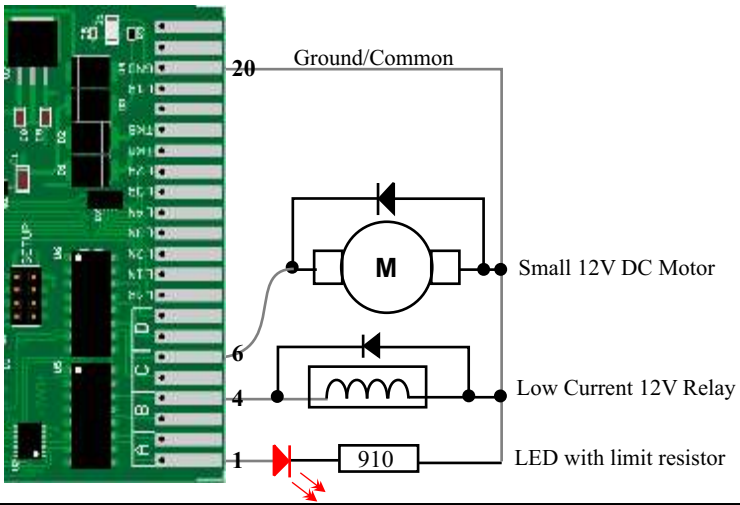




Typical track diagram and control panel arrangement for dual push buttons. A SPDT center-off toggle switch can replace two push buttons. It must be center-off.



Hooking Up Lamps, Relays and Other Devices - *continued*



Calculating An LED Limit Resistor

Most LEDs are plenty bright with 15mA of current. A resistor is required to limit the current to this value. If the resistor is not used, the LED will burn out. Use your calculator to determine the appropriate resistance using the equation below.

R (ohms) = Booster Voltage minus 1Volt divided by 0.015Amp

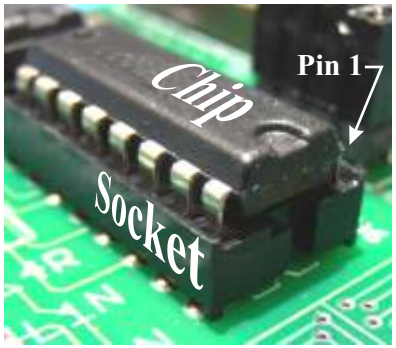
For a typical HO track booster, the typical output voltage is about 14 volts. Yours might be a bit higher or lower. When you divide 13V by 0.015, the resistance is 866 ohms. Using the table below, the nearest value is 910 ohms. Lower values equal brighter and higher values equal dimmer LEDs.

Standard 5% Resistor Values (1st 3 numbers)											
100	110	120	130	150	160	180	200	220	240	270	300
330	360	390	430	470	510	560	620	680	750	810	910

Replacing Output Drivers

In the unlikely event that you damage an output driver, it can be easily replaced. The output driver chips are in sockets and can be removed by slipping a small flat blade screwdriver between the chip and the socket. *Do not accidentally place the screwdriver between the socket and the board or you will permanently damage the board.*

Orientation is important. Pin 1 is shown and is marked with a dimple or notch on one end of the chip. Contact CVP Products for replacement chips.



Programming The AD4 Outputs For Other Devices

Other types of devices can be driven by the AD4. These include lamps, relays, solenoids and twin-coil machines. The different devices are easily sorted into those that are simply turned on or off and those that are only momentarily activated and then turned off. The table shows the type of AD4 output drive associated with common devices found on a layout.

Device	AD4 Output Type	CV# 515-518 Value
LEDs, Lamps, Bulbs	Continuously On	0
Relays	Continuously On	0
Flashing LED	Flash	128 to 255
Solenoids	Pulse	1 to 127
Twin-coils Switch Machines	Pulse	1 to 127

Programming Outputs To Pulse On For A Specific Time

The output's pulse "on-time" value ranges from a minimum of 1/10th of a second to a maximum of 12.7 seconds. The desired CV value is easy to calculate.

For example, assume the desired pulse on-time is 0.1 second. The CV value becomes 1. For another example, the desired pulse on-time is 1 second. The CV value becomes 10. For a value of 10 seconds, the CV value is 100. The pattern should be obvious but a complete listing for all 128 values can be found at this URL on the cvpusa.com website:

http://www.cvpusa.com/doc_center/rev1_New_AD4_Supp_Tbl_Misc_Info.pdf

Programming Outputs To Flash On/Off At A Specific Rate

An AD4 output can be programmed to alternately flash on and off. The output flash rate is set by programming CV513 to CV518. The rate varies from a fast rate of 1/10th of a second to the slowest rate of 12.7 seconds. To determine the required CV value it is best to look it up in the flash rate table located found at this URL on the cvpusa.com website:

http://www.cvpusa.com/doc_center/rev1_New_AD4_Supp_Tbl_Misc_Info.pdf

The table below shows some common flash rates and the corresponding CV value. The flash effect is not available if outputs are unlinked.

Flash Rate (s)	CV Value	Flash Rate (s)	CV Value
0.5	133	1.5	143
0.7	135	1.7	145
1.0	138	2.0	148

A flashing output is turned on and off by the remote throttle or local input. When using a remote throttle, the N-ON key turns on the flashing. The R-OFF key turns it off. When off, both LEDs are dark.

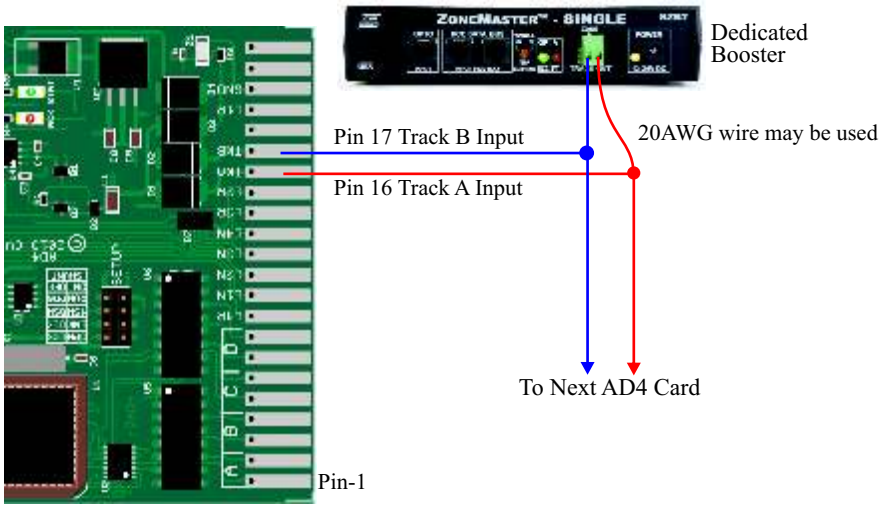
Installing The AD4 And Connection To DCC Booster

While it is OK to simply hook the AD4 to the track wiring, it is not recommended. If the track power is shut off due to a derailment, none of the turnouts can be thrown. A separate booster, dedicated to powering only the turnouts is recommended.

One benefit of using a dedicated booster is that you can set the booster DC power supply voltage to a value that works best for your switch machines without affecting locomotive operation.

Use #20 AWG wire connect the AD4 to the booster. #20 AWG is more than adequate for the AD4. Be sure and use the 22/44 edge connector for easy connection of wires to the AD4.

However, wires can be soldered directly to the pads if desired. But the board should be fully programmed and checked out before permanently soldering wires to the board. The connector is not shown in the hookup diagram below.



The best location for an AD4 is near the turnouts to be controlled. However, if you are going to install a large group of AD4s for a staging or classification yard, a card rack might be better. A card rack allows a group of AD4s to be installed in a central location and some of the wiring is easier. See the AD4 supplemental information on the cvpusa.com website.

http://www.cvpusa.com/doc_center/rev1_New_AD4_Supp_Tbl_Misc_Info.pdf

Wiring Diagram For Tortoise Machine

One AD4 can control up to 4 different Tortoise machines individually.

For cross-overs or other turnout arrangements where 2 switches are always thrown as a pair, the AD4 can have 2 switch machines tied to the same AD4 output.

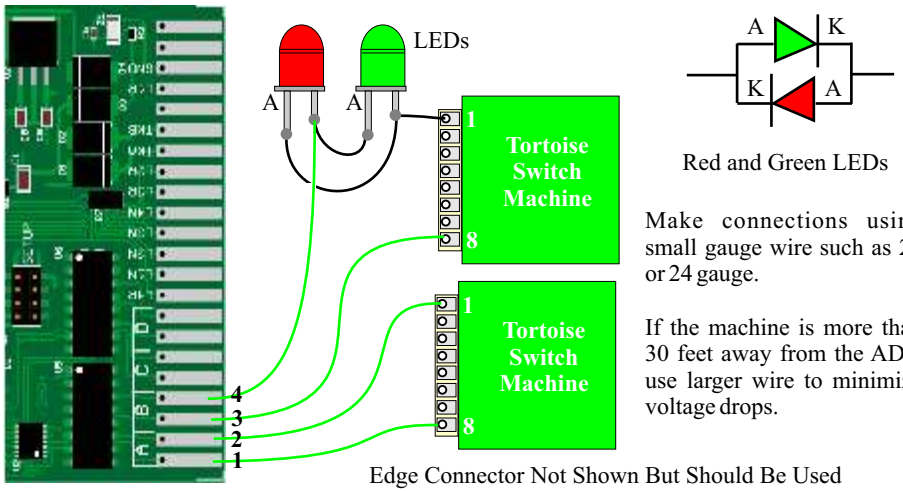
Small gauge wire such as 22 or even 24 gauge wire is OK to use with Tortoise machines. Their low current consumption will not create excessive voltage drop.

However, if the machine is many feet away, use larger wire, like 18 or 20 gauge to minimize voltage drops.

The machine connected to the B output has indicator LEDs. The LEDs are wired in series with the Tortoise machine to use as panel or track-side indicators. No limit resistors are necessary. The Tortoise motor resistance is just the right value to light up the LEDs with plenty of brightness. If not using the LEDs, wire directly from the AD4 to the Tortoise machine as with the A output machine.

continued on next page

Wiring Diagram For Tortoise Machine - *continued*



Tips For Kato And LGB Pulse-Type Machines

LGB turnouts have a solid snap when driven with standard DCC track power which provides about 14 volts to the machine. However, Kato switch machines are more sluggish in performance and don't have a solid snap when thrown. This is primarily due to their small size and weak magnets. Don't bother with longer duration pulses, they only heat up the switch machine and don't change its performance.

These switch machines require the use of a PULSE setting for the "on-time" CV. Never use the ALWAYS ON setting since that will damage the switch machine and the AD4. The original factory setting of 0.2 seconds works well. However, if there is drag on the mechanism, a longer duration may be necessary. Make the pulse duration long enough to throw the machine and then shut off.

Hooking Up Lamps, Relays and Other Devices

The AD4 can also control other loads and devices such as LEDs, lamps and low current relays. Maximum current is 600mA. If using LEDs, use a 750 ohm resistor in series with the LED. The output is protected against overheating but not against short circuits.

Standard incandescent lamps may be controlled. The lamps voltage rating should be close to what the DCC booster output voltage measures. We have used both 12V and 18V bulbs. The tradeoff is bulb life versus brightness. For best results, use a white LED instead. Not only will it be brighter, it uses much less current and can work with any voltage.

If using motors, relays or solenoids, their voltage rating must be close the booster output voltage. Devices rated at 12V work well. Be sure to include the protection diode across the coils of relays, motors or solenoids. Orient the diode as shown. A standard 1N4001 diode is perfect.

Relays and solenoids are high current devices. Use at least 18 gauge wire to minimize voltage loss.