NCE
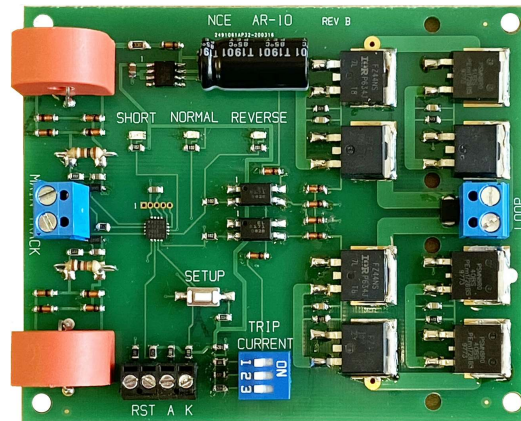## The Power of DCC

AR10 Auto Reverser

Automatic Reverse Loop Controller

Age **14+**

Features of the AR10:
- ✓ Automatically controls polarity of DCC reverse loops
- ✓ Provides short circuit protection for loop
- ✓ Ready to run without any programming
- ✓ Trip current adjustable 1 to 10 Amps
- ✓ Easy hookup using screw terminals, no soldering
- ✓ Solid state design provides silent, reliable operation
- ✓ Status indication LED
- ✓ Additional output for remote LED
- ✓ Automatic or manual reset after short circuit shutdown
- ✓ Adjustable short circuit response time

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Description:

The AR10 provides automatic control of reverse loop polarity using only two wires to the mainline track and two wires to the reverse loop. Note: The AR10 is designed to be used only with DCC systems. It will not work with any power system other than DCC.

Mechanical Installation:

The AR10 has 4 mounting holes that can be used to mount it to a convenient place on your layout. We recommend using #4 x 3/4" round orpan head screws. Do not over tighten the screws. Lightly snug the screws up just enough to keep the circuit board in place without bending it. Bending the circuit board can fracture the fragile ceramic electronic components.

Electrical Connections:

The drawing below shows the main track (DCC power) and reverse loop wiring which are the only required connections for automatic reverse loop control. As with all 2 rail reverse loops the loop portion must be isolated from the rest of the layout using insulated rail joiners or 'gaps' in the rails. The wires labeled "Main Track" should be hooked to the main bus that feeds the track leading into the reverse loop. The two wires labeled "LOOP" are connected to the reverse loop. The loop track should be longer than the longest train expected in the loop.

Typical hookup of AR10 to reverse loop
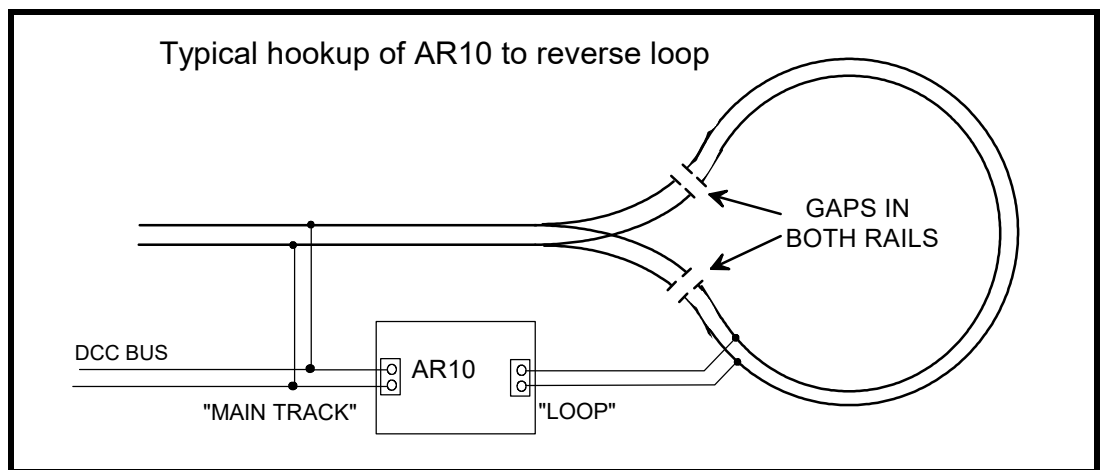
If you have a situation where the loop cannnot be made longer than your longest train you will need a second set of gaps in both rails creating a short dead section the length of the longest metal truck in the train. This will be required at both the entrance and exit of the loop.

The terminal strips on the AR10 accept up to #12 AWG wire. We recommend track feeder wires every 8-10 feet when using code 83 or larger rail size. If you're using code 70 or smaller rail we suggest feeders every 6 feet. Insufficient feeders can cause enough voltage drop to prevent the circuit breaker portion of the AR10 from working.

Once the power and track connections are made it is time to check the Trip Current switch settings and the AR10 is ready to use.   See the section on Trip Current on the facing page for switch settings.

We recommend that the trip current be set to about 75% of the maximum system current. The two most common settings are listed below:
 • 3 or 4 Amps if you have a 5 Amp DCC system
  • 1 or 2 Amps if you have lower power DCC system such as the NCE PowerCab or Digitrax^{tm} Zephyr.

Optional connections and features such as manual reset and remote status LED are illustrated on Page 4 in this manual. The factory settings have been chosen to provide suitable operation with most HO and N scale layouts. If desired you can fine tune the operating parameters of the AR10 to more closely match your DCC system and layout using the information presented starting on page 5. Before jumping in and changing any settings we suggest trying the AR10 with the original factory settings.
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Setting trip current:

The AR10 comes from the factory with the trip current set to 1 Amp. You can set the trip current higher by the switch positions below.   If all switches are "off" (open) the trip current is 1 Amp. The diagram below illustrates the switch positions to set the trip current in 7 increments from 1 to 7 Amps. The 8th setting (all switches "on") is for a custom trip current setting. Factory default is 8 Amps. See CV settings for more information on the custom traip current.

To change a switch position simply use your finger or a small screwdriver to slide the switch to the desired position.   The diagram below shows the settings.
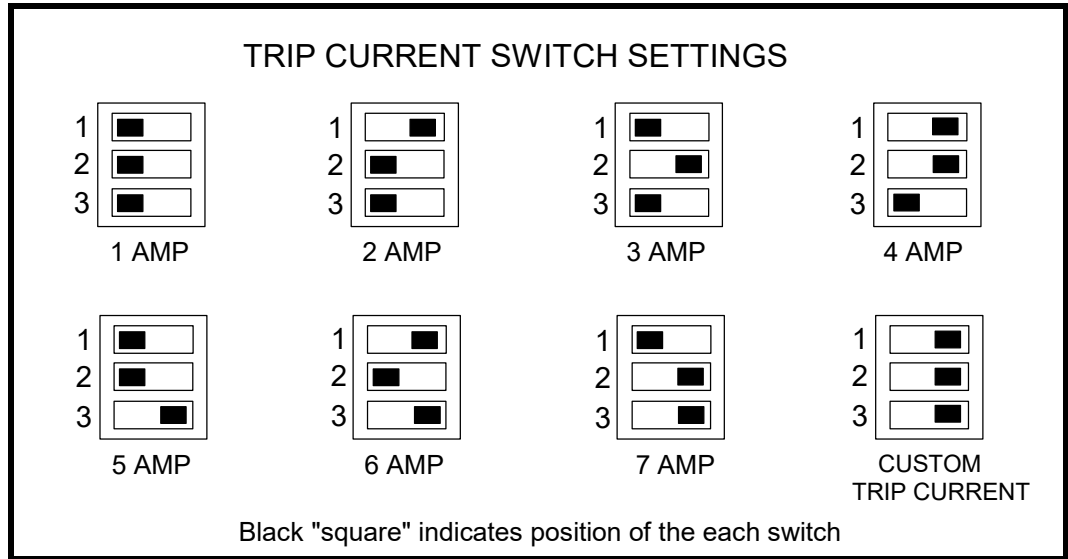
Testing the installation:

After setting the trip current we recommend testing your wiring. The "quarter test" is the fastest way to test your wiring. Use a coin or other piece of metal to short across the rails at various places in reverse loop. The AR10 should trip and shut down the power district at every place you short out the track. Once shut down the AR10 will try to restore power about once every 2 seconds. If there is still a short the AR10 will kill the power again, until the short is removed.

Indicator LEDs on the AR10:

SHORT - This red LED is off under normal operating conditions. It will light steadily (and both green LEDs will be off) when the AR10 has removed power to the loop because it has detected a short circuit or overload condition. The AR10 will attempt to restore power to the track every 2 seconds[default setting] until the short circuit condition is corrected. This LED will flicker rapidly when the SETUP button is pressed to indicate that the AR10 is ready to accept programming commands.

NORMAL - This green LED indicates the loop track polarity is at its normal state
REVERSE - This green LED indicates the loop track polarity has reversed
Note: The above polarity indications are arbitrary. They are primarily used to indicate that the polarity has automatically switched as trains enter and leave the loop.

Switches on the AR10:

TRIP CURRENT – Three switches that set the current trip level. See page 3 for a description.

Connections to the AR10:

MAIN TRACK - DCC power input from the DCC booster.

LOOP – DCC track power output terminal from the AR10 to the loop track.

[A] and [K] - You may connect an LED for use as a remote status indicator to terminals A and K of the the AR10. This LED will duplicate the actions of the small SHORTLED mounted on the AR10. Current limiting resistors are already mounted on the AR10 so all you need is an LED. The cathode (minus polarity) of the LED should be connected to terminal K. Use the diagram on below as reference for connecting this LED.

RST- You may connect an external pushbutton switch (normally open type) as a manual reset to recover manually from a short circuit. The AR10 must be setup for manual reset for this feature to work (see the following section on Fine Tuning the AR10).
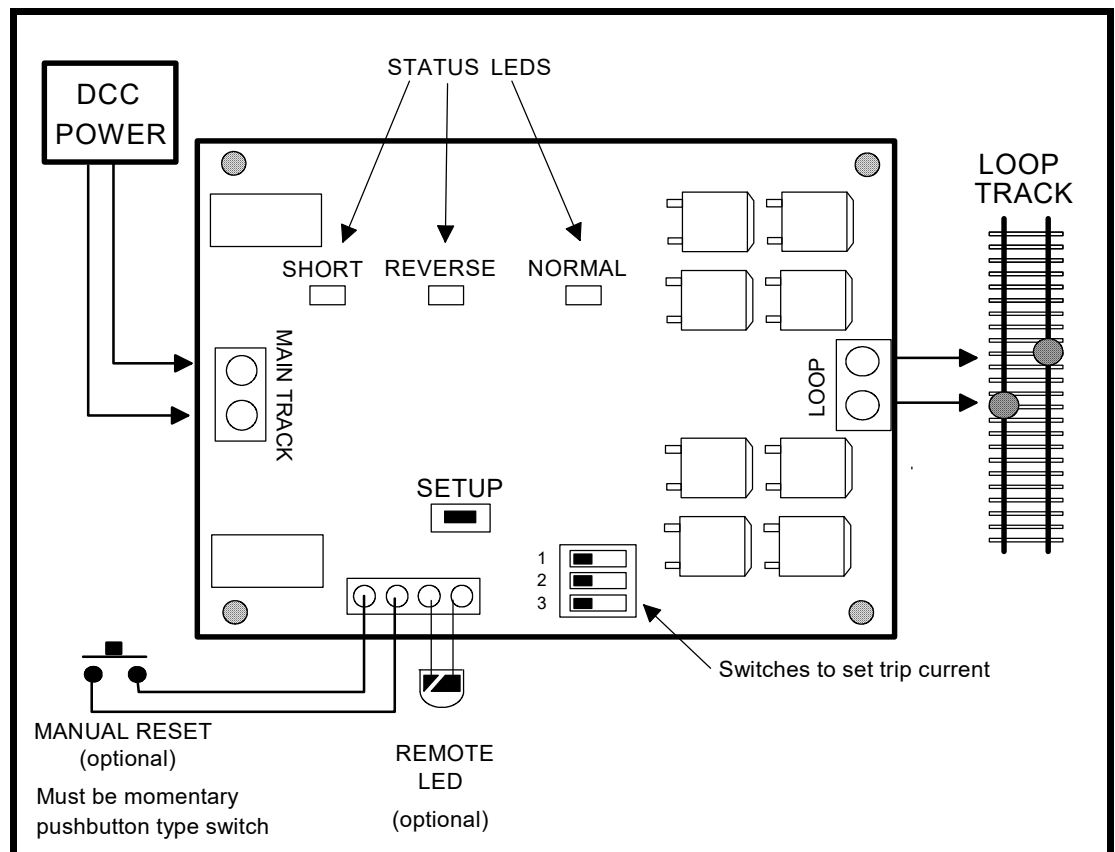
Setting up CV's and their values: Optional - Not Required

Method 1:
Any DCC system that has OPs mode programming (Program On the Main) for _**locomotives**_ can program CVs. Whenever the "SETUP" button is pressed the AR10 will flash the SHORT LED at 1 second intervals indicating it is ready to respond to loco OPS mode programming no matter what locomotive address is used. We recommend choosing an address that is not in use on your layout (we use 9999).   The SHORT LED must be flashing to use this method of setting CVs. The LED will flash rapidly until an OPs programming command is received by the AR10 or until 60 seconds has elapsed at which point the AR10 will return to normal operations.

Using method 1 you must press SETUP before each CV you wish to program.

Method 2 (NCE Specific):
If you have an NCE (or other system) that supports OPs mode programming of _**accessories**_ you can program CVs without having to press the "SETUP" button for every CV.

The AR10 comes from the factory preprogrammed to the accessory address of 1.

To change the address:
- Press the "SETUP" button (the LED will start flashing)
- Press SELECT ACCY on your controller
- Type in the new address you want to AR10 to use followed by ENTER
- Press 1 (for NORMAL) when prompted on your controller
- The LED will stop flashing and the AR10 will return to normal operations

The AR10 will now respond to Accessory Programming at the address you just programmed.

Using method 2 you _will not_ need to press the SETUP again to program CVs when using PROGRAM ACCESSORIES ON THE MAIN mode with an NCE system.

Fine Tuning the AR10

CV129 - Adjustment of short circuit response time (if necessary):
You can adjust the time delay between the occurrence of a short circuit and the time the track actually gets shut down. The AR10 comes factory set to 16mS (16 milliseconds = 16 thousandths of a second). This setting has been chosen because it can be used without problem on most layouts.   You can lengthen this delay from 16ms (1/60th second) out to 512mS (1/2 second).   Program CV129 to the number of milliseconds (divided by 16) you desire between 16mS and 500mS. A value of 1 = 16mS, a value of 32 = 512mS, etc.

CV130 - Adjustment of short circuit shutdown time (if necessary):
You can adjust the time the track power stays off after a short circuit is detected. The AR10 comes factory set to 2 seconds. This setting has been chosen because it can be used without problem on most layouts.   You can change this delay anywhere from 16mS to 4 seconds.   Program CV130 to the number of milliseconds (divided by 16) you desire. A value of 1 = 16mS, a value of 125= 2 seconds, 250 = 4 seconds, etc.

CV131 - Manual reset enable.
If CV131 is set to 0 the manual reset is disabled and the AR10 will automatically try to turn on track power after a short circuit. If CV131 is set to 1 the AR10 will not automatically restore track power after a short circuit until a connection (usually with a pushbutton) is made between he RST terminals of the four position terminal strip. You can also turn the track power back on by selecting the accessory address and setting the accessory to ON (also known as Normal, Thrown or +) .

CV135-CV146 - Custom Startup Table (Note: this if for the technically inclined)
The custom startup table provides a programmable method to pulse the track power on and off several times before the AR10 tests for over current. You can program the on and off times in increments of 1mS. Generally you will not use this table with most boosters but it may be useful with a booster that has weak startup capability.

An "off" time of 0 indicates the last entry of table. With the factory default of CV144 = 0 indicates the AR10 will not try to use the 6th "on" time.

If CV135 = 0 the table is disabled.

CV135 default = 0 Custom startup table initial "on" time
CV136 default = 4 Custom startup table initial "off" time
CV137 default = 8 Custom startup table 2nd "on" time
CV138 default = 4 Custom startup table 2nd "off" time
CV139 default = 16 Custom startup table 3rd "on" time
CV140 default = 4 Custom startup table 3rd "off" time
CV141 default = 32 Custom startup table 4th "on" time
CV142 default = 4 Custom startup table 4th "off" time
CV143 default = 80 Custom startup table 5th "on" time
CV144 default = 0 Custom startup table 5th "off" time
CV145 default = 0 Custom startup table 6th "on" time
CV146 default = 0 Custom startup table 6th "off" time

CV147 Factory reset
This will reset the AR10 to its original factory settings

Set CV147 = 85 to do a factory reset of the AR10 to the following values.

CV129 default = 1   16mS allowable short circuit
CV130 default = 128 2 seconds power off time
CV131 default = 0   Manual reset off
CV135 default = 0   Custom startup table disabled
CV136 default = 4
CV137 default = 8
CV138 default = 4
CV139 default = 16
CV140 default = 4
CV141 default = 32
CV142 default = 4
CV143 default = 80
CV144 default = 0
CV145 default = 0
CV146 default = 0
CV148 default = 204 (8 Amps)

Setting CV148, Custom trip current::

  CV148 = Desired Amps x 25.5

  Example: 1.25 Amps x 25.5 = 31.875

  Round to 32.

  Set CV148 = 32

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AR10 Specifications:

Dimensions: .... 3.90 x 3.20 inches, 99 x 81mm

Max. input current:..................... 10 Amps

Max. DCC voltage:..................... 22 Volts

Short circuit response:............... 16mS to 512mS in 16mS increments

Over current trip points:.............. 1.0 Amp +/- 100mA
2.0 Amp +/- 100mA
3.0 Amp +/- 100mA
4.0 Amp +/- 150mA
5.0 Amp +/- 150mA
6.0 Amp +/- 150mA
7.0 Amp +/- 200mA
8.0 Amp +/- 200mA (with factory default setting)

Ext. LED maximum current........10mA (360 Ohms in series with 5 volts)

Accessory address range...........1-2044 (2041-2044 are NMRA broadcast addresses)

Device Warranty
This device is fully factory tested and warranted against manufacturing defects for a period of 1 year. As the circumstances under which it is installed can not be controlled, failure of the device due to installation problems can not be warranted.   This includes misuse, miswiring, or operation under loads beyond the design range of the device. For warranty or non-warranty replacement send the device (and any payment, if required) to:

NCE Warranty Center
82 Main Street
Webster, New York 14580

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