# De-mystifying the Aristo-Craft Train Engineer System

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## Lots of Confusion

When it comes to power supplies, everyone should be familiar with the traditional 'transformer' that plugs into a wall outlet, has connections to the track, and includes a rotary knob for adjusting train speed (track voltage). But in the last few years, we've seen more and more remote controlled layouts. One such remote control system is the Train Engineer system by Aristo-Craft. Others are made by RCS and Locolinc (none of them are interoperable). When I was designing my layout, I thought it would be more fun to be able to walk around with the train, and still be able to control its speed and direction from anywhere around the layout. But I had a hard time figuring out just which components I needed to buy, and how many of each. I got confused on which components were compatible with each other. I wasn't able to figure it out from the Aristo-Craft catalog at that time. But I've got it figured out now, and via this article, I want to share what I've learned with others who might be just be starting out. (George Schreyer has written an excellent book on this subject, available from Aristo-Craft).

## What's a Train Engineer?

First of all, Aristo-Craft uses the term Train Engineer to refer to any of a number of different components. The Train Engineer is not a single item, and you won't find a specific part number for buying it. Rather, it is a family of components that when combined with a source of DC power, give you remote control of your trains. And the secret (it shouldn't be a secret, it should be clearly spelled out for any buyer) is deciding which components you need for **your** railroad. Both the catalog and the dealer ads are rather ambiguous, it's hard to tell what each component does, and what else it depends on, to remotely control your trains. In the following paragraphs, I will refer to each component by its specific name (and part number) and describe what function it performs.

The Aristo-Craft Train Engineer system (as well as RCS and Locolinc) is a collection of transmitters and receivers that use radio waves through the air to control the trains. This is in contrast to Digital Command & Control (DCC) that puts the control signals directly on the rails along with the DC power, using devices called boosters, allowing engines equipped with devices called decoders to respond to those signals (but that's a separate article).

## Volts and Amps

Some of the following information gets technical, so if you're feeling electrically challenged, let's start with an analogy. Think of a transformer or power supply as a water spigot. Voltage (volts) is the pressure of the water in the pipe. As you begin to open the spigot, some water flows out. Current (amps) is the amount of water flowing out of the spigot. With our trains, as we open the throttle (spigot), some pressure (volts) is applied to our train motors, which then draw a certain flow of electrical current (amps) to run. Open the throttle (spigot) further, there's more pressure (volts) applied to the tracks, and the train speeds up.

## Power Supply

For model trains, a power supply is required to convert household AC voltage to safe, low voltage DC used by the trains (exception: trains using on-board batteries). The Aristo-Craft Ultima Power Supply (#55460, about $95) generates 18 volts output and up to 10 amps of current. It is a **fixed** power supply, which is to say it has no controls for train speed or direction. Smaller ones are available (most notable: the ones found in starter sets), but if you expect to run long trains, or multiple engines, or trains up and down grades, then 10 amps is recommended. Most engines draw 1 or 2 amps at full speed, and less than that at slower speeds. Many USA Trains engines draw roughly twice this much current. The majority of engines run nicely at about 12-14 volts, and are on the verge of flying off the tracks at 18 volts. Some LGB engines run too slow with 18 volts, and run better with up to 24 volts. Recently, Aristo-Craft came out with an all-electronic power supply, called the Elite (#55465, about $130) that generates 22 volts output and up to 13 amps. Note that all Aristo-Craft power supplies and Train Engineer components are marketed under the name CREST. Other power supplies include one from MRC (#AG990, about $130), which **does** include a throttle, and the LGB Jumbo (#50101, about $430), which also includes a throttle. The point of listing several power supplies here is this: the Train Engineer will work with **any** DC power supply, including a 12 volt car battery. So if you already have a power supply, and want to take the next step to remote control, use what you have, as long as the voltage rating does not exceed 24 volts. If you have to buy a power supply, add up the current draw for all the engines you might run at one time, and buy a power supply that delivers at least that much 'juice' with some margin for the future. Best buy today: the 22 volt, 13 amp Elite.

## Trackside Receiver

So-called, because it is connected between your power supply and your track, the 2nd component in a remote

controlled layout is a trackside receiver (#55471, about $80). It increases or decreases the voltage to the track according to a 27Mhz radio signal it receives on its antenna. It does the job of a throttle, controlling the speed of the train, but without a rotary knob. The advantage of this component, besides the fact that you can control the trains from anywhere on the layout, is that there are **NO** modifications required to the engines. Any engine from any manufacturer can be controlled with this device without having to add electronics inside the engine. Usually, the power supply and the receiver are installed in the house or garage, and a heavy pair of wires carries the DC current to the tracks. It works best if the antenna is oriented vertically, and mounted up high.

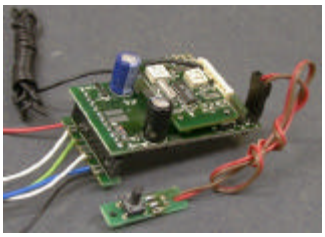
## Transmitter

The 3rd component in a remote control system is the hand held transmitter (#55473, about $65). About the size of a TV remote control (those work on infrared, not radio waves), it has a button to speed up the train, another to slow down the train, and a pair of buttons to change direction. There's also an emergency stop button, which instantly turns the track voltage down to zero, very handy if there's a derailment. The transmitter sends out a 27Mhz radio signal (only when you push a button), which in ideal conditions can be picked up by the receiver at ranges up to 100 feet or more, though in some installations, it might be less than that. I've found, much to my delight, that the radio signals pass through the concrete wall of my house and control the receivers in the basement, even at ranges beyond 100 feet. The transmitter can be purchased by itself, or paired with a receiver (#55470, about $120). The transmitter is a **universal** device, meaning that it can control as many receivers as you eventually add to your railroad (maximum of 100). So, using the same transmitter, you could control two or three or more receivers (train loops). This is done by selecting a different frequency and a different channel on the transmitter (There are ten frequencies, and for each frequency there are ten unique channels). These selections are made on the transmitter using some of the buttons and the LED display at the top. More on this subject later in the article.

## On-board receivers

This is where things might start to get confusing. Aristo-Craft makes another radio receiver, called the mini on-board receiver (#55490, was about $80). This is meant to be installed within the train itself (the engine, or a trailing car). Most people use these in conjunction with on-board batteries. The miniature receiver is wired between the battery pack and the motors, and controls the speed of the train based on radio signals. The same #55473 transmitter described above can be used with this mini receiver, because they both operate in the same 27Mhz frequency band. So now, instead of getting its current from the track, the train gets its current from on-board batteries. This has several huge advantages: This makes it easier to run multiple trains on the same track, and control the speed of each independently, and also it also sidesteps the requirement to constantly clean the tops of the rails as is often the case with track powered layouts. The big disadvantage is you must open up the engine and install the mini-receiver and its antenna. And if you have a lot of engines, that can get expensive. Some people put the batteries and the mini receiver in a trailing car, and run wires to the engine. That helps to keep the costs down, since you can use the same trailing car with a different engine each time you run, but you're always lugging around the **same** trailing car right behind the engine all the time. I did mention that the antenna for this receiver is now inside the train, and close to the ground. Unfortunately, that has the adverse effect of reducing the maximum range by which the receiver and transmitter can communicate, in some cases, to as little as 10 feet. Having said that, the #55490 is now out of production.

So in 2002, Aristo-Craft released a new mini on-board receiver (#55491, about $100) that operates in the higher 75Mhz frequency band, which performs all the same functions, but ideally offers **better** range performance than its predecessor. Oh, and now you have to use a new 75Mhz transmitter with it (#55003, about $65) since 27Mhz transmitters don't work with 75Mhz receivers. It's easy to tell them apart: 27Mhz transmitters are housed in a black case, and 75 Mhz transmitters are housed in a gray case, but the buttons and the functions are the same. 75Mhz stuff can be bought as a pair (#55492, about $160). One more thing: Aristo-Craft engines produced since 2002 have a receptacle inside so that this mini receiver can be plugged in, which eliminates the need to cut and solder a bunch of wires. The way they can be identified is by the small plug found near the coupler at each end of the locomotive, where a trailing car can optionally be connected.



There's more. The 27Mhz mini receiver and the 75Mhz mini receiver are each rated at 3 amps. Sometimes there's an engine (or a multi-unit lashup) that draws more than 3 amps. You can (and its been successfully done) take the trackside receiver, which is rated at 10 amps, out of its case, and mount the circuit board and its antenna inside the engine or trailing car, and connect it to some suitably sized batteries.

Here's another idea for those bigger layouts. You say you want multi train action, but batteries aren't for you? Then

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hook the Elite power supply directly to the rails (with fuses) and put a mini on-board receiver in every engine. Just don't put a stock engine on the rails, because at 22 volts it will take off like a slot car! (Described in Figure 4)

Last but not least, some of us have a considerable investment in 27Mhz equipment already, and don't want the hassles of intermixing 75Mhz and 27Mhz equipment. Since the #55490 is out of production, the #55491 can be retrofitted with a part that allows it to operate in the 27Mhz band. This is just an RF chip that attaches to the mini receiver (#55489, about $25).

## Accessory Receivers

If I didn't lose you yet, there are two additional receivers in the TE family. The accessory receiver (#55474, about $45) with its antenna is usually installed inside an engine to turn on or off various things like lights, a bell or a horn. The switch receiver (#55475, about $40) with its antenna, is usually installed in the layout where electrically controlled turnouts are employed, so that as many as 5 of those turnouts can be operated remotely. The **same** universal transmitter described earlier can operate both of these components, using the A through F buttons toward the bottom of the transmitter.

## How to Choose

Phew, still seems confusing, how does a person decide what to buy? If you like the idea of not modifying engines, and you have a method for keeping the track clean (Scotch Brite pad, track cleaning car, Rail Zip, Goof Off, stainless steel track, but that's outside the scope of this article), then track power is for you. A power supply (assuming you don't have one), a trackside receiver and a 27Mhz transmitter would cost about $240 street price. You could then operate one train or multiple trains (up to ten amps total), but they would all move in the same direction at roughly the same speed (depending on manufacturer). Track power has definite advantages for large layouts running multi-engine long trains, which could exceed the capacity of on-board batteries available today. But it does require investing in a power supply, some heavy gage wire (and probably a few rail clamps), and the periodic chore of cleaning the track.

If you like the idea of never cleaning track, never installing wires to the track, never worrying about track joiners, and don't mind opening up each locomotive to install electronics, then battery power is for you. The first mini receiver and 75Mhz transmitter would cost about $160 plus batteries (also outside the scope of this article). Each additional install would cost $100 plus batteries. Or, you could put the stuff in a trailing car, and use a plug to the engine. By the time you retrofit your 3rd engine, the outlay is higher than for track power, but the huge advantage is that each train is now independent, and can be slowed down or stopped even while the others continue to run. You don't have to buy another transmitter each time you equip another engine, because the transmitter is universal and can communicate with the entire line of receivers. Though technically the transmitter can control 100 receivers (10 frequencies times 10 channels), you have to take your eyes off the trains and look at the LED display to make the selection. From a practical viewpoint, I find controlling more than about 3 trains becomes tedious.

If you're going to run a combination of track power and battery power, you'll start with 27Mhz equipment for the track power, then add either 27Mhz on-board equipment (if you want to be able to use the same transmitters), or 75Mhz on-board equipment (if you don't mind using several transmitters).

## Linking

When you buy any receiver, you have to set its codes for the frequency and channel that it will respond to (just like a garage door opener). This setup is done just once, and from then on, it will remember that specific frequency and channel, even after power is turned off. This is accomplished through a process called linking. First you select the frequency and channel on the transmitter. Then you press and hold buttons on the transmitter and the receiver simultaneously to set that receiver's codes. Hint: This is a good time to write them down; after all, there are 100 choices. (Older style 27 Mhz transmitters supported just two channels instead of ten, and the frequency was fixed. While being much more limited, it did have the advantage of being very easy to use for two train operation, because you did not have to take your eyes off the trains. You could feel the ch1/ch2 switch with your thumb and make the selection more quickly.)

## Multiple Operators

If your railroad has grown to the point where you are trying to operate more than about 3 trains at the same time, you're a primary candidate for having more people and dividing up the workload. You will need to provide a separate transmitter to each operator at about $65 each. Each operator will be responsible for a subset of all the trains. This approach is safer and a more fun way to run multiple trains. As long as separate frequencies (e.g., 75.1, 75.2, 75.3, etc) are used, the transmitters will not interfere with each other, even if several operators push buttons at the same time.

So far, we've established that for track power, there is one receiver per track, and for battery power, there is one receiver per engine, yet just one transmitter is all that is required to run one or more trains. You can operate a battery-powered train on a track-powered layout because there's switch in the engine that disconnects the wheel pickups when running on batteries. So, you could have a

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big freight running on track power (and running and running, because there's no batteries to get depleted) while other trains, with on-board batteries, receiver and antenna scamper around on the same or different tracks.

## Multiple Independent Loops

Many railroads grow to the point where there are multiple loops of track. As long as there are no electrical connections between the loops, they can each be controlled by a separate trackside receiver, as explained in figure 2. And all the trackside receivers can be tied to a single power supply, as long as the combined currents of all the loops don't exceed the rated amp capacity of the power supply. This allows a train on the 1st loop to be controlled independently of a train on the 2nd loop, etc. You can use one or more transmitters, whatever is more convenient.

If the loops are connected via turnouts (and insulated rail joiners) and you expect that trains will traverse from one loop to the other, as explained in figure 3, then it is **imperative** that each loop have a separate receiver **and** a *separate* power supply. Unless the receivers are tied to separate power supplies, there will be *severe* damage to the receivers and the engine wiring when an engine crosses between the loops.

## Miscellaneous

So what are all those other components listed in the dealer ads? The Basic Train Engineer (#55480) is an entry level remote control system. It controls one train instead of several, has a 2 amp capacity, and limited RF range. This is the kind of system you would use for a loop under the Christmas tree, but would be too limited for a garden railroad. Housed in an orange case. The control pack adaptor (#55401) is a manual throttle (with rotary knob) that installs between a power supply and the track in lieu of a trackside receiver. Although it too provides pulse width control (a feature that enhances slow speed running and lighting), it has no remote control capabilities.

Oh, I didn't tell you about pulse width control (PWC). Normal DC power, like that from a battery or most DC power sources, is often called linear. The TE receivers have a switch where you can select either linear or PWC. In linear mode, the voltage output to the track starts at zero, and as you increase speed, the voltage goes up proportionally, till it reaches the maximum available from the power source. In PWC mode, the voltage to the tracks is rapidly switched between zero and the maximum available from the power source, like operating a light switch on-off-on 25,000 times a second. As you increase speed, you increase the % on time, and decrease the % off time. What's the advantage? Engine motors often run more smoothly at slow speeds on PWC. And train lighting is brighter at slow speeds on PWC. What's the downside? Sometimes circuit boards for sound systems don't operate as expected. All of the Aristo TE receivers feature PWC. On the trackside receivers, it can be switched off (linear).

## Momentum and Time Delay

The Train Engineer system includes two other features that most model railroaders find very desirable. One is Momentum, which determines how fast the speed increases as turn up the throttle. This simulates the weight of a heavy train as it tries to accelerate, thus avoiding a jackrabbit start. There are 5 choices for momentum, which is set during the linking process. The other is Time Delay, which determines how long the train pauses when changing from forward to reverse. This simulates the various engineer actions needed to get the train moving in the opposite direction, and reduces wear and tear on the gears in the motor blocks. There are 5 choices for time delay, which is set during the linking process.

## Conclusion

This article is intended to help model railroaders sort through the many components of the Aristo-Craft Train Engineer system, and make smart purchasing decisions when preparing to build or expand a remote control train layout. It is not a how-to article, nor is it meant to replace the instructions that come with the equipment (which, I admit, are poorly written). The Aristo-Craft Train Engineer system should meet the needs of the vast majority of model railroaders today at an affordable price. It is expandable by purchasing more components as the railroad or the number of operators grows. For more information, see George Schreyer's book, or the web site at www.aristocraft.com.

### Train Engineer component summary

| Component | 27Mhz equipment | 75Mhz equipment |
|---|---|---|
| **Transmitter** | #55473<br>10 frequencies times 10 channels (black) | #55003<br>10 frequencies times 10 channels (gray) |
| **Track power stuff** | | |
| **Trackside Receiver**<br>(used with DC power supply, bought separately) | #55471<br>10 amp capacity (with cooling fan) | none |
| Cooling fan for above | #55499 (above 5 amps) | n/a |
| #55473 / #55471 27Mhz set | #55470 | n/a |

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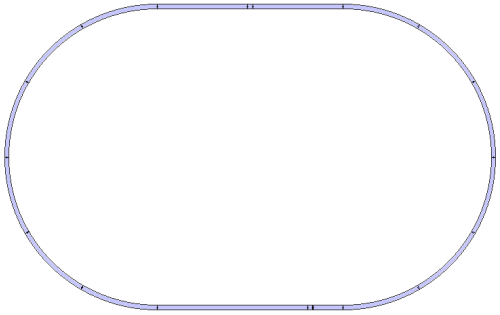
| On board battery power stuff | | |
|---|---|---|
| **Mini On-board Receiver** (used with on-board batteries, bought separately) | #55490<br>2.5 amp capacity<br>out of production | #55491<br>3 amp capacity |
| Cooling fan for above | #55498 | #55498 |
| Mini receiver RF conversion board for #5491 | #55489<br>allows 55491 to work with #55473 | n/a |
| #55003 / #55491 75Mhz set | n/a | #55492 |
| Accessory receiver | #55474 for 5 devices | #55074 for 5 devices |
| Switch receiver controller | #55475 for 5 turnouts | #55075 for 5 turnouts |
| Acces. Receiver for #55491 | n/a | #55495 for sound and smoke |

## Equipment list for various layouts

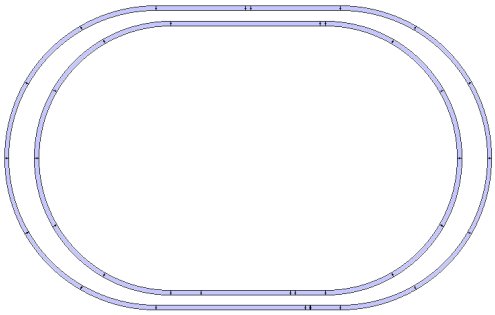
**Layout design** | **Equipment list**

Figure 1: Single line, loop, or point-to-point



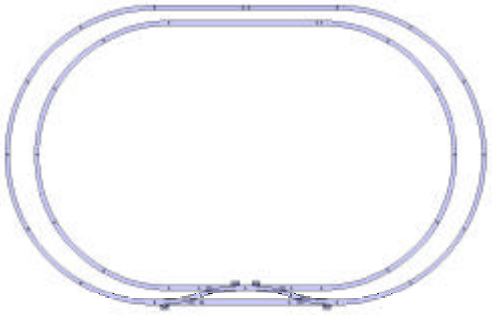
**Track power:**
➔ One power supply
➔ One (#55471) 27Mhz receiver
➔ One (#55473) 27Mhz transmitter
**Battery power:**
➔ One battery pack per engine or trail car
➔ One (#55491) mini receiver per engine or trail car, with optional #55489 converter for 27Mhz
➔ One (#55473 or #55003) transmitter per operator

Figure 2: Double line, two independent loops, NOT connected



**Track power:**
➔ One power supply
➔ One (#55471) 27Mhz receiver per track
➔ One (#55473) 27Mhz transmitter per operator
**Battery power:**
➔ One battery pack per engine or trail car
➔ One (#55491) mini receiver per engine or trail car, with optional #55489 converter for 27Mhz
➔ One (#55473 or #55003) transmitter per operator

Figure 3: Double line, two connected loops



**Track power:**
➔ One power supply per track
➔ One (#55471) 27Mhz receiver per track
➔ One (#55473) 27Mhz transmitter per operator
**Battery power:**
➔ One battery pack per engine or trail car
➔ One (#55491) mini receiver per engine or trail car, with optional #55489 converter for 27Mhz
➔ One (#55473 or #55003) transmitter per operator

Figure 4: Special case – DC power wired directly to track(s), any track plan, on-board receivers in every engine

**Power:**
➔ One power supply wired to all tracks
➔ One (#55491) mini receiver per engine or trail car, with optional #55489 converter for 27Mhz
➔ One (#55473 or #55003) transmitter per operator

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