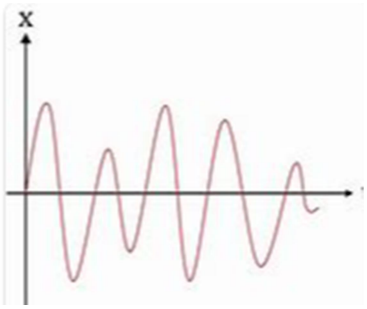
Analog to Digital…

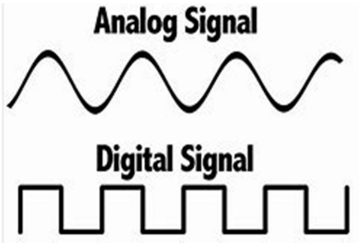
Ok let us begin…

Analog SIGNALS are recorded as “cycles per second”.



These cycles represent a positive swing to a negative swing based upon (1) the peak frequency, which is determined by the length of the time-base. Time-base is compared to “cycles per second” when measured as one cycle. A simple example is AC volts. Generally we see AC volts as 60 CPS. That is correct, but not actually true. You must understand 120 cycles, 400 cycles, even 3000 cycles are all analog and they are all audible. Analog signals can be thousands, even millions of cycles in both frequency and time-base. The shorter the time-base the higher the frequency; as in “megahertz” (millions of cycles per second). Although 144 MHz is 2 meters long, in reality those cycles are no different in their makeup than, say 1000 cycles. Still there is a difference in the scientific nature of the signal itself. You see 1000 cycles we can hear; 144 MHz is a RADIO FREQUENCY and it is not audible or visible without use of scientific equipment.

All SLOT-CARS run on a wired track. The track can be most any compound…wood, plastic, fiberglass and so on. There are two conductive rails that run parallel to a “slot groove” cut in the track material. The voltage applied to these “rails” is DC. Direct Current is not “analog”. DC is DC. DC voltage can be any voltage, when applied, is positive or negative compared to “0” (neutral).



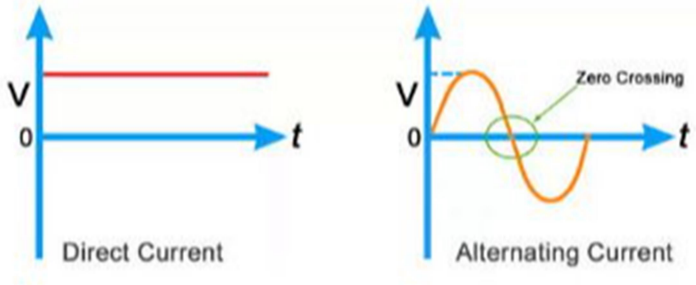
Slot-car motors are DC driven. They are controlled by the resistance applied through the hand controller. The greater the resistance, the less voltage applied to the DC motor. Push down the thumb plunger, the resistance is lowered and the DC slot motor turns faster. All wire has resistance. Some conductive materials like gold or silver have the least resistance. Common wire like copper is best used for this application. Resistance wire, like that found in a toaster would be very dangerous in a hand controller. However after long runs, even the copper wire controller will feel warm, almost hot in some cases.

Therefore, there is no such thing as ANALOG slot-cars. So how is it we call them DIGITAL slot cars. Well, they are not really DIGITAL. Not to get fussy here, but the basics remain the same today as 50 years ago. Actually further back than that, because most all of us have had some connection with electric trains. The drive wheel contacts the track, the voltage DC/AC applied to the track turns a small motor in the locomotive and away the train went, till it fell off on a curve. Pretty much like SLOT CARS!! We called this racing for the longest time, but in reality until DIGITAL racing came along; there was never any real competitive feeling at all. You must remember…one car, no matter how many lanes you race on, one car will always have an advantage.

In the illustration above the ANALOG signal is AC (alternating current). The top of the cycle is positive and the

bottom of the cycle is negative. The line, drawn through the center is "0". No current, therefore in real time the voltage would swing the motor forward to reverse an equal number of times (cycles) per second. Thus the motor would never turn enough in the positive direction to overtake reverse!!

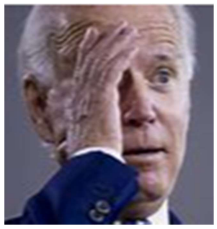
Enter the DC motor. The DC signal looks like this compared to AC signal.



The Direct Current red line is the VOLTS applied above (+) or below (-) ZERO. In a slot car…applying POSITIVE voltage drives the car forward. That means NEGATIVE voltage becomes the "braking system"; and interesting enough, that is REAR BRAKE BIAS. Applying 100% RBB in a tight turn will throw the car out of control. You apply brake bias entering the turn. However, you never apply 100% braking. In a DC motor slot-car, you are in reverse!

That said, DIGITAL has the ability for you to "program" motor control. You can preset "motor control speed" for both FORWARD POWER and BRAKE BIAS. That alone should be enough for you to fancy yourself a DIGITAL racing experience, even if you do not add anything else to your race circuit. The controllers for DIGITAL racing offers adjustability above and beyond that of DC only (analog) racing.

What is really happening here?



Ok, in a DC race world (analog-whatever), your lane is simply a voltage source. You can connect a volt-meter to the track, and unless your thumb is on the controller, there is NO VOLTAGE in the track. In a DIGITAL system, the track is FULL POWER, 100% of the time…all lanes…over all the circuit. You place your car on any lane, anywhere push down on the go-button and the car runs…unless your car has not been programmed to the track; along with your controller. In that moment you have that "nadaklu" (WTF) dumb look on your face…you know that look!

The DIGITAL system is a programming interface device that speaks directly to a "decoder" chip located in the racecar. The decoder isolates and controls the signals applied to the DC MOTOR mounted in the chassis. This is the best "novice" explanation I can give you. The GURU understands the fascinating aspects of all this. In better terms, the decoder is processing your (you the driver) "controller" interfaced actions and reactions. In a modern digital sense of the term…you are controlling the car. The entire circuit can be used by you and your reactions to race traffic, slower cars and the track configuration. *Note: The decoder maintains a binary code. Your personal information code is DCU controller-port specific*. You are in control, you don't have to concern yourself with lane choice…throw away those colored stickers. But wait "here's the deal Jack"…in real racing, on dirt, or asphalt there are only a certain number of lanes available. There are only a certain number of track locations where you would attempt a lane change. Generally speaking you change lanes on "entry" or "exit" in order to take advantage over lap-traffic ahead. Why would you change lanes in the middle of a fast straight stretch? Yes…I agree, if you can overtake another car. However on straight runs you are flat to the floor as you race for that prefect line into the next turn. That "next" turn entry can make up for any delays encountered on the straight stretch. If you enter the turn correctly and exit into a fast straight, you can be ON the throttle sooner. The "bonus", you become your own spotter, so you react to the situation quicker than real life.

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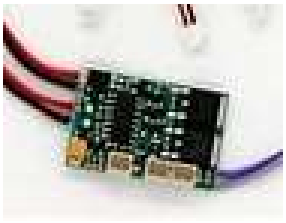
Ok, you are lost here…

Don't be. The track programmer/processor (Digital Control Unit, the DCU) is the heart of the DIGITAL CONTROL system. Up to 6 "live" decoder codes can be processed by these units. The process timing is about 15 cycles per second. That means throughout the race circuit your in-car decoder processes the command signals generated in your controller. This occurs every 400th of a second. There are some critics who believe that is not fast enough, but you can't think that fast so who are they kidding? *Note: There will be greater numbers and faster process times in the future. The results will allow increased traffic and of course…cost more money!!* The future of the DCU is only limited to what the traffic will bear. For me, the more cars the better…as for more lanes and faster cars…three lanes would be all I need. Car speeds are irrelevant when the more the merrier is what makes DIGITAL RACING hundreds of times less boring than single lane "analog slot-car-club" style racing.

The fun stuff…

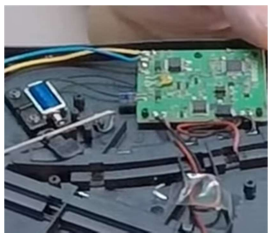


I mentioned fun, because I meant it!! Rubbing is racing…there is not much of that on the standard SLOT-CAR track found in hobby stores and club centers. The DIGITAL SLOT-CAR is basically no different than any TWO-WIRE unit connected to the track through a set of wire braids; except there is that "decoder board" in between. *Note: The decoder can add several dollars to the price of the car.*

However, this means you can run in the same lane as Joe, but you can push, plow or change lanes to pass Joe on a DIGITAL TRACK layout. If Joe is slower than you, push him to the LANE CHANGE and make the pass. Push him into the chicane and bump him off or plow him into the next "S" curve and spin him out! Rubbing is racing but always remember…what goes 'round comes 'round. That is what you came for.

To give you an idea of that the IR decoder does. The board has several functions. First it decodes the controller THROTTLE and BRAKE functions. It decodes the CHANGE LANE trigger and it engages the DIGITAL LAP counter as it passes over the finish line from GREEN to CHECKER and all laps, and times in between. But it has the ability to TRIGGER the LANE CHANGE mechanism in the track and it handles any optional lights (including brake lights) on the car…did I say BRAKE LIGHTS? Yes! How soon till we get a horn?

One must understand there are 6 cars that can be controlled by humans…there are also 2 additional codes that can control one "ghost car" and one additional that controls the PACE CAR. For that you need a PIT STALL installed so the PACE CAR can enter and exit when called for. That PIT STALL is also used during long races when you are called in to add fuel or tires or change driver for those endurance races. Seriously there are DIGITAL tracks that require a pit stop. I personally have passed cars going through the PIT STALL.



How is this possible?

Pictured here is a typical LANE CHANGE track with the relay shown and the sensor board connected to the track's "infra-red" (IR) receiver. There can be as many lane changes as you desire, however you need a single straight or full curve directly ahead in order for the IR receiver to decipher the code and activate the "lane change".

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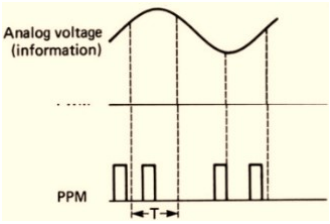

This is accomplished by using a technique known as Pulse Position Modulation or PPM. PPM encodes the "sample values" of (T) by varying the position of a constant pulse duration. The duration of pulse timing is only a fraction of the 15 CPS time-base hiatus or time lapse. PPM is very efficient and uses less power. However PPM is complex and requires a somewhat wider bandwidth. Not your worry…

What does it all mean?

Well what if I tell you it means you practice your skills? I must apologize; I cannot refer to DIGITAL racing without reminding you it is far more intense, more involved than analog racing could ever be. Even if I take away all the lane change excitement, just having the ability to control how hard you enter a turn is something most racers have never thought about. Then there is a defense strategy that you have never had to consider. You can actually change lanes to "block" a racer. Try that on an analog racetrack. Prior to DIGITAL racing you concentrated on keeping the guide in the slot. You used tiny wheels up front and basically created a guide that would never jump the groove. Now you control the car from the sense of BRAKE BIAS, ENTRY SPEED, including GEARS and TIRE SURFACES. Believe it or not, the front tires actually touch the track. The cars look more like scale models rather than blocks of wedge type door stops!! I remind you club officials reading this, do your members a favor and change that analog (DC voltage) race track to a DIGITAL environment. You don't need to change the track, just how the drivers control their cars. They will be excited to race more than 4 or 5 across when they can race anywhere on any lane. Lead, Follow or get the Hell out of the way!

Racing should never be so WOKE that you expect to win right out of the box. My son and I have raced on dirt and asphalt; for almost 20 years. We did our time on carpet and hobby-shop wood tracks. That was back in the early 90's. We would never come this far if we thought this was going to be boring. At my age, I can fall asleep at most anytime. I thank God for all the extra hours I get with my family and friends. DIGITAL racing has kept my interest ever since my son bought his first setup. I miss the real racing, trust me, but my body says I can't keep up with it anymore. So I scaled down just a little…and it scaled up my "good times".

BTW: I do all the diorama too…

References:

How they work: https://www.youtube.com/watch?v= lbqXPwxruBo

A basic family layout: https:// www.youtube.com/ watch?v=bfXEWdQ1Isc

A great DIGITAL controller: https://www.truspeed.co.uk Carrera D-VI controller with brake button.

Http://www.churchfieldracing.com

http://www.churchfield.racing