

# Perfect Timing Setup

Setup Tips and Tricks for using FarmTek timing system in autocross applications

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# Background

- Note: I have inserted my opinions in here. I am not writing an engineering paper for you. It reads a little like a book. It is intended to be used as presentation material for a course on timing head setup. There is some techie stuff in here and there are some items from my point of view.
- Much of the information provided here is from the Farmtek website, Farmtek manuals and from the guy at Farmtek.
- Several years ago the Detroit Region SCCA purchased two complete FarmTek timing systems to replace the outdated, and wired JACircuits timer which had been in service for over 10 years.
- At first glance, the FarmTek system seem significantly easier to use, and more robust to alignment and rain than the JACircuits system. Then the problems started setting in.
- The region suffered from a significant number of “no trigger” events, especially on the finish lights (eyes).
- Turns out that the system has nuances and issues which are different from the JACircuits system. This paper is a primer on how the FarmTek system works and how to properly set the system up for a day of “perfect” timing.

# Perfect Timing Setup-Timing Head Summary

- Alignment: Timers need to be precisely aligned to function properly. While robust to some amount of mis-alignment, each timing head must be aimed within ~5 deg of the opposing timing head. Use the case parting line to point the timing heads at each other.
- Height: The optimum height for the timing head is 8" off the ground. Note: The tripods provided by FarmTek are too tall (13") for use with Jr. Kart drivers. While timers sometimes work when at ground level, they are too low for regular autocross cars.

# FarmTek Polaris Timer (aka Timing head)



# Yagi Antennas



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# Setting up the timing heads

- Ensure batteries are installed
- Power on the units and ensure red LED is illuminated
- Install the units on tripods
- Point the units at each other
- Voila – you have a system which will work 80% of the time and you will spend hours wondering why they don't trip properly, especially the finish. There are some caveats to how these units work, so read further to know how they work and what can go wrong.

# Timing Light Function -Infra-red transmitter and receiver.

- Two basic Parts
  - Light Transmitter – an infrared light source with a twist. The light source blinks at 2200 times per second (2.2 kHz), much like an infrared remote control
  - Light Receiver / Data Transmitter – an infrared light receiver with CPU
- The Farmtek timing lights operate by establishing a “connection” between the light transmitter and light receiver. Then, when the connection is interrupted, a radio transmission is sent to the Polaris timing head.
- The connection must be broken for a minimum of 0.012 sec (12 ms) in order for the light receiver to send the radio transmission. If the connection is broken for less than 12 ms, the light receiver ignores the interruption and waits until the 12 ms interruption occurs to transmit its data.
- The timing heads use a Fresnel Lens to concentrate the light beam from the light transmitter (similar to a light house lens) and the receiver has a similar Fresnel Lens to concentrate the beam into the light collector. This allows a properly adjusted transmitter / receiver to be placed up to 200 ft apart.

# Timing Light Diagram





# Jr Kart vs KM vs Others



# Timing Light Height Matters

## Too High

- Beam will not break long enough when Jr. Kart drivers cross finish



## Too Low

- Beam shoot under vehicles and wheels will not break beam long enough



# Radio Connections – Timing Eyes

- Clearly, the advantage of the Farmtek timing system is the elimination of wires between the timing eyes and the timing head. Proper setup will eliminate issues with this part of the timing system.
- The timing heads operate in the 903.37-921.3 MHz band. This band is used in the Amateur Radio Service and the Location and Monitoring Service (LMS). Operation of unlicensed Part 15 Devices is permitted between 902 and 928 MHz. This band is used by some older wireless LANs, wireless switches, z-Wave home automation, and others.
- It is used because it does not require an FCC license.

<https://fccid.io/frequency-explorer.php?lower=903.37000000&upper=921.37000000>

# Radio Connection – Timing Eyes

- The low power of the timing eye transmitter and distances to the Polaris receiver (timing head) require that the radio transmission path be as efficient as possible.
- A basic rule is that the radio transmission will be properly received if there is a clear line of sight between the transmitting antenna and the receiving antenna.
- The other basic rule is that the transmitter should be ~ 48” above the ground. This is to ensure that the signal is not absorbed by the pavement, but also ensures that the signal line of sight is higher than most cars participating in the event.

# Issues which cause timing errors

- Improperly aimed timing heads.

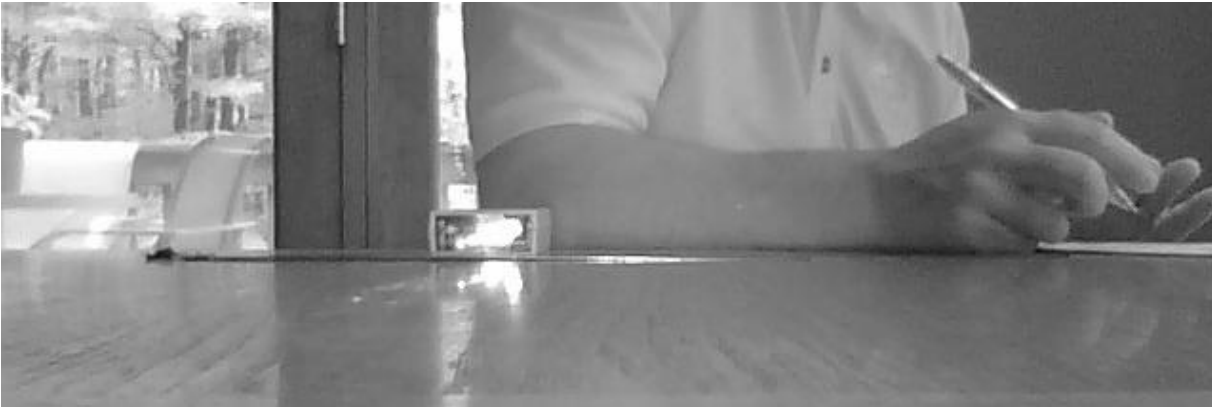
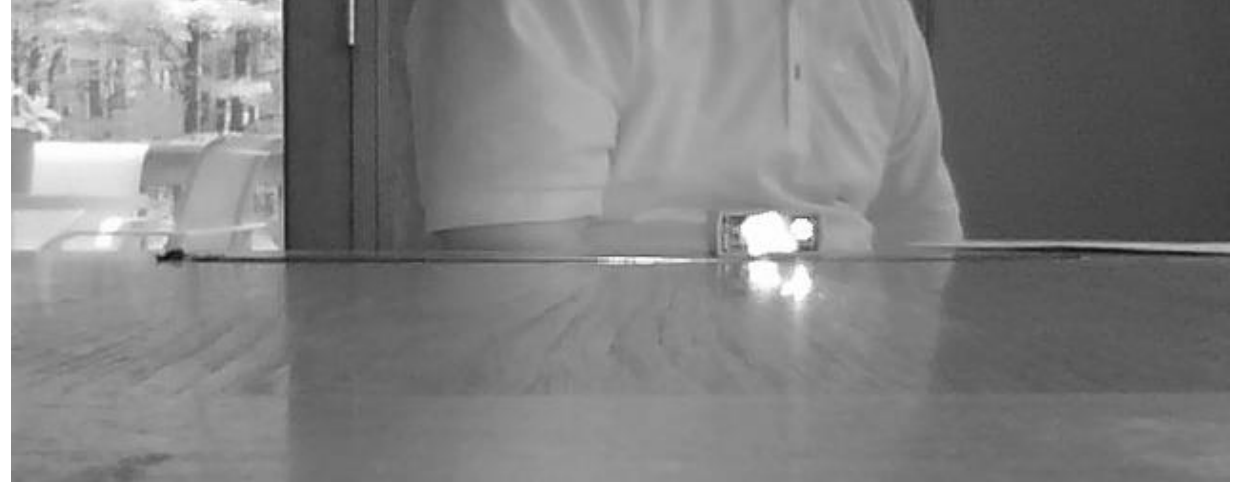
Improperly aimed timing heads prevent the light receiver from establishing a connection. This improper aiming can range from non functioning system to a partial functioning system. The light receiver must be able to detect the flashing of the transmitter and if units are not properly aimed, the flashing light may be too “dim” to detect among the background infrared light.

- Obstacles to the radio transmission.

Since the radiated power from the transmitter is quite low, the “line of sight” rule needs to be strictly followed

- Eye radio transmitter should be at least 48” above the ground to ensure maximum transmission power and to ensure the line of sight is not broken by automobiles.
- Yagi directional antennas should be used at the electric eyes and pointed directly at the Polaris timing head antenna to provide maximum signal transmission. Ensure that the yagi elements are in the same orientation as the receiver antenna (Typically vertical)
- Polaris timing head antenna should be placed in a high location, typically above pedestrian heads to ensure line of sight is not broken.
- Use of a Yagi antenna may improve the sensitivity of the Polaris timing head, remember that the Yagi is highly directional and the start, finish and wireless displays may not be in line in most circumstances.

# Infrared View of the light source



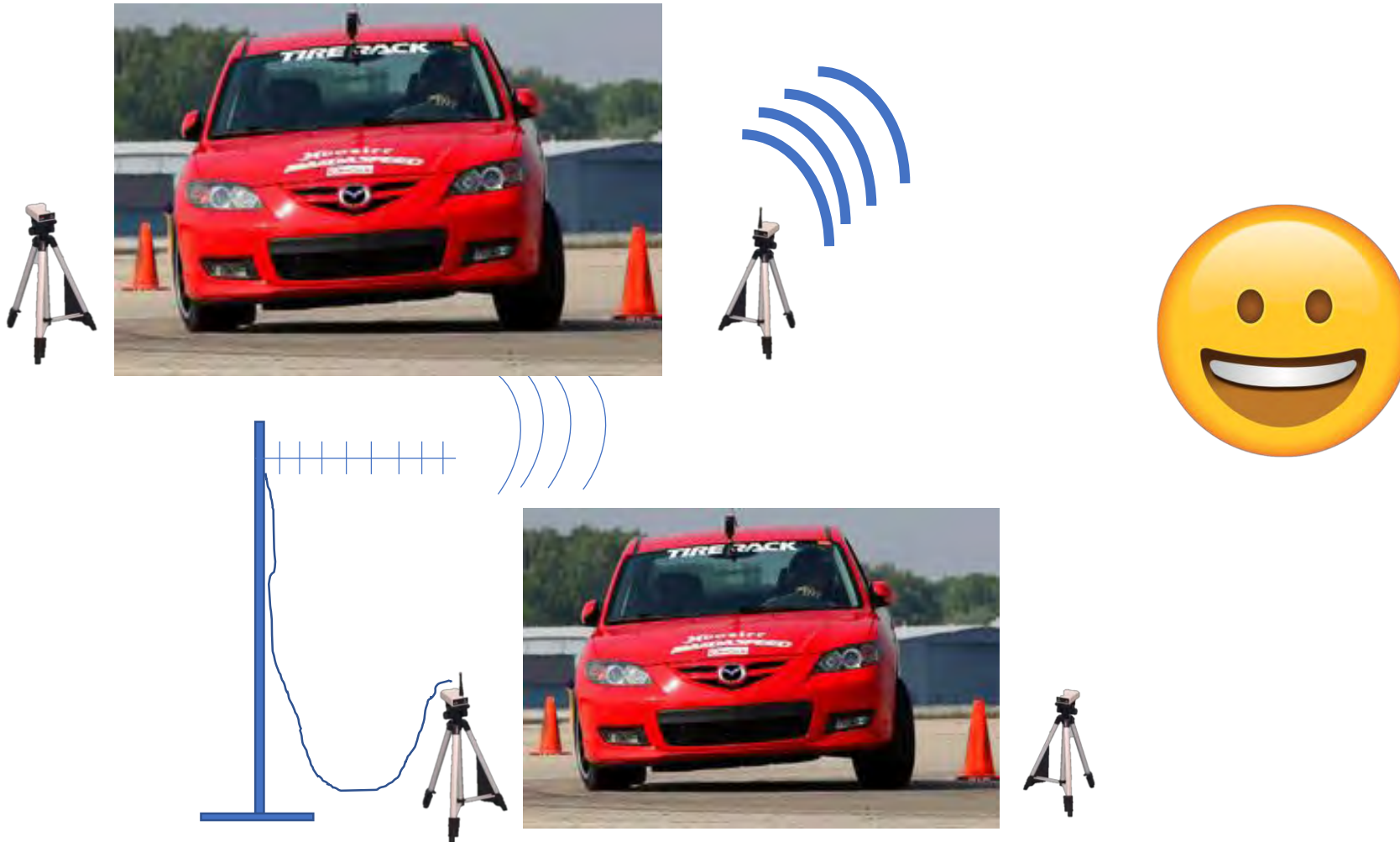
Proper alignment provides the best light signal and reduces drop outs.

# Obstacles to Radio Transmission



Placing the finishing car between the transmitter and timing head can cause missed finishes.

# Better Transmitter arrangements





# Issues which cause timing errors

- Suspect antenna cables.
  - The least robust component in the “wireless” timing system are the wires or antenna cables.
  - These cables were not designed to be installed and removed hundreds of times. Typically they are made to be installed a few times, the cables properly supported.
  - Given the environment, the cables tend to be very stiff, unsupported and this causes high stress at the connections.
  - Always inspect the antenna cables for evidence of overbending at the connections and always
- Note: The connections to the timing eyes can be quite fragile. DO NOT overtighten the connection and even though they have a hex ferrule on the wire, don't even think of using a wrench on them.

# Issues which cause timing errors

- Sunlight – it is not the sunlight!
  - Sunlight is the 2<sup>nd</sup> most erroneous root cause for timing errors (after batteries)
  - Typically, the errors in autocross timing are lack of signal when the cars cross the finish line (no finish).
  - Sunlight errors cause the Receiving Eye to be overloaded with light and washes out the signal from the Transmitting Eye. This causes a false finish to occur. So, if your timing equipment finish or start eye has false starts or false finishes, you are probably suffering from sunlight errors. While many regions create elaborate sun shades, boxes and whatnot, they are not necessary as the fix is to swap the eyes so the Receiving Eye is pointed away from the Sun

# Issues which cause timing errors

- Water

- If there is one item which is the Achilles heel, krypton, or other suitable metaphor, it is water in the electric eyes.
- The FarmTek electric eyes are not waterproof, or even water resistant.
- Most electronics which require waterproof or weather resistance are in high cost sealed containers or are “potted” with epoxy resin.
- Farmtek devices were developed for indoor use. While they are used in some outdoor applications, further development would more than likely increase costs.
- Farmtek recommended solution is highly effective and low cost. – The use of low cost “sandwich bags” from hefty or ziplock can be placed over the timing heads to be used as “rain coats”. Their transparent plastic does not interfere with the operation of the timing heads and they are clean, low cost and disposable.

# Batteries

- The most over rated fix for Farmtek components are battery replacements.
- This is because when the eyes are picked up and batteries replaced, the eyes are typically re-aligned and the units begin to operate more repeatably.
- These are digital devices. They operate using highly efficient 5V voltage regulators. The 9 volt batteries have a significant power capacity and higher voltage at low states of charge which prevent substandard operation as the battery state of charge gets low.
- FarmTek has low battery indicators on all of their devices.
  - The red (visible) power LED's on the eyes will begin to blink when the units have roughly 2 hours of power left in them.
  - The Polaris timer has a low battery indicator on the LCD display panel.
  - Did you know the typical life of the 9 volt battery in the Eyes is 72 hours! If the Eyes were powered for 12 hours per autocross event (8 am to 8 pm) the Eyes could be powered for 6 events!

# Trouble shooting summary-It is not the battery

- It is not the Batteries! – Check to see if the red LEDs are blinking, if not...
- Check the alignment of the Eyes. Both Eyes need to be aligned and pointing at each other. Use the parting line on the side of the Eye as an aiming device. Better yet use tubular alignment sights or a small laser.
- Eye Separation. While Farmtek states that the eyes work up to 200 ft apart, a more practical distance is 30 ft. The farther apart the eyes, the more critical the eye alignment. Closer is better until you get to about 3-4 ft apart, then reflected transmitter light can prevent the lights from tripping.
- Eye height. The optimum height is 8". If you are using the tripods from Farmtek, they are likely too high for Jr. Karts, especially if the carts are not tripping the finish eyes. Lower than 8" and you run the possibility of shooting under the cars and only catching the tires. High finish speeds can prevent the Eyes from tripping.
- Antenna aiming. Ensure the line of sight rule is being followed. Ensure there are no cars, corner workers, spectators in the line of sight between the antennas. Higher is better 4 ft minimum on the eye antenna, 8 ft or higher on the Polaris antenna.
- Antenna cables. Check the antenna cables for sharp bends, kinks or other damage. Pay particular attention to the wire nearest the connectors where the wire strain is high and unseen damage can occur. If you have gotten this far, you might want to install a new cable. Destroy the old cable, cut it in half. Do it now!
- Water. Water is bad. Cover the timing eyes BEFORE it rains. If you did not cover the timing eyes and the units got wet, you are in for some down time. The units need to be dried before they will work again (they will work again, when fully dried). Time to switch to your back up timing eyes. Best to pull out the back up Polaris timer as well. It will set up much faster than re-programming the eyes.
- Batteries – I told you it was not the batteries. Are the LED's blinking? You turned the unit off when the Red LED was blinking and when you turned it back on, it no longer blinks? If the units ever blink, replace the batteries.

# Next Time... Advanced Topics – FarmTek 201

- Wireless Display setup – Just follow the directions from FarmTek
- Wireless Display technology
- Timing Head Usage
  - False finish
  - Car did not finish
  - Looking back at previous times.
  - Common Setup for autocross usage
  - Programing Eyes to the Polaris timer
- Storage
- The 12 ms limit!
- FarmTek's radio transmission error management.

# Thank You

# Wireless Display

- Polaris timer transmits on the 418 Mhz frequency to the Wireless display receiver.
- This band is used in the Industrial/Business Radio Service. This band is allocated for both Federal and Non-Federal use. Operation of unlicensed Part 15 Devices is permitted between 410 and 420 MHz.

<https://fccid.io/NWNMIO52-2RA>

- The wireless display receiver is powered by the display power supply and has no batteries.





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