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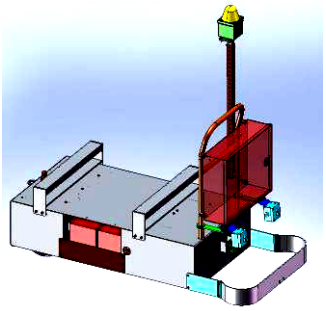
FREQUENTLY ASKED QUESTIONS



FAQ
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FREQUENTLY ASKED QUESTIONS (Continued)

1. **How fast can an AGC travel?**
   ANS.: We experimented and helped train an athlete for a triathlon. This speed is not recommended. Our vehicles are comfortable at a "creep" speed to 165 fpm and up to 225 fpm.

2. **How does the AGC know where it is?**
   ANS.: Our vehicles have an automotive grade pulse counter built into the drive motor. It is mounted on the drive motor to provide a very high resolution.

3. **How is the AGC guided?**
   ANS.: We have developed an improved digital camera algorithm which allows the AGC to perform tasks which would normally require a computer interface. The algorithm is used for multiple purposes in the decision logic of the AGC.

4. **Does an AGC need be put on the path at only one specific location?**
   ANS.: Depending on the type of system you require, "from-to" or detailed routing selection, the AGC can be introduced anywhere on the guidepath. The AGC will determine where it is when it reaches the next "STOP" plate. All location information is contained on the AGC without need for an upper level control system. The cart will travel at a slow speed until it reaches the next passive floor marker plate.

5. **Is an upper level control system required in complex systems?**
   ANS.: An upper level control system, PLC in our case, is ONLY required if communications is required with a Factory Information System or there are interlocks required for robots, conveyor or tooling interfaces.

6. **Do we need to install a wireless system in our plant?**
   ANS.: No, there is no need to install a wireless system, if you do not have one. As a matter of fact, we would prefer to have our own independent wireless system so we can control the communication traffic. If we must be on your wireless system, we would request that we be assigned as a node on the network so we can control the communication traffic.

7. **Does your communication system "speak" only when spoken to?**
   ANS.: One of the reasons we prefer a stand-alone wireless system is that we can "continuously" communicate with each cart and know where it is at all times. This allows a real time map to be shown on an HMI as well as battery updates and other diagnostic and status bits. We do not have to wait for RF or magnetic inputs to determine our carts position.

8. **How does your cart know where to STOP?**
   ANS.: We use a STEP program, based on our incremental encoder, to provide cart function and location. Passive floor markers are used to provide a hard STOP for a workstation. A soft, programmed STOP is also used where positional accuracy is less important. The STEP program is resident on the cart and therefore does not need any off-board intelligence.

9. **How do you handle the positional error (count) created by drive wheel slippage or skidding to a stop?**
   ANS.: We have 2 ways to correct the count. We can do periodic soft resets with the STEP program or passive floor marker plate can reset the encoder count to zero. Also, if we get lost, the next passive floor marker plate will re sink the program and update its location.

10. **Can your cart be routed to different destinations?**
    ANS.: A Route Selector may have to be added if the cart does not have an HMI interface. We use what we call a "JUMP" STEP to route the cart left or right from the mainline. Another STEP program feature allows us to change from guiding on the right side of the tape to left. We can use the passive floor marker plates to denote different workstation locations.

FREQUENTLY ASKED QUESTIONS (Continued)

11. How sharp of a turn can your cart accomplish?

ANS.: The radius of the turn is dependant on speed, wheel base and heading angle of the steering wheel. One approach is to look at your tightest layout condition and adjust the speed of the cart to safely negotiate the turn. If the wheel base is too long, the steering wheel may turn to sharp on a small radius causing the steering wheel to be pushed off the guidepath. For example, if you have a 25" wheel base, the turn radius (180°) should NOT be less than 35" at 90fpm. If the cart is allowed to run at a "creep" speed, the smallest radius is whatever radius which keeps the tape in camera view.

12. What happens if there are tape gaps from fork truck or pallets being pushed around?

ANS.: The cart comes with a pre-set factory dead reckoning parameter that determines the size of gap the cart will cross before faulting out. If you have an especially active crossing where the tape continually damaged, the guidepath can be epoxy painted on the floor or the tape can be covered with a clear cover tape to give added protection. Other conditions may allow a dead reckoning over larger gaps (aisles). Your safety group will need to be included in the decision to cross larger gaps.

13. What if the tape gets dirty?

ANS.: Any system requires a certain amount of housekeeping. The guidepath is no different. We suggest putting a clear cover tape over the tape to allow it to be cleaned more often. A floor scrubber can be used or it can be cleaned by hand mop. Our camera system also has an auto-teach feature to reprogram the color stripe if the color changes.

14. How do you repair the tape if it gets damaged and the steering is affected?

Ans.: We suggest cleaning the floor and existing tape with soap and water or whatever will not damage the tape. Lay the new tape over the top of the old tape. The old tape does not have to be removed unless it is all balled up and will prevent the new tape from laying flat.

15. How do we replace the tape if it is not serviceable?

ANS.: First remove a small section of tape. Clean and dry the area thoroughly. A shadow of where the tape was should still be visible. Clean and dry the remaining guidepath to be replaced. Relay the tape and begin to use.

If a shadow of where the tape had been is not visible after cleaning and drying the floor, only remove sections of tape which can be replaced by laying tape between 2 known points.

Remember, the tape is very forgiving if you mess up. Just remove the messed up tape and lay new tape. If you must change the guidepath by more than 10" to 15" in a guidepath controlled by a STEP program, you may have to change 2 of the adjacent STEPs to correct the counts between the 2 points. This is a simple task and easily accomplished. We will even help if you are having trouble.

16. Can complex paths be laid out?

ANS.: Yes. Complex layouts can be done and kept very simple with regards to control of the carts. If carts must cross paths, merge or exit a mainline, additional controls or communications may be required. Remember, keep it simple.

17. How do we get a cart to stop "exactly" where we want it to stop?

ANS.: You can get very fancy with a CAD layout and detail it on the floor and lay the tape. The path may still have to be changed to tweak the final cart position and location. We suggest that the time you spend detailing the CAD drawing instead be spent tuning the guidepath on the floor. There will always be dunnage, changes in workstation which were not communicated to you. So, you will have to change the path anyway.

We suggest having a general layout, noting the clearance and safety requirements for cart travel and workstation locations as best known. When the tape ready to be laid, contact all of the workstation owners and get their consensus of where they want a cart to stop and its position regarding access to parts or the assembly line. Use an actual cart. Drive it to the workstation manually so everyone involved

can see how the cart interfaces with operators and dunnage. Use this information to develop the actual path in the workstation. Connect the dots from workstation to workstation. Now, the changes will be minimal.

18. How can the camera see the tape?
ANS.: The cart provides its own modulated light source.

19. How does the cart know when and where to stop?
ANS.: We use inductive proximity switches and passive floor marker plates. The cart controls ignores metal in or on the floor that is smaller than 4" (nuts and bolts, concrete anchors, etc.). With a 2nd proximity switch, we can make other activities happen at intermediate guidepath locations

20. How does a cart stop at a stop?
ANS.: A cart, controlled by a STEP program, will begin to slow down approximately 20" before a programmed stop. If the cart is just going from stop-to-stop, then we double the width of tape and the cart will automatically slow down. In both cases, the electronic drive will dynamically brake the drive motor and stop the cart when the stop proximity switch is activated.

21. How does the steering wheel know what direction to turn?
ANS.: The camera follows either the right, left or center of the guidepath tape. A custom camera algorithm analyzes the direction the tape is turning and cart controls command the steering wheel to turn right or left. A steering wheel position sensor knows how far the wheel has turned. The steering wheel will not over steer or create a wheel skid scenario.

22. Will the cart bump into things left in the guidepath?
ANS.: We strongly recommend outlining the profile of the load being carried or towed to gently remind plant people not to set anything in the path of the AGC. If this cannot be done, we provide a pair of ultrasonic sensors which detect "things" out in front of the vehicle. When sensed, the vehicle will slow down and speed back up when the threat disappears. If the threat remains, the cart will come to a stop and wait for someone to clear the obstacle. We will play some annoying music, flash a light and the sensor will beep. The cart will resume normal travel when the obstacle is cleared.

23. If there are obstructions near the path (ex.: a rack structure or a bin), can they be ignored?
ANS.: Several solutions are available. Our cart changes the depth of field of the ultrasonic sensors based on speed: the faster the speed (a wider view)…the further ahead we look or the slower we go (the narrower the view)…the closer to home we look. The speeds can be changed by the end user or the tape width can be modified to slow the cart down. Another approach is to control which ultrasonic sensor is active. The cart controls can be modified by the end user such that when the cart is turning right, only the left sensor is active until the cart straightens out after the turn and vice versa. This enables a cart to effectively turn around a column and still have a cone of obstacle protection covering the front of the vehicle.

24. Are the ultrasonic sensors safety rated?
ANS.: No they are not safety rated. Safety rated laser scanners can be provided. They are quoted separately. If laser scanners are used, normally, a flexible bumper is not provided. The laser scanner has multiple programs controlling 2 zones: a warning zone and a safety zone.

25. Can flexible bumpers be used as a safety device?
ANS.: Yes, as long as a dual channel safety relay is applied along with 2 safety rated sensors which monitor the bumper movement. Each sensor has to be wired to a separate input. Usually, a flexible safety bumper will be used with some other collision avoidance sensor.

26. Are there other safety features required or supplied?
ANS.: We provide an Emergency Stop button. An additional E-Stop button can be provided and can be quoted as an option. Wide load protection can be provided if the end user requests a means to protect a

load which protruded beyond the edges of the cart. Side protection and rear bumpers can also be quoted if required.

27. Does the cart have load present sensors?

ANS.: Depending on the product being carried and the level of information the end-user requires, we can provide proximity switches or a 24vdc photo eye. Other options are available and maybe product specific. If a product, such as a pallet, is placed on the cart deck, we suggest using 2 sensors to help insure the rack has been placed on the cart and is resting level on the deck.

28. Can off-board controls be used to release the cart from a stop?

ANS.: Yes, there a variety of sensors, flags and devices that can be used to release the cart. They can be as simple as a traffic cone placed in front of the vehicle to stop and re start the cart. Or, they can be a series of interlocks, cart signals, torque tool signals and other traffic control signals.

29. How is a disabled cart recovered from an assembly line or moved off-line for service?

ANS.: Manual recovery of the cart is very simple. We do not require having a handle to lift a wheel or a motor to lift the drive and steering wheel(s) from the floor. Our manual recovery feature will continue to move the deck load or trailer train or tunnel slave cart. A simple 3 position selector switch provides steering and a 2 position auto/manual selector switch provides the service mode. The cart will drive, in creep mode, with the operator attending the cart and steering with the selector switch.

30. How can we diagnose a cart problem?

ANS.: The first and most useful method to diagnose a cart problem is to train the operators to not to become complacent with the carts moving about them. If they can be your eyes and ears on the floor, their input will quickly lead to the problem.

A basic cart uses the running light and the melody module to display and enunciate codes which provide diagnostics. An upper level cart which will probably have a HMI display which can display codes. Another way to check cart status is to view the setup screens to make sure the cart is setup correctly. The Operation and Maintenance manual will provide in-depth diagnostic information including some multi-meter readings.

31. How long will the batteries last?

ANS.: Good question! *Battery chemistry is science but battery charging is an art form.* There are many factors affecting battery “life” such as: length of guidepath, live load, number of charge cycles the battery has experienced, depth of discharge, length of charge, type of charger and voltage drop from charger to batteries. The battery pack (MK GEL or OPTIMA AGM) has been tested to last at least 8 to 10 hours at maximum rated speed, 3 foot radius turns, full battery pack and at maximum live load, on our test track. The battery tests are run continuously and also with 2 in the middle of the long leg of our test track. Field conditions at your facility will probably be different and may affect the battery “life”.

We will try to help qualify your application to provide the best and most economical battery and charging application for your system.

32. Why is there a RUN and SERVICE position on the back of the cart?

ANS.: The fail-safe brake lever has 2 positions: RUN and SERVICE. RUN is part of the drive enabling circuit and the lever must be in the RUN position to start the drive motor. The SERVICE position allows you to manually push the cart for positioning it over the tape or for removing it from the active production line to an out-of-service location.

33. Why is there a fail-safe brake on the drive motor?

ANS.: The fail-safe brake activates when the Emergency Stop button is pushed or the flexible bumper is collapsed. The cart will stop immediately.

We also use the fail-safe brake to as a parking brake when the cart is stopped.