Attachment C

End User Manual for the *GO CARD®* System MK5 Target

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Changes or modifications not expressly approved by Cubic Transportation Systems (CTS) could void the user's authority to operate the equipment.

Note: This product was FCC certified under test conditions that include the use of shielded I/O cables and connectors between system components. To be in compliance with FCC regulations, the user must use shielded cables and connectors and install then properly.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received including interference that may cause undesired operation.

FCC ID: LVCMK5

Cubic Transportation Systems (CTS) Overview

CTS is comprised of a variety of different divisions which provide equipment to various world-wide transportation authorities, including bus, rail, and parking-lot ticketing equipment. CTS-San Diego has developed a non-contact read/write storage device called a Tag (which is similar to a device known as non-contact smart-card but which is tailored to the requirements of revenue collection). Field trials have been conducted in London (on the underground) and in Washington DC (on the Washington Metro).

Equipment provided by CTS includes fare-gates, vendors, bus fare-boxes, and point-of-sale terminals. These usually include ticket transports or swipe-readers to handle magnetic tickets which are used for employee access and patron transactions. The ticket transport is to be supplemented or replaced by a device known as a Target. The Target will communicate with the Tags (which are to supplement or replace the magnetic tickets).

***GO CARD®* System**

The ***GO CARD®*** System consists of Tags, Targets, core software routines, and the associated fare collection system.

The Tag

The Tag is a non-contact read/write storage device designed to supplement or replace magnetic tickets in automatic revenue collection systems (such as subways, rail, bus, parking, etc.). The discrete component version of the Tag is packaged as a thick credit card, the custom ASIC version is packaged as an ISO thin credit card.

The Target

The Target is an interface device which, when connected to a revenue-collection controlling unit, enable that controlling unit to read and write Tag data. The Target interfaces to various pieces of fare collection equipment (such as gates, vendors, point-of-sale terminals, etc.) through a standard serial communications port. A point-of-sale terminal application could consist of an off-the-shelf personal computer and an appropriately packaged Target.

Circuitry

The Tag

The Tag contains control electronics, memory, power, and communications circuitry. An early version used a microprocessor and battery to implement the control electronics and memory. A later version replaced the battery and microprocessor RAM data memory with an external serial ferroelectric data memory (FRAM). The current version uses a custom ASIC which contains all of the circuitry. Power is coupled from the Target to the Tag by means of an induction field.

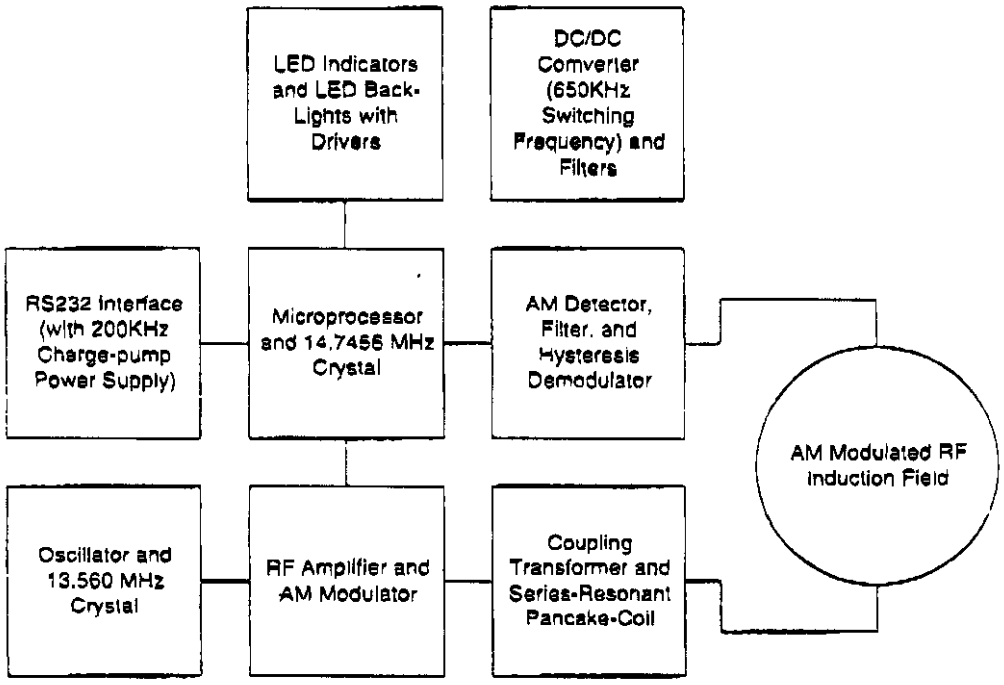
[redacted]

The Target

The Target consists of:

- a standard RS232 interface (providing 19.2, 38.4, 57.6, and 115.2 Kilo-Baud communications),
- a microprocessor and it's 14.7456 MHz crystal (for baud rate conversion and other control functions),
- an oscillator (using a 13.560 MHz crystal as the frequency determining element of the RF amplifier),
- a modulator, RF amplifier, and coupling transformer (to provide modulated RF energy to a coil),
- a tuned, series resonant, pancake-coil (acting as the primary of an air-core transformer - the secondary being a corresponding coil on the Tag),
- a detector, filter, and demodulator (which responds to amplitude changes of the RF voltage across the pancake-coil),
- a three color indicator LED and four back-lighting LEDs and,
- a DC to DC converter and filters (which provide the required regulated 5 Volts for the rest of the circuitry).

Both the Target and the Tag coils are tuned to the induction field frequency to increase the circuit efficiency, to decrease the amplitude of any generated harmonic frequencies, and to help reject out-of-band interference.



Target Block Diagram

Operation

The Target is powered from a source of 7 to 28 Volts DC, using on on-board DC/DC converter, or may be battery powered. The Target, depending upon operating mode, provides either an un-modulated or a modulated induction field which interacts with a Tag only when the Tag is in close proximity to the Target (approximately two inches or closer).

When a Tag is brought near a Target, the Tag absorbs energy from the Targets induction field. The absorbed energy provides power to some or all of the Tag circuitry (some of the operating power can be provided by a battery in the Tag if one is used).

Upon receiving sufficient power for proper operation, the Tag will, when appropriate, modulate its absorbed power (at a rate of 19,200 Baud, 38,400 Baud, or 115,200 Baud depending upon Tag version) thereby causing the Target induction field to vary in amplitude and causing the Target detector to respond to the field changes. The Target will convert the field amplitude changes to corresponding RS-232 levels and send these signals to the controlling device.

The controlling device connected to the Target would process the received signals and then send a response to the Target via an RS-232 signal. The Target would use the received RS-232 signal to modulate the intensity of the induction field (approximately 10% amplitude modulation) and the Tag would detect and process the AM signal.

Upon completion of a transaction or upon removal of the Tag from the immediate vicinity of the Target, the induction field either becomes un-modulated or is modulated at the 115,200 Baud rate. A Tag is usually held near a Target for much less than a second but the exchange of signals between Tag and Target is typically accomplished in about one-tenth of a second.

Equipment Configurations

There are two variations of the basic MK5 Target. The variations are identical except for the size of the bottom (mounting) plate. They both use the same electronic subassembly (P/N 061-1303). The standard version (P/N 061-1305) uses the larger mounting plate. The bus fare-box version (P/N 061-1304) uses the smaller mounting plate and also includes a protective plastic cover.

CTS end-item equipment can include either or both of these Targets. The end item may have various configurations.

There are four representative Target packaging or mounting methods: fully enclosed, desktop, subsurface, and surface mount. The pertinent characteristics of each of these methods and representative types of equipment are:

Fully enclosed: a standard Target is fully enclosed by a large metal cabinet. Cables are internal to the cabinet and power is provided by an internal power supply. The fully enclosed Target is typically mounted on a ticket vendor cash-box vault.

Desktop: a standard Target is enclosed in a small metal and plastic cover (with attached cables) and connected to a dedicated PC (or similar controller). Target power may be supplied by the controller or by an external small (portable computer style) power supply. The typical use for the desktop unit is for encoding Tags (i.e. card encoders, point of sale terminals, and station controllers).

Subsurface mount: The Target is mounted behind a plastic covered circular cut-out in an enclosing metal cabinet. Cables and power supply are internal to the metal cabinet. The typical use for this configuration is in passenger gates and parking lot units.

Surface mount: The Target is enclosed in a plastic or a plastic and metal housing which is then mounted on the surface of a metal enclosure. Cables and power supply are internal to the metal enclosure. The typical use for the surface configuration is in ticket vendors and bus fare boxes.

Target Installation

The Target is certified for installation in CTS equipment with the following constraints:

Fully enclosed: an un-enclosed Target may only be used inside a totally enclosing metal housing.

Example: a Target mounted inside a vender to access a Tag on a cash-box.

Desktop: a desktop unit must consist of the Target mounted in a metal and plastic housing with shielded power and signal cables.

A complete desktop kit (061-1012) for retrofitting to an existing PC consists of a MK5 Target (mounted in a metal and plastic dome with attached signal and power cables) and a regulated 12 Volt power supply and AC power cord.

Subsurface Mount: the Target is mounted vertically or horizontally on the inside fare collection equipment and accessed externally by the patron or employee.

An internal vertically mounted, externally accessed Target must be mounted so that:

a. the access to the Target is via a 4.5" diameter opening in a metallic surface
b. the front surface of the Target must be recessed by 0.2" or more behind the opening
c. the surface containing the opening must have an area of at least TBD sq. in.

Example: a target incorporated into a new or field-modified vendor for access by patrons with Tags.

An internal horizontally mounted, externally accessed Target must be mounted so that:

a. the access to the Target is via a 4.5" to 5.0" diameter opening in a metallic surface
b. the front surface of the Target must be recessed by 0.2" or more behind the opening
c. the surface containing the opening must have an area of at least TBD sq. in.

Example: a Target incorporated into a new or field-modified gate for access by patrons with Tags.

Surface Mount: the Target is mounted vertically or horizontally on the outside of fare collection equipment and accessed externally by the patron or employee.

An external vertically mounted, externally accessed Target must be mounted so that:

a. the Target is contained in a surrounding housing which includes a conducting ring
b. the conducting ring is in the same plane as, or above, the front surface of the Target
c. the surface the Target is mounted upon must be metallic and have an area of at least TBD sq. in.

Example: a Target retro-fitted to an existing vendor for access by patrons with Tags.

An external horizontally mounted, externally accessed Target must be mounted so that:

a. the Target is contained in a surrounding housing which includes a conducting ring
b. the conducting ring is in the same plane as, or above, the front surface of the Target
c. the surface the Target is mounted upon must be metallic and have an area of at least TBD sq. in.

Example: a Target retro-fitted to an existing gate for access by patrons with Tags.