SIEMENS


Rail Automation

# What is ACSES?

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Siemens, a specialist in the area of US Cab Signal design, offers a carborne product that provides both Civil Speed Enforcement and Positive Train Stop capability in one integrated package. This product is known as the Advanced Civil Speed Enforcement System (ACSES).

Working in conjunction with existing Cab Signaling systems, ACSES acts as an overlay, enforcing predefined civil speeds and ensuring positive stops at all interlockings when Cab Signal is receiving a restricting aspect.

In contrast to continuous Cab Signaling products, which employ modulated carriers in the rails to provide a continuous stream of information to the train, ACSES relies on an intermittent approach to information delivery. The two systems together provide an FRA approved PTC implementation.

Passive Transponders are placed between the rails at convenient locations along the right-of-way. Each Transponder is capable of transmitting "packages" of information to the train as it passes over. This information describes the Civil Speed Restrictions between this transponder set and the next. In this way ACSES is able to enforce Civil Speeds and Positive Train Stops without the need of a continuous stream of data.


Since ACSES is an intermittent overlay type enforcement system it can be integrated with your current Cab Signal system through our ATC Interface Unit (AIU) or if you need 9-Aspect capability with our 9-Aspect Cab Signal system. The choice is yours.

### System Overview

Siemens designed and implemented ACSES for AMTRAK® on the Northeast Corridor (NEC).

ACSES works in conjunction with the Siemens "9-Aspect Cab Signal System" presently installed on the NEC. It can also be interfaced to your existing non-Siemens Cab Signal system by means of a Siemens ATC Interface Unit (AIU), See "ACSES Interface Options".

Cab Signal system ensure "Safe Train Separation" and "Signal Speed Enforcement" while the ACSES acts as an overlay to the Cab Signaling system to enforce Civil (Track) Speed Restrictions, temporary (workzone) speed restrictions and Positive Train Stops (PTS) at interlocking home signals. These satisfy the core mandates of PTC.

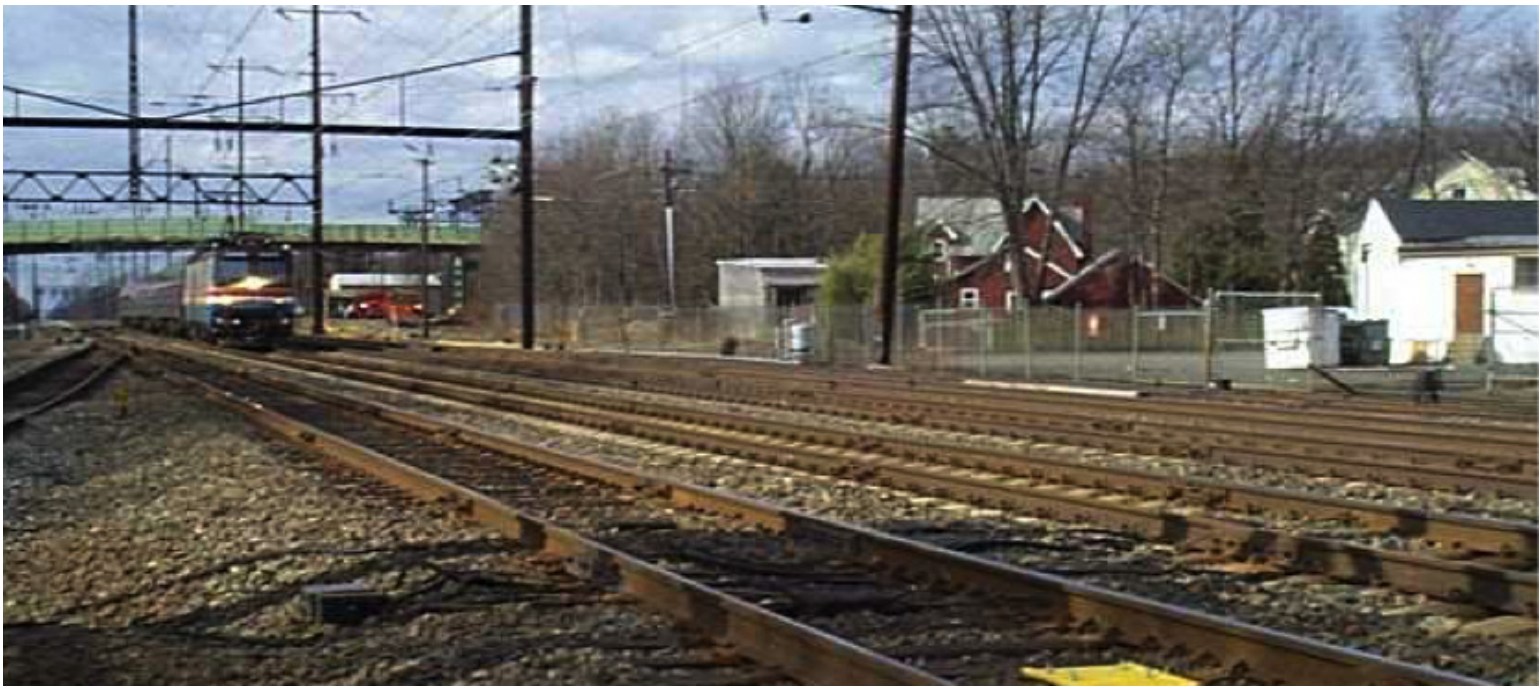
ACSES utilizes passive (fixed) transponders at convenient wayside locations.

ACSES utilizes sets of wayside transponders installed at home signals, distant signals, pre-distance signals, block points, or cut section locations to communicate to the on-board ACSES the Civil (Track) Speed Restrictions for the territory ahead, thereby ensuring that speeds are kept safe for the various types of restrictions not caused by train occupancy (bridges, curves, tilting, etc.).

ACSES operates under three distinct types of territories: Non-ACSES Territory, ACSES Territory and ACSES Installation Territory.

Within ACSES territory, ACSES has two main areas of operation, interlocking areas and automatic block (between interlockings) areas.  Within these two areas, ACSES provides different functions depending upon whether the Cab Signal system is operating normally or is inoperative.

ACSES also supports several miscellaneous non-civil speed related functions, which are Phase Break control, Power Break control, Tilt On/Off control and the use of Temporary Speed Restrictions for work crews.



### Non-ACSES Territory

This mode of operation is initiated when ACSES is turned on, or at the end of ACSES Territory or when passing a transponder set identifying the end of Installation Territory.

In this mode of operation the ACSES does not enforce civil speed restrictions, but does enforce a speed cap. This speed cap is given by a transponder set at the exit of ACSES Territory. While in this mode, if transponders are installed the following (optional) miscellaneous functions are enforced:

- Phase break
- Power break
- Tilt on/off (high-speed train only)
- Temporary speed restrictions (less than speed cap)

### ACSES Territory

This mode of operation is enabled after the train has passed a transponder set including a Civil Speed and/or a PTS.

In this mode of operation the ACSES is enforcing the following:

- Permanent civil speed restrictions
- Temporary civil speed restrictions
- Positive train stop
- Phase break
- Power break
- Tilt on/off (high-speed train only)

### ACSES Installation Territory

This mode of operation is enabled after the train has passed a transponder set directing the start of ACSES Installation Territory. While in the Installation Territory, the on-board ACSES system is inhibited from enforcing information received from future transponder sets. This is to allow transponder sets that are being installed and not yet placed in-service to be ignored by the on-board ACSES. When the territory is ready to be placed in-service, the Installation Territory directives are removed.

This territory is exited when a train passes a transponder set directing the end of ACSES Installation Territory.

### Position! Position! Position!

ACSES is a distance-based positioning system. This distinguishes it from Cab Signaling systems, which are speed-based systems. Positioning is critical for ACSES because Civil (Track) Speeds exist at specific locations along the right-of-way as opposed to Signal Speeds, which change with traffic flow.

ACSES establishes its position from the transponder sets it encounters. In between transponder sets train positioning is ascertained by counting the speed pulses from the tachometer. This technique is known as “Dead Reckoning”.

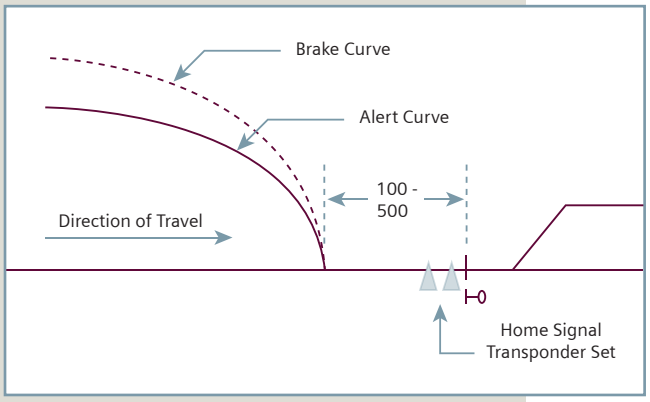
Any accumulated error is reset when the train encounters the next transponder set. Slip/Slide compensation adjusts for any error along the way. In this was ACSES is able to maintain a high level of accuracy.

### Enforcement on a Curve

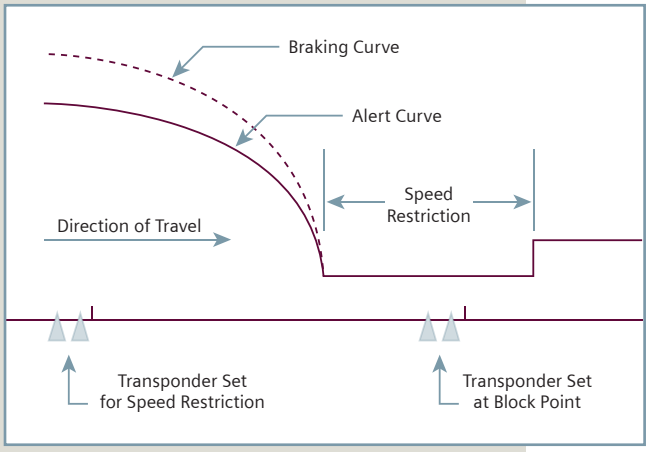
ACSES incorporates alert and braking curves to provide profile type braking characteristics for both Civil Speed Restrictions and PTS.

When the train speed exceeds the alert curve, an audible alarm sounds and the operator must apply brakes within 8 seconds to forestall a penalty. If he returns the train's speed to the civil speed limit the alarm is silenced.

However, if the operator does not slow the train down and he exceeds the braking curve, penalty brakes are immediately applied. This penalty application is released once speed is at or below the Civil Speed. This is called a "Running Release".

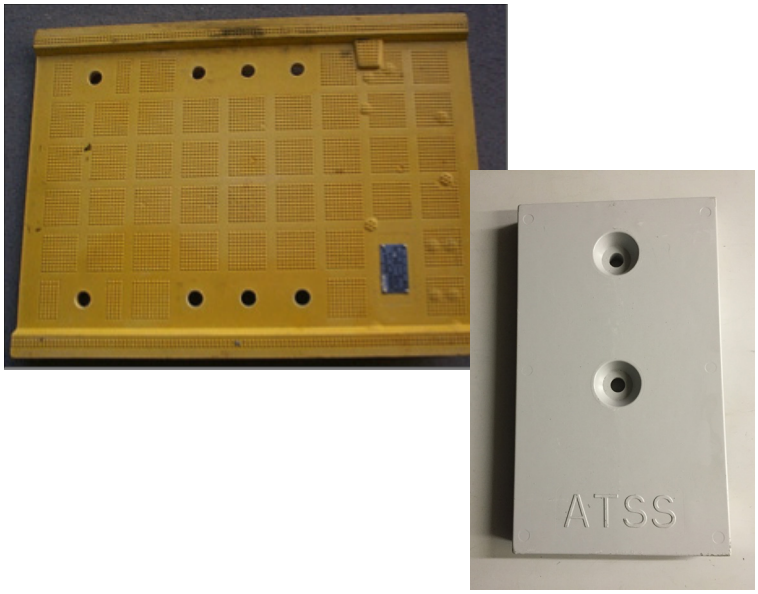



Braking Curves for PTS at Home Signal




Braking Curves for Civil Speed Restriction

### Transponder Top View




### ACSES Components

ACSES is composed of both wayside and on board components. The components are:

- Passive Transponders
- Axle Generator
- Antenna & CTV
- ACSES On-Board Computer
- Operator Display
- Data Radio

### Transponders

Transponder sets are mounted between the rails and are composed of no less than two (2) and no more than four (4) physical transponder devices. This is done to improve reliability, increase information capacity and provide automatic identification of traffic direction.

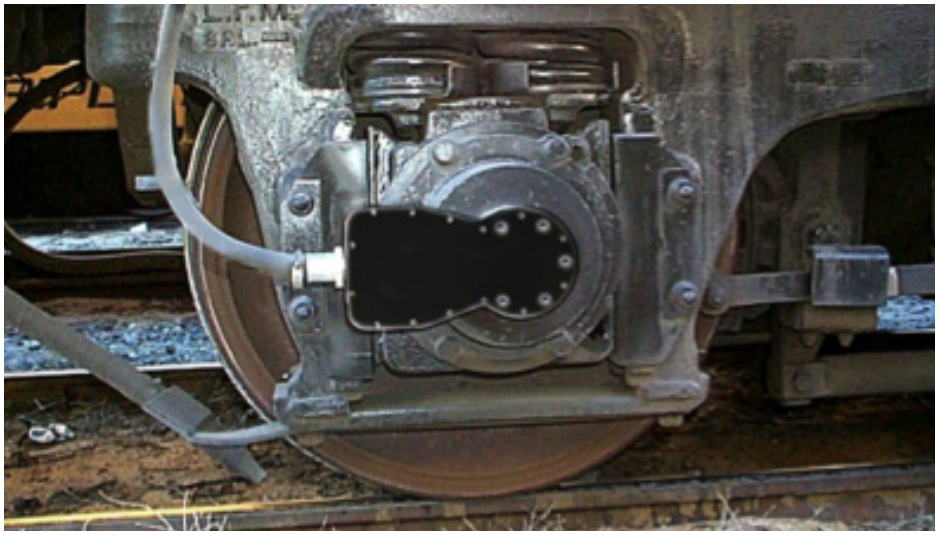
### Transponder Top View

Transponder sets are not required to be located at the start of civil speed restrictions. They can be placed at convenient locations such as signals or cut sections where track crew access already exists. Information contained within the transponders points to the start and duration of civil speed restrictions ahead.

The transponders are passive devices requiring no wayside power supplies. Their programming is accomplished by means of a "plug" that is inserted into each transponder. The energy required to activate the transponder is transmitted by an antenna mounted underneath the vehicle. The antenna then picks up the information contained within the transponders "plug".

Transponder Bottom View

Axle Generator Assembly



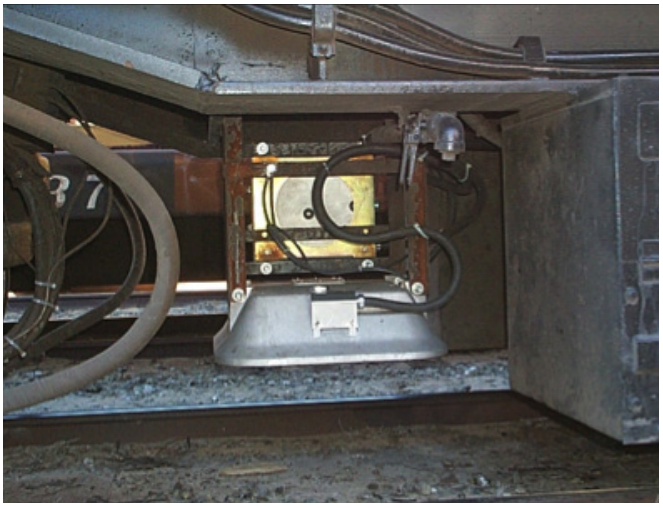
### Transponder Bottom View

Each transponder set is "linked" to the one prior to it and the one after it. As the train traverses transponder sets, ACSES uses the linking distance to know when to expect the next transponder set. By this method, missing transponder sets are detected.

### Axle Generator

Speed pulse information is supplied to ACSES via a Siemens designed end-of-axle generator or a similar type of speed pickup.

Using a high-resolution variable reluctance speed sensor and a 60-tooth gear, this unit produces a signal to allow accurate train positioning (better than 1%) and speed measurement.



Antenna and CTV Box

### Axle Generator Optimization

The axle generator also contains a variable reluctance speed sensor with a 40-tooth gear that is available for use with an ATC system.

### Antenna & CTV

The antenna & CTV provide a field proven means by which transponders can transfer information to the ACSES on-board computer.

The antenna is mounted under the vehicle and is connected through the CTV to the ACSES on-board computer. When the vehicle is in motion, the antenna is turned on and continuously transmits a sweep frequency of 27.115 MHz downward to the tracks.

### Antenna and CTV Operation

When the train passes over a transponder, the 27.115 MHz carrier powers the transponder, which allows it to send a 4.5 MHz signal back to the train with coded information representing the restrictions ahead.

In order to properly channel the electromagnetic field radiation, the antenna features mechanical and electromagnetic protection plates on all its surfaces, except the bottom one where the electromagnetic field is transmitted.

## ACSES On-Board Computer

Designed and developed by Siemens, the ACSES on-board computer employs the same distributed micro-controller architecture that is used in our 9-Aspect Cab Signaling systems.

Integrated into a single lightweight cardfile are several half-height circuit boards, which comprise the ACSES on-board computer along with the antenna interface. The circuit boards handle processing of all the digital and serial I/O for the system, as well as the system logic and event recording functions.

The ACSES system logic was designed for AMTRAK® and is being utilized on all locomotives that run on the NEC, including the Acela™ High Speed trains and tenant locomotives, and is the same across all these railroads.

The ACSES on-board computer system logic provides departure test capability and is able to be configured for a given vehicle by PC interface software. This PC software is also be used to download event data from the event recorder located within the ACSES cardfile.

## Cardfile with PCBs

The ACSES on-board computer is a vital system. It employs both hardware and software crosschecking techniques to ensure vital operation. These techniques were developed by Siemens and are used in our 9-Aspect Cab Signal system, not to mention several other ATC products already in service.

## Operator Display

Siemens offers an operator display that integrates both our 9-Aspect Cab Signal display along with the ACSES display.

Developed for AMTRAK® by Siemens, the Aspect Display Unit (ADU) displays both the Cab Signal Aspect Speed and the ACSES Civil (Track) Speed in three-digit numeric form. An “underline” indicator under each numeric display illuminates, informing the operator which displayed speed is lower and which is currently being enforced.

**ACSES and ATC ADU**

Original


New


**Cardfile with PCBs**

## Siemens ACSES and ATC ADU

The ADU also contains indicators which inform the operator whether ACSES is cut-in, cut-out or failed. A “- - “ on the ACSES numeric display indicates a missed transponder set or that ACSES is not enforcing civil speeds.

## Civil Speed Restrictions

Civil speed restrictions are classified in two categories: Permanent Speed Restrictions and Temporary Speed Restrictions.

## Permanent Speed Restrictions

Permanent civil speed restrictions are those restrictions that are placed into the permanently mounted transponder sets which include data for both directions of travel and define civil speeds for bridges, curves, hills, interlockings, etc. Permanent speed restrictions do not generally change unless there is a physical change to the tracks.

## Temporary Speed Restrictions

ACSES can enforce temporary speed restrictions from temporary transponders (those placed by work crews).

Three sets of transponders are used for a temporary restriction. The first transponder set is the Advance Warning set. The second is the Start Temporary Restriction set and the third is the Resume set.

When ACSES encounters an Advanced Warning transponder set the train will immediately start to decelerate so that it will be able to be at the prescribed temporary speed upon arriving at the Start Temporary Restriction set.

This is because the Advance Warning set is usually placed at braking distance from the Start set of the temporary speed restriction.

For bi-directional temporary speed restrictions, four transponder sets are required.

Temporary speed restrictions supersede any other speed restriction, unless a lower speed restriction is received.

Upon encountering the Resume set, ACSES returns to the last civil speed enforced for that section of track. Wayside temporary sets are replaced by TSR’s via Data Radio in ACSES II.

*"PTC is defined as the means to prevent train collisions and overspeed accidents by requiring automatic control systems to override mistakes by human operators."*

**Source, NTSB**

### Positive Train Stop (PTS)

One of the most critical and sought after features of ACSES is its ability to provide Positive Train Stop.

Current Cab Signal technology only allows for a restriction aspect of 20 mph when approaching a red home signal which may be calling for a stop and proceed or an absolute stop.

ACSES implements the PTS by targeting a stopping point just ahead of the home signal and enforcing train speed using its braking curves. Violation of the braking curve results in brakes being applied. Once stopped under a PTS, the operator pushes the Stop Bypass pushbutton after receiving permission from central control to release the train.

### ACSES Interface Options

Siemens has designed the ACSES on-board computer to interface seamlessly with our current 9 Aspect Cab Signaling system. However, you may be asking, "I already have a Cab Signaling system, can ACSES work with my existing system?" The answer is Yes!

Siemens is the only carborne supplier currently offering a solution to your Cab Signal interface question. Our ATC Interface Unit (AIU) allows you to interface your current Cab Signaling system to ACSES via our Aspect Display Unit (ADU).

The AIU converts discrete digital inputs connected to your Cab Signaling Aspect outputs to a serial message that is sent to ACSES through the Siemens ADU.

This convenient and economical solution allows you to add ACSES capabilities to you railroad without investing in a Cab Signal system upgrade or replacement.

### Summary of Characteristics

- No Continuous Communication Required
- Passive Transponders (No External Power Supplies Required)
- Braking Curves Instead of Time
- Train Type Dependent Braking Curves
- Grade Compensated Braking Distances
- Permanent Speed Restrictions
- Temporary Speed Restrictions
- Positive Train Stop at Interlocking
- More Restrictive Braking Curves for PTS
- Missing Transponder Detection Through "Linking"
- Overspeed Detection & Running Release
- Integrated Operator Display
- On Board Departure Test
- On Board Data Logger
- Vehicle Parameters Configurable by Laptop PC
- -40°C to +70°C Operation

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