RAIL COMMUNICATION SOLUTIONS

SINCLAIR
A DIVISION OF NORSAT INTERNATIONAL INC.

EXPERIENCE IN THE RAIL INDUSTRY

Wireless connectivity is essential for a “fail-safe” Positive Train Control (PTC) system, which serves as a railway protection system designed to automatically stop a train before accidents such as collisions and derailments occur. It requires integrating thousands of components across the telecommunications spectrum, such as GPS, Wi-Fi, radios, cellular technology, antennas, base stations, and first-of-its-kind software. These technologies can monitor the precise locations, directions and speeds of trains and relay time-sensitive directives to train operators to prevent unsafe train operation.

Sinclair Technologies is a pioneer in developing antenna and RF conditioning technologies that cover a wide range of operating frequencies from low band to 6000 MHz. Sinclair’s products guarantee excellent wireless connectivity for railway operators to exchange real-time command and control information to ensure operational safety. Sinclair offers a wide range of rail technologies, including Positive Train Control (PTC), GSM-R, LTE-R, Tetra, P25, and RFID that meet “mission-critical” standards to ensure the implementation of a “fail-safe” system. Sinclair also develops wayside, base station and locomotive solutions that allow for highly reliable wireless coverage. It offers an extensive product portfolio of wireless communication equipment, including specialized collinear and dipole antennas, train-top mobile antennas, pass/ reject filters, and directional dual yagi and panel antennas. With a ruggedized design, Sinclair’s antennas can withstand extreme conditions like harsh weather, highspeed travel, and vibration. This durability has made Sinclair’s Excaliber model the standard component for railway communications worldwide.

SINCLAIR'S ANTENNAS ARE BUILT TO OPERATE IN EXTREME CONDITIONS

SD214

SY203

GPS SATELLITE

ST221

SM2600D

SY206

SD212

SY2062

BASE STATION

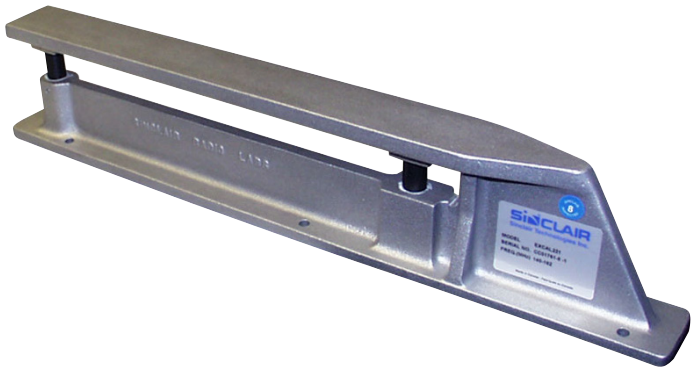
WAYSIDE STATION

FP201

SD210

EXCALIBER RAIL ANTENNAS

Excaliber ST221 and ST321 series of low profile VHF antennas have become the North American standard antenna for railroad locomotive service. They are designed for a wide range of mobile transportation applications such as trains, taxis, police cars, emergency vehicles, buses and trucks. The rugged cast aluminum design ensures consistent dependable performance, relatively inconspicuous appearance and is resistant to damage.



KEY FEATURES

› **Low profile**
As low as 2.5 inches and suitable for a wide range of compact mobile transportation applications

› **Durable**
Made from cast aluminum which is resistant to damage under extreme weather conditions

CUSTOMIZABLE OPTIONS

› N-Female or UHF-Female connector option

› Extremely low profile option

› Wideband option

Models	ST221		ST221-LP	ST321
Frequency Range	138 to 174 MHz	217 to 223 MHz	159.5 to 225 MHz	380 to 520 MHz
Average Power Input (max)	300 W	300 W	300 W	50 W
Bandwidth	2.5 MHz	6 MHz	2 MHz	15 to 20 MHz
Gain	2.1 dBi	2.1 dBi	2.1 dBi	2.1 dBi
Input VSWR (max)	1.5:1	1.5:1	1.5:1	2:1
Pattern	Omni-directional	Omni-directional	Omni-directional	Omni-directional
Height	4 in (101.6 mm)	4 in (101.6 mm)	2.5 in (63.5 mm)	2.5 in (63.5 mm)
Weight	7 lbs (3.17 kg)	6.3 lbs (2.85 kg)	3.9 lbs (1.76 kg)	3 lbs (1.36 kg)
Temperature Range	-40 to +140°F (-40 to +60°C)	-40 to +140°F (-40 to +60°C)	-40 to +140°F (-40 to +60°C)	-40 to +140°F (-40 to +60°C)

EXCALIBER RAIL ANTENNAS

Excaliber ST221R, ST321R and ST421R are rugged radome-enclosed antennas specifically designed for rail and heavy transport applications. The ST421R covers both the public GSM and railway GSM-R frequency bands. The ST221R and the ST321R cover VHF and UHF bands, respectively. The low profile makes them ideal for train use where antenna height is limited.

KEY FEATURES

› Low profile

› Suitable for both fixed and mobile installations

› Proven performance in harsh environments

CUSTOMIZABLE OPTIONS

› N-Female or UHF-Female connector option

› Fire retardant radome option

Models	ST221R	ST321R	ST421R
Frequency Range	132 to 174 MHz	380 to 512 MHz	764 to 960 MHz
Bandwidth	1, 1.3, 2 MHz	14 to 20 MHz	42, 64, 90 MHz
Gain	2.1 dBi	2.1 dBi	2.1 dBi
Input VSWR (max)	1.5 : 1	1.5 : 1	1.5 : 1
Polarization	Vertical	Vertical	Vertical
Pattern	Omni-directional	Omni-directional	Omni-directional
Average Input Power (max)	300 W	30 W	200 W
Height	4.8 in (122 mm)	3 in (76.2 mm)	2.1 in (53.3 mm)
Weight	3 lbs (1.36 kg)	5 lbs (2.26 kg)	2.5 lbs (1.13 kg)
Temperature Range	-40 to +140°F (-40 to +60°C)	-40 to +140°F (-40 to +60°C)	-40 to +140°F (-40 to +60°C)

FP161R-200 & FP220R-161

Sinclair's FPxxxRxxx-(C) series band pass / band reject lumped element filters are compact, making them convenient to be installed with other RF devices. These filters provide superior performance for channel isolation between close frequency bands. They can be used both for vehicle and base station applications.

KEY FEATURES

› Suitable for close frequency band signal isolation

› Designed for panel surface mount

› Compact construction with one N-male connector and one N-female connector

› 100 Watts power handling capability

Models	FP161R220/098-NMF	FP220R161/098-NMF
Frequency Range - Pass Band	160 to 162 MHz	217 to 223 MHz
Frequency Range - Reject Band 1	217 to 223 MHz	160 to 162 MHz
Frequency Range - Reject Band 2	88 to 108 MHz	88 to 108 MHz
Average Power Input (max)	100W	100W
Bandwidth	2 MHz	6 MHz
Pass Band Insertion Loss (max)	0.7 dB	0.7 dB
Rejection Level	70 dB	70 dB
Dimension (H x L x W)	0.96 x 4.83 x 1.45 in (24 x 123 x 37 mm)	0.96 x 4.83 x 1.45 in (24 x 123 x 37 mm)
Weight	0.2 lbs (0.09 kg)	0.2 lbs (0.09 kg)
Temperature Range	-22 to +140°F (-30 to +60°C)	-22 to +140°F (-30 to +60°C)

SM2601D

This multi-band, multi-port transport antenna platform is designed to provide the full access to multiple wireless networks simultaneously. The SM2601D comes with 5 ports, one for PTC band, one for GNSS, one for WiFi and two broadband ports for 694-2700 MHz full band. They feature a low profile and unobtrusive black housing that is perfect for mounting to a typical metal vehicle rooftop with minimal visual impact.

KEY FEATURES

› **5 in 1 Antenna Farm**
› **Broadband/Multi-Band**
From VHF throughout to 6000 MHz
› **Durable**
Heavy duty base plate equipped with a weather resistant and fire tested radome
› **Easy Installation**
A single side or bottom cable exit point to avoid multiple access holes
› **Low Profile**
Fits tight height constraints on vehicles & other applications

CUSTOMIZABLE OPTIONS

› Regular GNSS, or Triband high-precision GNSS module available
› Bottom or side cable exit point
› 220 MHz or 256 MHz frequencies for PTC
› Dual 694-2700 MHz elements for diversity, LTE MIMO or different radios
› Expandable to support additional radio systems using Sinclair's combining solutions
› Custom feed cable lengths and connectors are Available
› Different combinations of antenna elements are available
› 5G coverage available upon request

• The two broadband ports have identical broadband radiation element, which can be used for diversity or MIMO purpose. They can also be used for different radios providing maximal flexibility for a multiple radio system.

• The PTC port covers 219-223MHz. WiFi port covers 2400-6000MHz full band applicable for various WiFi systems. The GNSS module features a high-gain low noise amplifier and a saw filter, and it supports GPS, Galileo, GLONASS, and Beidou.

FP20107 SERIES

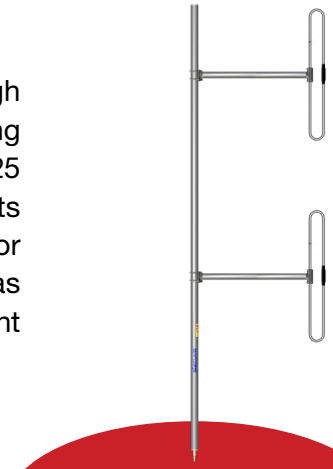
The FP series band pass filters are designed to:

› Protect one receiver further from front-end overload by carriers of co-located transmitters.
› Suppress IM generation in one transmitter by protecting it further from incoming carriers of co-located transmitters (usually in conjunction with a ferrite isolator).
› Suppress sideband noise of a single transmitter on co-located receiver frequencies.

Models	FP20107 series
Frequency Range	108 to 174 MHz
Average Input Power (max)	90 to 400 W
Impedance	50 Ω
Input Connectors	N-Female
Input VSWR (max)	1.5 : 1
Insertion loss (max) Tx to Ant	3 dB
Insertion loss (min)	0.5 dB
Output Connectors	N-Female
Depth	7 in (178 mm)
Width	7 in (178 mm)
Temperature Range	-40 to +140°F (-40 to +60°C)

SD210 SERIES

The SD210-L series of antennas is unique in its high efficiency and exceptionally wide bandwidth, covering the frequency ranges of 118-138, 138-174, or 109-225 MHz with a VSWR of 1.5:1 or better. Because of its bandwidth, the SD210-L series is perfectly suited for multicoupled systems. The SD210-L low PIM antennas use industry-leading designs that offers excellent bandwidth and high reliability.



Flange mount connectors available for enhanced durability

Inverted version available with new top cap design for extra robustness

Models	SD241 Series (International) SD210E Series (North American only)	SD242 Series (International) SD212E Series (North American only)	SD244 Series (International) SD214E Series (North American only)
Frequency Range	118 - 138 MHz 138 - 174 MHz 190 - 225 MHz	118 - 138 MHz 138 - 174 MHz 190 - 225 MHz	118 - 138 MHz 138 - 174 MHz 190 - 225 MHz
Average Input Power (max)	300 W	300 W	300 W
Gain (nominal)	2.0 or 2.5 dBd	5.0 or 5.5 dBd	8.0 or 8.5 dBd
Input VSWR (max)	1.5 : 1	1.5 : 1	1.5 : 1
Pattern	Offset or Bi-directional	Offset or Bi-directional	Offset or Bi-directional
Polarization	Vertical	Vertical	Vertical
Length/ Height	60 in (1524 mm)	120 in (3048 mm)	240 in (6096 mm)
Weight	9 lbs (4.09 kg)	23.2 lbs (10.5 kg)	Up to 63 lbs (28.6 kg)
Temperature range	-40 to +140°F (-40 to +60°C)	-40 to +140°F (-40 to +60°C)	-40 to +140°F (-40 to +60°C)

SY203

The SY203 series of antennas consist of a 3-element yagi of outstanding durability and performance. All elements including the folded dipole are maintained at DC Ground potential for lightning protection. All elements on this antenna are attached to the boom with solid cast aluminum clamps.

This highly versatile antenna is supplied as an end mount yagi, or the SY203 series can be ordered as a center mount.

As with other yagis, this VHF antenna is available in multiple-unit arrays for added gain.

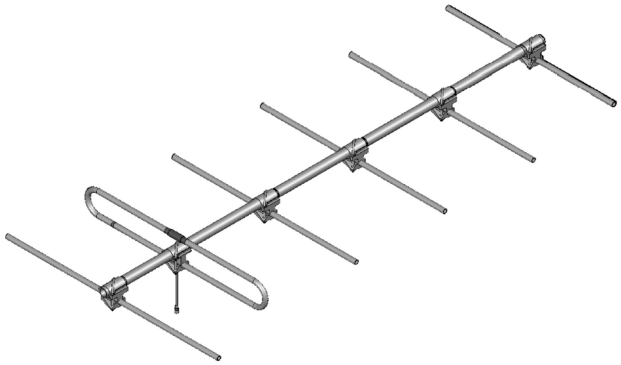
Electrical Specifications	SY203(C) Series	SY203(E) Series
Frequency Range	138 to 174 MHz	138 to 174 MHz
Bandwidth	6 to 7 MHz	6 to 7 MHz
Connector	N-Male	N-Male
Gain (nominal)	5.5 dBd (7.6 dBi)	5.5 dBd (7.6 dBi)
Input VSWR (max)	1.5:1	1.5:1
Polarization	Vertical or Horizontal	Vertical or Horizontal
Impedance	50 Ω	50 Ω
Pattern	Directional	Directional
Horizontal beamwidth (typ)	87 degrees	87 degrees
Vertical beamwidth (typ)	61 degrees	61 degrees
Average Power Input (max)	200 W	200 W
Front-to-back Ratio (typ)	12 dB	12 to 17 dB
Lightning protection	DC ground	DC ground
Mechanical Specifications		
Dimensions (W x D x H)	42 in x 6.5 in x 40.1 in (1067 mm x 165 mm x 1019 mm)	42 in x 6.5 in x 75.3 in (1067 mm x 165 mm x 1913 mm)
Weight	3.2 lbs (1.45 kg)	5.5 lbs (2.5 kg)
Mounting Hardware (Included)	Clamp001	Clamp001
Environmental Specifications		
Temperature range	-40 to +140°F (-40 to +60°C)	-40 to +140°F (-40 to +60°C)

SY206

The SY206 series of antennas consists of a six-element yagi of outstanding durability and performance. All elements including the folded dipole are maintained at DC Ground potential for lightning protection. All elements on this antenna are attached to the boom with solid cast aluminum clamps.

This highly versatile antenna is supplied as a standard mount yagi, or, as an endboom mounted unit.

As with other yagis, this VHF antenna is available in multiple-unit arrays for added gain. Horizontally or vertically parallel kits of 'H' frames can readily be supplied to mount two or four yagis with a common feed.



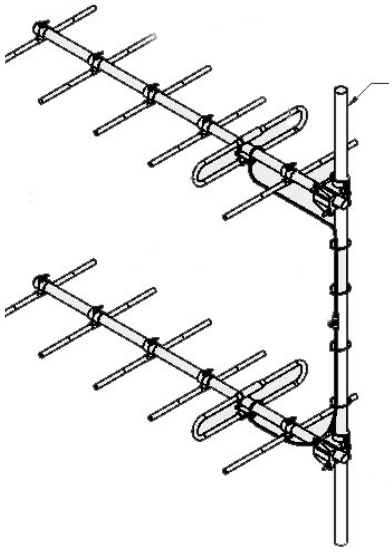
Electrical Specifications	SY206(E) Series
Frequency Range	137 to 225 MHz
Connector	N-Male / N-Female
Gain (nominal)	9.5 dBd (11.6 dBi)
Input VSWR (max)	1.5:1
Polarization	Vertical or Horizontal
Impedance	50 Ω
Pattern	Directional
Horizontal beamwidth (typ)	54 to 56 degrees
Vertical beamwidth (typ)	44 to 46 degrees
Average Input Power (max)	200 W
Front-to-back ratio (typ)	17 dB
Lightning protection	DC ground
Mechanical Specifications	
Width	26.75 to 42 in (679 to 1067 mm)
Depth	5.25 to 6.1 in (133 to 155 mm)
Length/Height	63 to 113.38 in (1600 to 2880 mm)
Weight	12.5 lbs (5.68 kg)
Mounting Hardware (Included)	Clamp001 / Clamp008
Environmental Specifications	
Temperature range	-40 to +140°F (-40 to +60°C)

SY2062

The SY206 series of antennas consists of a six-element Yagi of outstanding durability and performance. All elements including the folded dipole are maintained at DC Ground potential for lightning protection. All elements on this antenna are attached to the boom with solid cast aluminum clamps.

This highly versatile antenna is supplied as a standard mount Yagi, or, as an end boom mounted unit.

As with other Yagi's, this VHF antenna is available in multiple-unit arrays for added gain. Horizontally or vertically parallel kits of 'H' frames can readily be supplied to mount two or four Yagi's with a common feed.



Electrical Specifications	SY2062 Series
Frequency Range	137 to 225 MHz
Bandwidth	5 to 9 MHz
Connector	N-Male / N-Female
Gain (nominal)	12 dBd (14.1 dBi)
Input VSWR (max)	1.5:1
Polarization	Vertical or Horizontal
Pattern	Directional
Average Power Input (max)	300 W
Front-to-back ratio (typ)	17 dB
Lightning protection	DC ground
Mechanical Specifications	
Width	5.5 to 26.75 in (140 to 679 mm)
Depth	5.5 to 125 in (140 to 3175 mm)
Length/ Height	63 to 111.75 in (1600 to 2838 mm)
Weight	13 to 26.2 lbs (5.9 to 11.89 kg)
Mounting Hardware (Included)	Clamp001 / Clamp008
Environmental Specifications	
Temperature range	-40 to +140°F (-40 to +60°C)

SM601 / SM701 / SM715 SERIES

TRANSeon family is Sinclair's next-generation transport/ mobile antenna which features high RF performance and rugged design.

Sinclair's SM701 series multifunctional transport antennas are specifically designed to address the need for compact, low profile, broadband antennas used in harsh environment, which makes it truly universal.

SM715 series is a rugged high performance 5 in 1 vehicle/ transit antenna.

SM701 Series

Electrical Specifications	SM601	SM701	SM715
Frequency Range	694 to 2700 MHz	694 to 6000 MHz	LTE 698-5600 MHz WiFi 2.4-2.5 GHz, 4.9-5.9 GHz
Bandwidth	2006 MHz	5306MHz	Multi-band
Gain	2.1 dBi	2.1 dBi	LTE 4 to 6 WIFi 5 to 6
Connector	Various options available		SMA-male
Input VSWR (max)	1.5:1	2:1	2:1
Polarization	Vertical	Vertical	Vertical
Impedance	50 Ω	50 Ω	50 Ω
Pattern	Omni- directional	Omni- directional	Omni- directional
Average Power Input (max)	100 W	200 W	LTE Port: 50 W; WiFi Port: 10 W
Lightning protection	DC ground	DC ground	DC ground
GPS/ GNSS Frequency	1575.42±10 MHz	1575.42 MHz	1559-1606 MHz
Mechanical Specifications			
Dimensions	Height: 1.95 in (50 mm) Diameter: 5.75 in (146 mm)	Height: 2.6 in (66 mm) Diameter: 6.3 in (160 mm)	Height: 2.65 in (67.3 mm) Diameter: 6.3 in (160 mm)
Weight	0.9 lbs (0.41 kg)	1.35 lbs (0.61 kg)	2 lbs (0.91 kg)
Ingress protection	IP67	IP67	IP67
Environmental Specifications			
Temperature Range	40 to +140°F (-40 to +60 °C)	40 to +140°F (-40 to +60 °C)	-40 to +158°F (-40 to +70°C)

SGS811R

The SGS811R Series is a triple band GNSS antenna that provides triple band GPS (L1/L2/L5), GLONASS (G1/G2/G3), Beidou (B1/B2/B3), Galileo (E1/E5/E5b), L-band, and associated augmentation signals (WAAS, EGNOS, and MSAS).

It features consistent performance (gain, axial ratio) across the full bandwidth of the antenna. It also features a precision-tuned twin circular dual feed, stacked patch element, 38dB gain, a pre-filter, multiple high rejection filters, and ESD circuit protection. In addition, it provides consistent and clear GNSS signal reception while minimizing loss-of-lock in high RF fields.

Electrical Specifications	SGS811R-SWBSBM
Frequency Range	1164 to 1587 MHz, 1189 to 1610 MHz, 1164 to 1591 MHz
Gain (peak)	4 dBi
Connector	BNC-Male
Polarization	RHCP
Impedance	50 Ω
Pattern	Omni-directional
Horizontal beamwidth (typ)	360 degrees
Axial ratio at zenith	1.5 dB
GNSS Noise Figure (typ)	2 dB
GNSS Out of Band Rejection	> 55 dB @ <1050 MHz, > 30 dB @ < 1125 MHz, >45 dB @ > 1350 MHz, > 40 dB @ <1450 MHz, > 40 dB @ > 1690 MHz, >45 dB @ > 1730 MHz
GNSS VSWR (typ)	1.5:1
Operating voltage	3 to 16 VDC
Operating current	45 mA
ESD circuit protection	15KV air discharge
Mechanical Specifications	
Dimensions (W x D x H)	5.75 in x 5.75 in x 1.95 in (146 mm x146 x 50 mm)
Cable	RADOX_RF_316_D
Radome material	UV stabilized ABS, UL94 HB
Ingress protection	IP67
Environmental Specifications	
Operating temperature range	-40 to +185°F (-40 to +85°C)
Storage temperature range	-49 to +185°F (-45 to +85°C)
Humidity	95%

MR SERIES / MD SERIES

Sinclair's MR256 series of mobile duplexers are compact units, fabricated from lightweight, rugged aluminum extrusion, which affords maximum structural integrity. These duplexers provide superior performance for trunking and conventional applications, and may also be used as low-power base station duplexers.

MD256 and MD356 series are Sinclair's new line of mobile duplexer that features six resonators for outstanding performance. These duplexers allow bi-directional communication over a common antenna and is ideal for applications that call for a compact rugged unit, such as in vehicles, or where space is constrained.

MR256 Series

MD256 Series

Electrical Specifications	MR Series	MD Series
Frequency Range	136 to 174 MHz 330 to 512 MHz	MD 256: 136 to 174 MHZ MD 356: 380 to 480 MHz
Number of Cavities	3	3
Connectors	Various	N-female
Input VSWR (max)	1.5:1	1.5:1
Insertion loss (max)	1.5 dB	1.5 dB
Impedance	50 Ω	50 Ω
Isolation	80 dB (MR256) 75 dB (MR356)	80 dB (MD256) 75 dB (MD356)
Average Input Power (max)	50 W	50 W
Mechanical Specifications		
Dimensions (W x D x H)	6.26 in x 7 in x 1.31 in (159 mm x 178 mm x 33 mm)	6.05 in x 7.03 in x 1.25 in (154 mm x 179 mm x 32 mm)
Weight	2 lbs (0.91 kg)	2.2 lbs (1 kg)
Mounting Configurations	Mounting holes on unit	Mounting holes on unit
Environmental Specifications		
Temperature range	-22 to +140°F (-30 to +60°C)	-22 to +140°F (-30 to +60°C)

SINCLAIR ENSURES THE NORTH AMERICAN RAILWAYS STAY 'ON THE RIGHT TRACK' THROUGH POSITIVE TRAIN CONTROL

PTC (Positive Train Control) is a railway protection system that requires integration of thousands of components across the telecommunications spectrum, such as GPS, Wi-Fi, radios, cellular technology, antennas, base stations and first-of-its-kind software that decides when to slow or stop a train. Sinclair has become the North American standard for wireless communications by supplying specialized antennas and RF conditioning equipment for the rail industry for more than the past 25 years.

Summary

Sinclair Technologies is a pioneer in developing antenna and RF conditioning technologies for PTC implementation in the United States. We initially consulted with all the Class One Railways to assess their individual needs and worked with them to develop antenna and filter solutions that would allow them to implement PTC throughout their rail systems. Sinclair developed wayside, base station and locomotive solutions that allowed highly reliable wireless coverage. The main concept of PTC as defined for North American Class I freight railroads is that a train receives information about its location and where it is allowed to safely travel, also known as movement authorities. Wireless communications equipment like antennas on board the train and alongside the track -then relay these directives to prevent unsafe movement. PTC systems may work in either dark territory or signaled territory and may use GPS navigation and radio signals to track train movements. Various other PTC-associated benefits such as increased fuel efficiency or locomotive diagnostics, are also achieved. For decades, Sinclair's engineering team has been working along with the rail industry, understanding the unique requirements and developing products exclusively for facilitating wireless communications to enable critical PTC technology. Sinclair presented a holistic solution including specialized dipole antennas, train-top mobile antennas, pass/reject filters, directional dual yagi antennas within the PTC frequency range from 190 MHz to 225 MHz.

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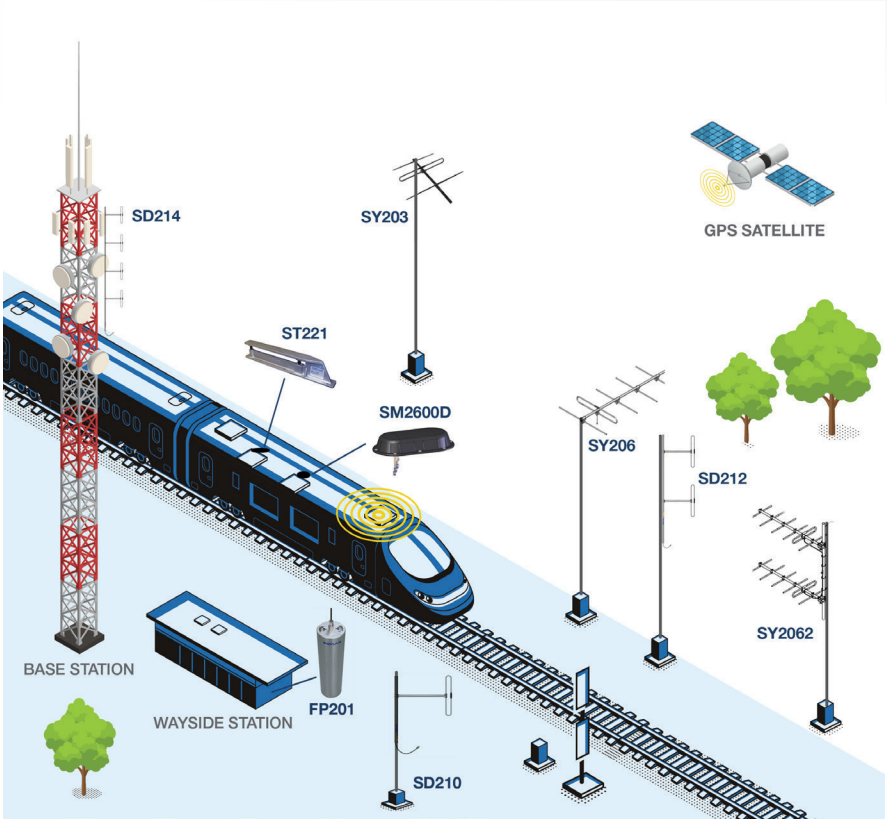
SINCLAIR ENSURES THE NORTH AMERICAN RAILWAYS STAY 'ON THE RIGHT TRACK' THROUGH POSITIVE TRAIN CONTROL

Background

With a decline in railway transit after World War II, there was less impetus for investment in train security. Towards the end of the 1980s, a search for solutions re-emerged along with an inventory of technical possibilities. Initially, the vast majority of rail lines relied on the human crew for complying with all safety rules, and a significant fraction of accidents were attributable to human errors, as evidenced in several years of official reports. The US Congress then enacted a new rail safety law for implementing PTC technology across most of the US rail networks. The implementation process involved major Class 1 railroads partnering with organizations and taking time to carefully design and test antenna and monitoring equipment for interoperability, manufacture the technology, and obtain radio spectrum along the entire rail network. Moreover, extra care was taken to ensure that the systems, once installed, was extremely robust and weather-proof.

Solution

There are two main PTC implementation methods - The first method makes use of fixed signaling infrastructure such as coded track circuits and wireless transponders to communicate with the onboard speed control unit. The other makes use of wireless data radios spread out along the line to transmit dynamic information. The wireless implementation also allows for the train to transmit its location to the signaling system which could enable the use of moving or "virtual" blocks. The first set of antennas supplied as part of the solution was Sinclair's SD series of VHF exposed dipole antennas. The SD210 antenna was unique in its high efficiency and exceptionally wide bandwidth with a VSWR of 1.5:1 or better. Further, the SD212 (2-bay) and SD214 (4-bay) antennas were the perfect fit for moderate gain applications in transportation networks.



Sinclair's rugged SY series of Yagi antennas were also a part of the solution to enable seamless train-to-track communications. The SY203 (3-element), SY206 (6-element) and SY2062 (stacked 6-element) antenna series featured outstanding durability and performance, and they were DC grounded for lightning protection as demanded by railway applications.The SD210, SD212 and SY series antennas were installed at the waysides, while the SD214 antennas were used at the base stations. The next part of the solution was Sinclair's FP series filters. These cavity filters served as the building blocks of the finest antenna systems, as they passed a band of frequencies while attenuating frequencies on either side of the desired frequency band. The insertion loss of the passband could be preset or adjusted in the field. Sinclair engineers carefully developed the FP filters for railway communications and transportation applications to protect receivers from front-end overload by carriers of co-located transmitters, as well as transmitters from Intermodulation (IM) interference generated from co-located transmitters.

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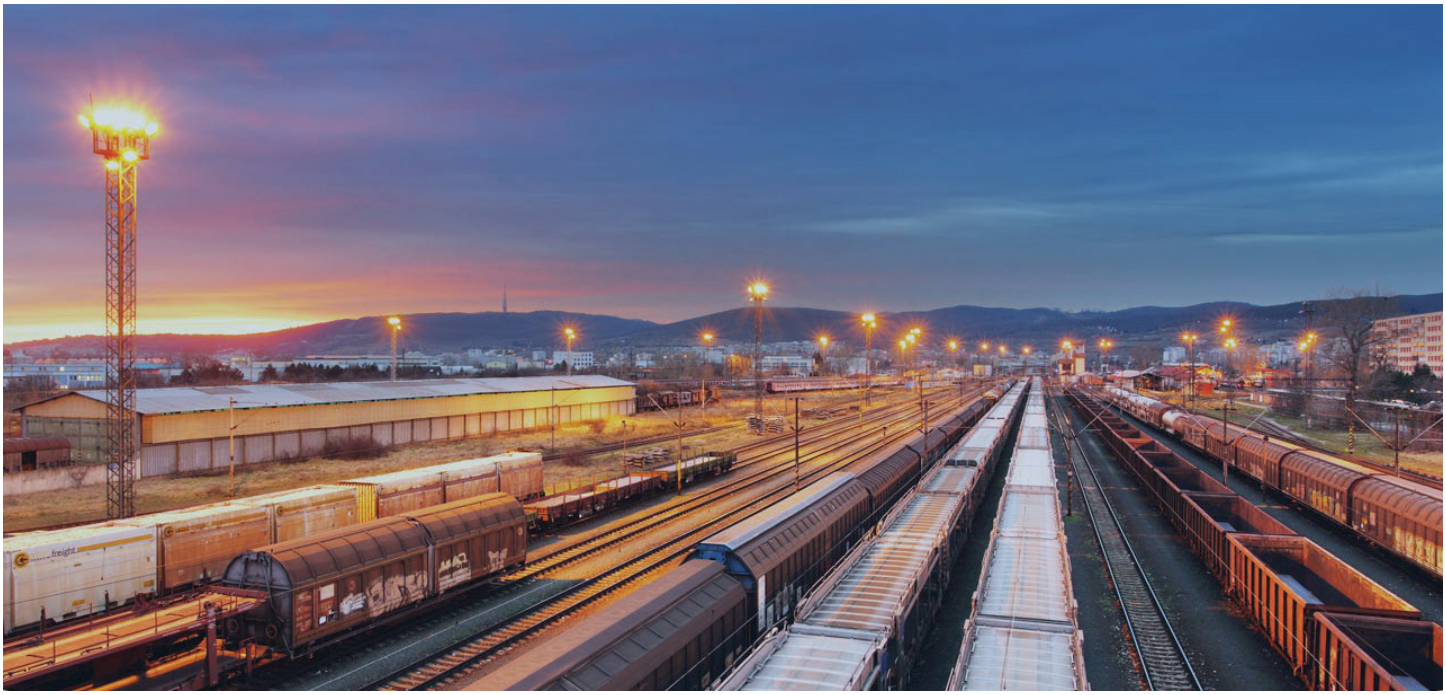
SINCLAIR ENSURES THE NORTH AMERICAN RAILWAYS STAY 'ON THE RIGHT TRACK' THROUGH POSITIVE TRAIN CONTROL

Sinclair then supplied the Excaliber ST221 series of low profile omnidirectional antennas with a cast aluminum structure designed exclusively for mobile applications. They were chosen as their design rendered them relatively inconspicuous and resistant to damage. They have truly become a standard solution for railroad locomotive service in North American and are an important part of the solution well-received by the industry. To date, more than 70% of Class One North American railway trains employ the Excaliber VHF antennas. In the past few years, the Sinclair SM2600D and SM2601D series antennas were highly sought after by the railway industry. This 5-port antenna supports PTC, GPS, Wi-Fi or WiMAX, as well as dual 694MHz-2700MHz bands in the same unit. In addition, the antenna meets the requirements in terms of weatherproofing, low profile form factor, and inconspicuous appearance, making it very suitable for locomotive deployment. Its black, weather-resistant and fire-resistant radome provides excellent environmental protection.

The ST221, SM2600D/SM2601D Series were all installed on locomotives.

Company Overview: Sinclair Technologies

With over 60 years of transportation communications experience on a global scale, Sinclair has the product line and technical experience to keep your communications running smoothly. Many of Sinclair's antennas are low profile for discreet implementation and can fit into virtually any type of land mobile, transit, or transport vehicles. These antennas are designed to withstand harsh outdoor conditions anywhere in the world ensuring there is no service interruption. Sinclair antenna and filter products provide solutions for data collection, tracking and controlling on a real-time basis, and supporting multiple services.



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SINCLAIR CONTRIBUTES TO TIMELY COMPLETION OF ASIA METRO RAIL PROJECT THROUGH QUICK CUSTOMIZATION CAPABILITY

Asia Rail Transportation

One of Asia's largest provider of rail transportation control systems had placed an order of ST221 series VHF transportation antennas from Sinclair at the end of 2018 for an overseas project. When Sinclair received the frequencies from the customer, it was quickly realized that something didn't seem right. Based on the quantity ordered, Sinclair was able to deduce that the customer had planned to use only one antenna on each train. The frequency plan showed a 1.9MHz TX span and a 1.9MHz RX span with a 4.6MHz TX/RX separation. Essentially, the customer wanted to have one antenna to cover the entire RF system frequency range that is 6.5MHz wide.

The issue was that the VHF band antenna ordered only has a 2.5MHz bandwidth, which isn't wide enough to cover a 6.5MHz frequency span. Sinclair notified the customer immediately of the issue. Upon some clarifications with the customer's system designer, the following details were uncovered:

1. The land mobile radio system design was completed by a local partner who was a global leading LMR OEM company specifically appointed by their end customer.

2. Due to limited train roof space and cost consideration, the TX and RX paths would have to share the one antenna on the train.

3. The system designer did understand the bandwidth issue. Given the constraints, it was decided to optimize the antenna for the TX frequencies only - a common practice for mobile device antennas.

4. The project had already commenced and no fundamental changes could be made because this was a public tender.

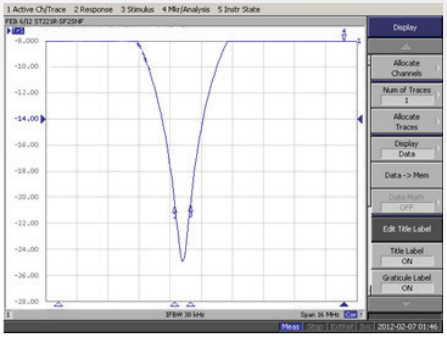
5. There is a penalty clause for any project delay due to any acceptance test failures.

SINCLAIR TECHNOLOGIES OFFERED A QUICK CUSTOMIZATION

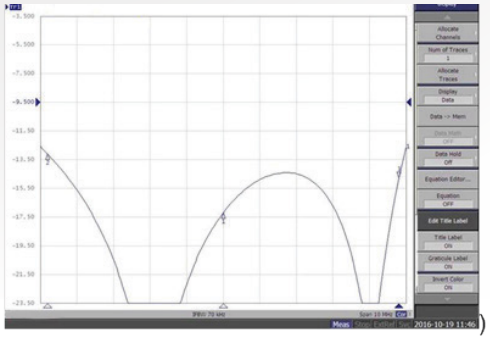
At first glance, it appeared that there would be no risk for the customer to do what the system designer had proposed. However, Sinclair pointed out there was an underlying clause that very likely could expose them to a penalty if they were to proceed with this plan. This was related to the maximum VSWR value of 1.5:1 in the antenna specifications. The customer would not be able to satisfy this requirement at RX frequencies by having the antenna optimized only for the TX frequencies.

This posed a major dilemma for the customer. They would not be able to pass the acceptance tests based on the current system design, and could face an expensive penalty if they were to follow their system designer's advice. Concurrently, it would be challenging to persuade their end customer to implement a system change to a closed deal, especially when the change required additional costs and time.

Fortunately, Sinclair had in-depth knowledge of the application and was able to develop a customized solution to address the issue, not only without causing delay to the project, but also at a nominal cost which was significantly lower than the potential penalty. To overcome the physical limitation that made it impossible for the antennas to cover the specified TX and RX frequencies with a 6.5MHz bandwidth, Sinclair was able to quickly develop a quasi-broadband solution that optimized the antenna for both TX and RX frequencies.



Standard antenna (illustration)



Customized antenna (illustration)

To the delight of the customer and their end client, Sinclair's professional advice and quick customization capability contributed significantly to the timely completion of the project. A grand opening ceremony was held in earlier 2020 to inaugurate the client's metro line.

Company Overview: Sinclair Technologies

With close to 70 years of transportation communications experience on a global scale, Sinclair has the product line and technical experience to keep your communications running smoothly. Many of Sinclair's antennas are low profile for discreet implementation and can fit into virtually any type of land mobile, transit, or transport vehicles. These antennas are designed to withstand harsh outdoor conditions anywhere in the world ensuring there is no service interruption. Sinclair antenna and filter products provide solutions for data collection, tracking and controlling on a real-time basis, and supporting multiple services.

SINCLAIR TECHNOLOGIES

Sinclair Technologies is a global leader in the design and manufacture of high-quality fixed and mobile antennas, filters, combiners, and related products. Designed to function in extreme conditions, Sinclair's products have a globally recognized reputation for quality, reliability, durability, and value. For over 60 years, Sinclair has provided custom-designed antennas and RF signal conditioning products to fit our customer's unique requirements. From simple to complex issues, Sinclair offers antenna and RF signal conditioning solutions for utilities industry paired with the industry's best RF expertise.

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