Southern States

The Quality Name in High Voltage Switching

Type Automation & Sensors

Intelligent Circuit Sensor (ICS®)

TFDIR

72.5kV – 550kV

INSTALLATION & INSTRUCTION MANUAL

⚠ WARNING

IMPROPER HANDLING, INSTALLATION, OPERATION OR MAINTENANCE OF THIS EQUIPMENT MAY CAUSE IMMEDIATE HAZARDS WHICH WILL LIKELY RESULT IN SERIOUS PERSONNEL INJURY OR DEATH.

⚠ WARNING

The equipment covered by this publication must be handled, installed, operated and maintained by qualified persons who have direct knowledge and experience dealing with the hazards involved and are thoroughly trained in the handling, installation, operation and maintenance of high voltage transmission and distribution equipment. These instructions are meant for only such **Qualified Persons**. They are not intended to be a substitute for adequate training and experience in safety procedures for this type of equipment.

A **Qualified Person** is one who is trained in and has skills necessary:

- to read and comprehend this instruction book – understanding that these instructions are general in nature
- to accept personal responsibility to prepare and maintain an intrinsically safe work environment and maintain control of the work site to safeguard all persons present
- to develop and implement a proper rigging, lifting, and installation plan along with all safety precautions required to insure safe and proper lifting and installation of the equipment.
- to distinguish between energized and non energized parts
- to determine proper approach distances to energized parts
- to properly work with and around energized or de-energized equipment that may be pressurized with gas
- for proper use of personal protective equipment, insulating and shielding materials, insulated tools for working near energized and /or pressurized electrical equipment
- to recognize and take necessary precautions for the unique and dynamic conditions of site and specialized equipment to maintain a safe work environment during handling, installation, operation, and maintenance of high voltage switching equipment

The instructions in this manual are general guidelines for this type of equipment and not specific to the equipment supplied. Portions of it may not be applicable or may not have complete instructions for your specific equipment.

If you do not understand any part of these instructions or need assistance, contact Southern States Service Division at 770-946-4562 during normal business hours (8:00am – 4:30pm EST, M-F) or 770-946-4565 after normal business hours.

LIMITED WARRANTY

Southern States, LLC ("SSLLC") warrants only to the Warranty Holder (hereinafter defined as the "End User" or the "Immediate Purchaser", as applicable, pursuant to the terms and conditions of this Limited Warranty as set forth below), that the Product identified below will, upon shipment, be free of defects in workmanship and material for the applicable Warranty Period. The "Warranty Period" is that period of time during which this Limited Warranty is effective, and such period begins on the invoice date issued by SSLLC for the Product, and continues until the earlier to occur of (1) the expiration of the Warranty Duration period, or (2) the Number of Operations, both as specified in the table below. If the Product is both purchased and installed within the United States or Canada, this Limited Warranty is granted to each end user of the Product who acquired the Product for its own use during the Warranty Period ("End User"). In all other situations, this Limited Warranty is granted only to the first purchaser of the Product ("Immediate Purchaser") from SSLLC. No primary or remote purchaser or owner of the Product who is not a Warranty Holder may claim any benefit under this Limited Warranty, or any remedial promise included in this Limited Warranty. SSLLC shall, upon prompt written notice from the Warranty Holder, correct a nonconforming Product by repair or replacement at the sole discretion of SSLLC of the nonconforming Product or any part or component of a nonconforming Product necessary in SSLLC's discretion to make such Product conforming. Any transportation charges, labor for removing, reinstalling the Product or part, and/or costs related to providing access to the Product shall be the responsibility of the Warranty Holder. Correction in this manner will constitute the Warranty Holder's exclusive remedy and fulfillment of all SSLLC's liabilities and responsibilities hereunder. SSLLC's duty to perform under this limited warranty may be delayed, at SSLLC's sole option, until SSLLC has been paid in full for all products purchased by the Warranty Holder. No such delay will extend the Warranty Period. If SSLLC does not make such repair or replacement, SSLLC's liability for damages on account of any claimed nonconformity will in no event exceed the purchase price of the Product in question. This Limited Warranty does not apply to any Product that has been disassembled, repaired, or altered by anyone other than SSLLC. This Limited Warranty will not apply to any Product that has been subjected to improper or abnormal use of the Product. SSLLC has no responsibility to repair or replace any Product or component thereof manufactured by another party, but SSLLC will assign, to the extent assignable, to the Warranty Holder any manufacturers' warranty that applies to products and components not manufactured by SSLLC.

THIS LIMITED WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES. THERE ARE NO OTHER EXPRESS, IMPLIED, OR STATUTORY WARRANTIES. ALL IMPLIED WARRANTIES WHICH MAY ARISE BY IMPLICATION OF LAW, OR APPLICATION OF COURSE OF DEALING OR USAGE OF TRADE, INCLUDING, BUT NOT LIMITED TO, IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, NONINFRINGEMENT OR OTHERWISE ARE EXPRESSLY EXCLUDED. SSLLC SHALL NOT BE LIABLE OR RESPONSIBLE FOR ANY CONSEQUENTIAL, INCIDENTAL, INDIRECT, EXEMPLARY, SPECIAL, OR PUNITIVE DAMAGES, EVEN IF SSLLC HAS BEEN ADVISED OF THE POSSIBILITY OF SAME. THE WARRANTY HOLDER IS SOLELY RESPONSIBLE FOR THE SUITABILITY OF THE PRODUCT FOR ANY PARTICULAR APPLICATION.

Product Purchased Region	Product Installed Region	Warranty Holder	Warranty Duration
U.S and Canada	U.S and Canada	End User	2 years from shipment date
All Other Conditions		Immediate Purchaser	Earlier of 1 year from installation or 18 months from shipment

ICS®

TFDIR

Installation & Instruction Manual

Preliminary

Table of Contents

1 Summary & Introduction 6
1.1 Summary 6
1.2 Important 6
1.3 Introduction 7
1.4 Ratings 8
2 Product Description 9
2.1 Standard *ICS TFDIR* 9
2.2 Receiving & Unpacking 11
2.3 Storage 11
3 Installation & Configuration Procedures 11
3.1 Assembly 11
3.2 Installation 13
3.2.1 Mounting 14
3.3 Wiring (Refer to wiring diagram in drawing package) 16
3.3.1 Receiver Antenna Enclosure Wiring 16
3.3.2 Control Cabinet Wiring 16
3.3.3 Control Power Supply 17
3.4 Voltage Test 18
3.5 Itemized Post –Installation Test Checklist 19

1 Summary & Introduction

1.1 Summary

These instructions do not intend to cover all details or variations in equipment, or provide for every possible contingency to be met in connection with installation, operation, or maintenance. Should information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the local Southern States Representative.

The contents of this instruction manual should not become part of or modify any prior or existing agreement, commitment, or relationship. The sales contract contains the entire obligations of Southern States. The Warranty contained in the contract between the parties is the sole warranty of Southern States. Any statements contained herein do not create new warranties or modify the existing warranty.

1.2 Important

The information contained herein is general in nature and not intended for specific application purposes. It does not relieve the user of responsibility to use sound practices in application, installation, operation, and maintenance of the equipment purchased. Southern States reserves the right to make changes in the specifications shown herein or to make improvements at any time without notice or obligations. Should a conflict arise between the general information contained in this publication and the contents of drawings or supplementary material, or both, the latter shall take precedence.

***NOTE: Ensure power source(s) are disengaged and lockout/ tagout is installed before proceeding with commissioning of unit(s). Ensure that all proper safety procedures are adhered to.**

***Current source less than 10 amps is not sufficient for accurate current measurement.**

1.3 Introduction

The Intelligent Circuit Sensor (ICS®) is a digital measurement and control system designed as a solutions platform for transmission networks. It is designed to operate in the same environments as transmission substations and power lines. The ICS® provides information currently not available on transmission networks easily and economically. The device is designed to be installed with circuit switchers and capswitchers in substations and/or line switches at switching stations or taps.

A standard package consists of:

- 3 ea. Single phase High Voltage Sensors.
- 1 ea. Receiver
- 1 ea. Receiver antenna box with three whip antenna
- 1 ea. Control Cabinet (contains power supply, Receiver and host computer.)

The instructions contained within this manual are necessary for the safe installation, maintenance, and operation of the device. A qualified person, familiar with this type of equipment, should carefully read and follow the instructions.

These instructions are intended to provide a general guideline for the installation, adjustment, and maintenance of the device. It is not possible to cover all details, equipment variations, and potential conditions. Contact Southern States, LLC in the event conditions associated with a specific application are not sufficiently addressed.

All photographs and sketches in this manual are for illustration purposes only and may not be to scale. During installation, it may be necessary to make adjustments other than those described in this manual. Contact your local representative or Southern States facility if questions should arise. Southern States After Sales and Service Department are available for field installation assistance along with providing parts support for all Southern States products. Contact After Sales and Service at 770-946-4562.

⚠ DANGER	Indicates an imminently hazardous situation, which, if not avoided, will result in death or serious injury.

⚠ CAUTION	Indicates a potentially hazardous situation, which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

⚠ WARNING	Indicates a potentially hazardous situation, which, if not avoided, could result in death or serious injury.

1.4 Ratings

Table 1: Ratings Table	
Rated Voltage	72.5kV - 550kV
Rated Load Currents	Up to 4000 Amps
Rated Fault Current	40kA
Communication	Serial and Ethernet
Protocols	DNP 3.0, Modbus
Turn on Time	Less than 1 cycle
Installation	Zero footprint, mounts on Circuit Switcher/ CapSwitcher ® / Load Break Switcher or other devices

Above ratings apply to the following service conditions:

- The maximum ambient air temperature range is +122ºF (+50ºC) to –40ºF (–40ºC).
- The maximum wind velocity should not exceed 90 mph (40 m/s).
- The seismic performance is Low Performance Level as defined in IEEE 693.

Higher service conditions are available and will be stated in other documents associated with the specific purchase.

The *ICS*® Intelligent Circuit Sensor brings true digital measurement, control, and automation to the transmission grid.

Special Features

• Digital solutions platform for smart algorithms
• Communicates with network using standard protocols
• Remotely programmable and configurable
• Compatible with digital relays and RTUs
• Zero footprint, can be mounted on overhead structures
• Easy installation
• Automated, remote, or manual switching
• Sensing units do not require batteries for life, requiring no maintenance.
• The Southern States Intelligent Circuit Sensor (ICS®) provides real time waveform captures.

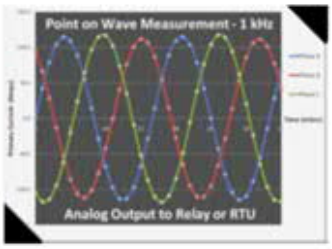
2 Product Description

2.1 Standard *ICS TFDIR*

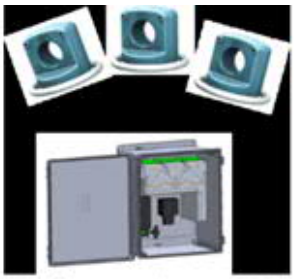
The device is a three-phase sensor and concentrator that uses solid state technology to detect currents and give a user over-current protection as well as phase angle information. It can be combined with a customer's relay to be used for real time switching or monitoring.

The ICS consists of:

- Electronic current and voltage sensor
- Receiving Module
- Substation hardened digital computer



Real time waveform capture



Digital processing receiving

Patented electronic current sensor requires no batteries

Intelligent Circuit Sensor

High Voltage Sensing Technology

2.4 GHz Radio

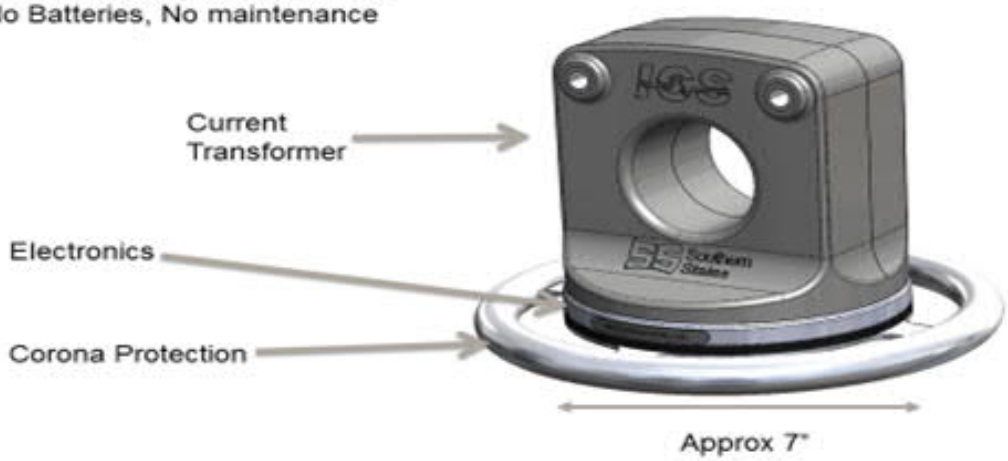
- Energy Harvesting – no batteries or solar panels at high voltage!
- Single Receiver per 3-phase set
- Minimum startup current 10 Amps
- Startup time – less than 1 cycle

Real Time Measurement

- Current and Voltage

Components - Sensor

Environmentally Sealed for Life
No Batteries, No maintenance



Smart Trip™ on 115KV CapSwitcher®

Powered by ICS

2.2 Receiving & Unpacking

Unpack equipment and check for damage and shortage of parts. If damage or shortage is noted, file a claim with the carrier immediately and notify the factory.

- **Do not remove any identification tags attached to the components**, as they will be useful for identification during the installation.
- The packaging is meant for maintaining the assemblies as clean and dry while in transit and for short periods of storage. Upon receipt of the equipment, the material received should be checked against the packing lists to be sure that all parts are received. An examination should be made to determine if any damage was sustained during shipment. If damage or shortage is noted, file a claim with the carrier immediately and notify the factory.

2.3 Storage

All components of the device are suitable for outdoor use. The storage requirements are listed below:

- Inspect all packing material thoroughly prior to storage.
- Store Indoors.
- Protect cabinets that encase electronic components. Treat with care as you would a SCADA network terminal unit (NTU) or digital relay.
- Protect unit from being immersed in water and away from high humidity.
- The 3 components should be stored in their original packing boxes until preparation for installation.

3 Installation & Configuration Procedures

3.1 Assembly

The device is shipped from the Southern States factory fully adjusted and ready for installation and configuration to the customers relay.

The device is shipped with the intent to minimize and simplify installation. Once installed the assembled unit is ready to be configured. Configuration of device will be described in a later section.

The device is typically shipped in three major sections:

1. **Sensors**:
    - Correctly orient each sensor to the 3 phases, one for each phase. (If installed on a CapSwitcher® or Circuit Switcher, connect the sensor directly to the interrupter bus. If on a switch, connect to the phase or interrupter bus.
    - Orient each sensor eye toward the Receiver Cabinet position.
    - Tighten all bolts to proper torque using customer's lock tight procedures.
2. **Receiver Antenna Enclosure:**
    - Three whip antennas per enclosure.
    - Mounting brackets - Mount cabinet on structure in line of sight of sensors.
    - Conduit - Install conduit between Receiver (control) Cabinet.
3. **Control Cabinet**:
    - Install cabinet to structure with mounting brackets at working height and connect conduit from Receiver Antenna enclosure.
    - Host Computer Module
    - Southern States supplies a Schweitzer SEL 751A Relay (or customer supplied relay)

3.2 Installation

The installation of the ICS system is performed in (3) three steps:

1. Mounting
2. Wiring
3. Voltage Verification

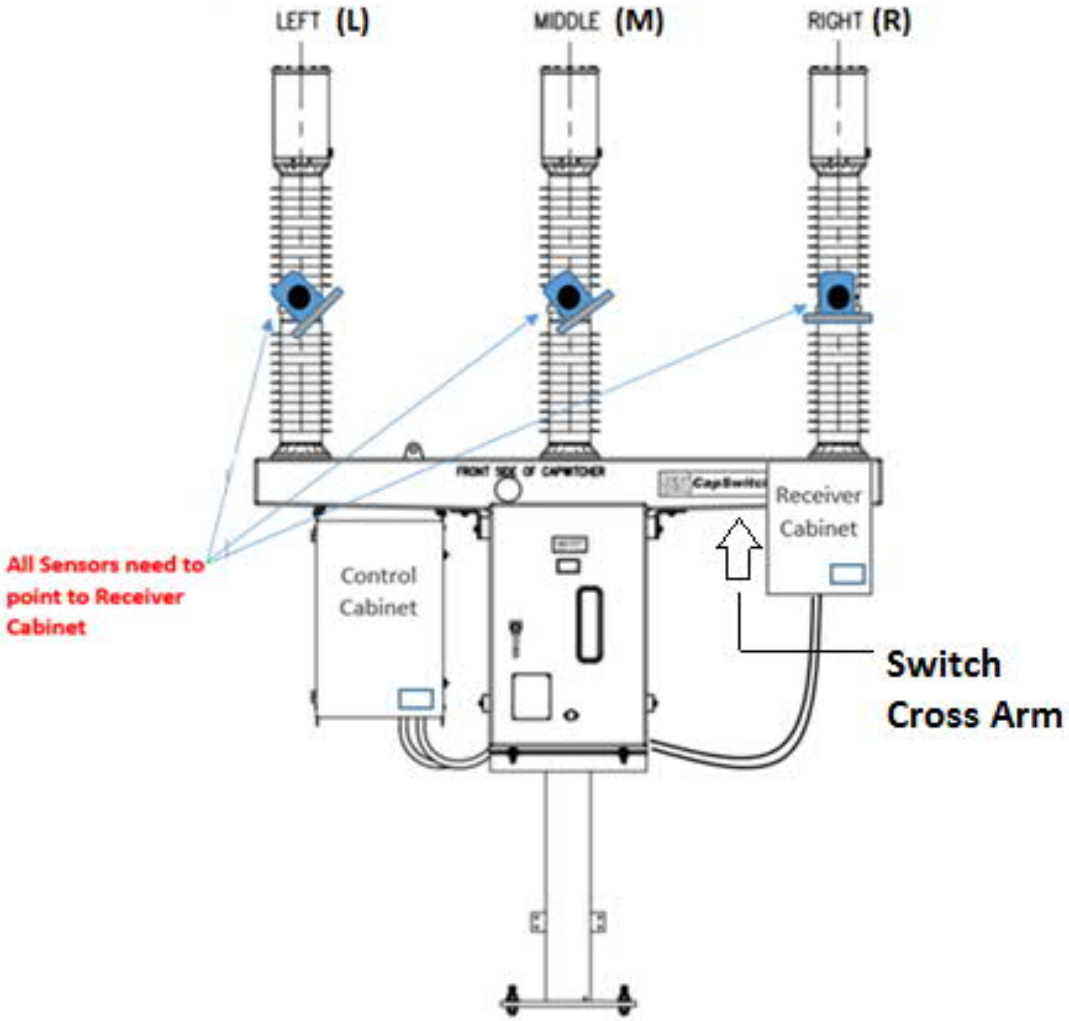


Figure 3-1 Example of ICS unit mounted on a Southern States CapSwitcher®

3.2.1 Mounting

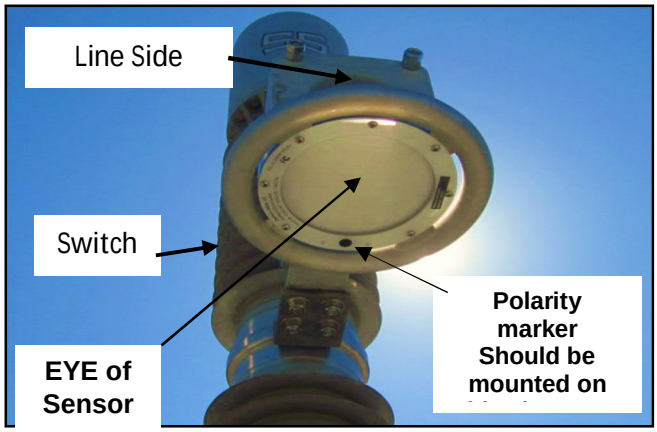
3.2.1.1 Sensors

Mount the three sensors according to their preset designations as marked on each sensor (L, M, R). The orientation shown in Figure (1) on the preceding page is shown from the side of the switch where the sensors and receiver will be mounted.

A. Brackets - Begin by identifying left, middle, and right sensors (sensors will be labeled accordingly). Left, middle, and right sensors should be mounted on the same side as the receiver cabinet.
   i) Mount the sensors in their predetermined position (shown in Figure 2 and 3) utilizing the included sensor mounting bracket to adjust the angle of the sensor (one bracket per phase).
B. Adjust each sensor bracket (Figure 3 Item 3) so that the “eye” of each sensor is aimed directly at top of the receiver cabinet.

C. Bus bar – The conductor (line) will attach to the end of the bus bar provided. Bus will run through the sensor and connect to the original customer bus tab (Figure 3.)

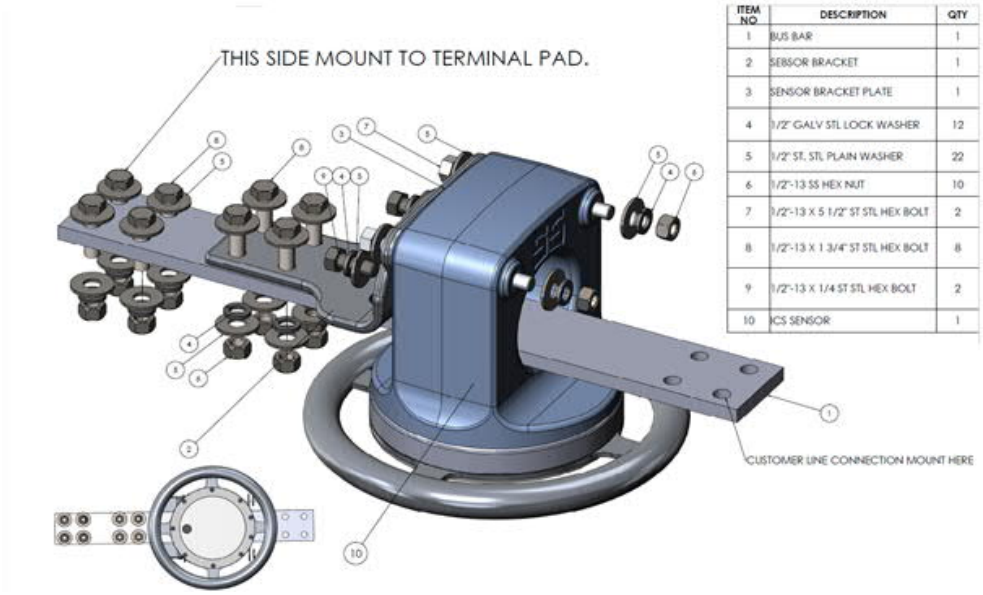
D. Polarity marker - Each sensor is marked with a black dot (polarity marker) on the information ring mounted on the eye of the sensor. **THE SENSOR IS TO BE MOUNTED SO THAT THE POLARITY DOT IS CLOSEST TO THE SWITCH OR.** Example shown below in Figure 2 and 3.



Orientation of the sensor showing the polarity marker.

Figure (2)

E. Make certain that polarity marker on all 3 sensors in configuration are oriented in the same direction. Figure (2) shows proper sensor mounting orientation.



ITEM NO	DESCRIPTION	QTY
1	BUS BAR	1
2	SEBSOR BRACKET	1
3	SENSOR BRACKET PLATE	1
4	1/2" GALV STL LOCK WASHER	12
5	1/2" ST. STL PLAIN WASHER	22
6	1/2"-13 SS HEX NUT	10
7	1/2"-13 X 5 1/2" ST STL HEX BOLT	2
8	1/2"-13 X 1 3/4" ST STL HEX BOLT	8
9	1/2"-13 X 1/4 ST STL HEX BOLT	2
10	CS SENSOR	1

Figure (3)

3.2.1.2 Control Cabinet

A. After the sensors are properly installed, mount the control cabinet on the same side the sensors were installed previously.
B. Top of cabinet should always be below the switch cross arm.

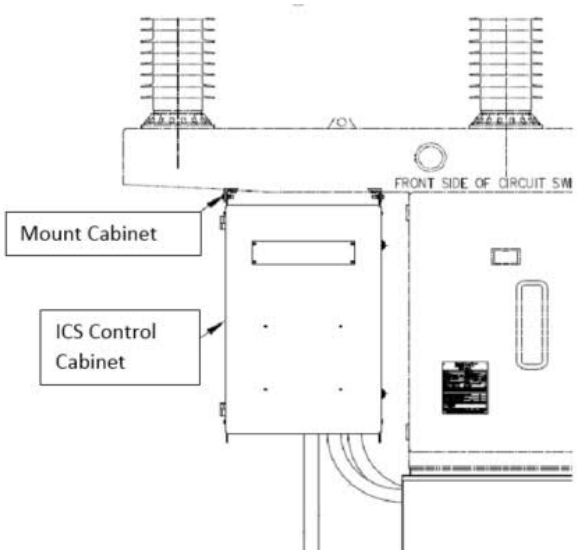


Figure 3-2 Control Cabinet Mounting Example

3.2.1.3 Receiver Antenna Enclosure

Mount the antenna enclosure on a cross arm or pole with line of sight to the sensors. Mount the Southern States supplied antennas to the enclosure.

3.3 Wiring (Refer to wiring diagram in drawing package)

3.3.1 Receiver Antenna Enclosure Wiring

Attach the antenna conduit (if not already attached) to the enclosure and attach the antenna cables according to the corresponding wiring diagram in enclosed drawing package.

3.3.2 Control Cabinet Wiring

Attach the antenna conduit (if not already attached) to the cabinet and attach the antenna cables to the Receiver according to the corresponding wiring diagram in enclosed drawing package.

Attach the Ethernet cable provided from the Digital Module to the yellow Ethernet switch on the din rail. Attach an Ethernet cable from the modem to the Ethernet switch on the din rail.

3.3.3 Control Power Supply

Connect the power supply conduit from the switch or control center to the Control Cabinet and wire according to the ICS Control Cabinet Wiring Diagram (refer to SS wiring diagram).

3.4 Voltage Test

The following instructions shall be performed after VAC + VDC power sources have been restored.

Equipment- You will use the following equipment to test system:

- DC power
- AC Power
- Multimeter

<u>Testing DC + AC Power</u>

1. Ensure that you have connected the VAC and VDC wires of the conduits to the correct terminal blocks and locations in the ICS large cabinet (refer to SS wiring diagram). Open all circuit breakers/ fuses in the Control Cabinet.
    - An open circuit breaker will be in the down position as shown below.
    - Perform visual inspection of all wiring within Control Cabinet and Receiver Cabinet. Verify that all wires are properly landed and ensure power supply wires (AC and DC) are wired in their correct positions.
2. Disconnect power inputs from all modules.
3. Using a multi-meter, ensure you have the correct VAC + VDC feeding the ICS cabinet at the inputs located at the breaker switch.

If this is a unit that is set up for remote monitoring, please contact Southern States and ask to be connected to the Automation & Sensors Division at 770-946-4562 to confirm that the unit is online and we are able to monitor the unit.

3.5 Itemized Post –Installation Test Checklist

Date of Installation: _____

Substation or Line Switch Information:

Location:		
Address:	City:	State:

Visual Inspections: Check parts for damage or shortages.

Material	Comments
Sensors	
Receiver Antenna	
Control Cabinet	
Brackets	
Bus bars	
Other	

Installation Component Checklist

Item	Complete (√)
a. Sensors are mounted on correct location (Left, Middle, Right) – Polarity orientation correct. b. Sensors aimed at Receiver Cabinet antennas. c. Receiver antennas aimed directly at sensors. d. Receiver Cabinet in clear sight of sensors. e. Hardware securing sensor bus bar to customer bus tab secured tightly. f. Control Cabinet mounted at working height.	

Internal Control Cabinet Check:

Item	Complete (√)
a. Control Cabinet mounted at working height. b. Inspect field wiring- correct connections have been made according to SS Wiring Diagram. c. Cabinet wiring secure- Pull test before energizing. d. Note any loose pieces in Control Cabinet.	

Site Acceptance (Operational) Tests – Confirmed by Southern States Facility

TESTS	PASS YES/NO	Comments
Data Packets Received		
RSSI (Connectivity)		
PPM		
Modem Signal		

Contact Information

	Date	Name	Number	Email
Installation Completed by:				
Verified by:				

INSTALLER SIGNATURE: _____

VERIFIED BY SIGNATURE: _____

Intelligent Circuit Sensor (ICS)

TFDIR

Limited Release

Abnormality Report

This document is a template of data that needs to be captured when a customer experiences any abnormality with a LIMITED RELEASE Version of the ICS TFDIR application. The data or answers that coincides with each question should be filled out and returned to: J.Keister@southernstatesllc.com

1. What is the error rate experienced or number of errors?

2. How often did the abnormality occur?

3. What was the HIGH current experienced?

4. Please provide any and all recorded historical data at time of abnormality.

5. Please provide any relay data that is relevant to the abnormality.