



SEL-734W Wireless Capacitor Bank Control and SEL-WCS Wireless Current Sensor

The SEL-734W Wireless Capacitor Bank Control is a system that includes the controlling device (SEL-734W) and the line current sensors (8340). The sensors report line in the current via radio transmission. The SEL-734W includes a radio receiver used solely for the purpose of receiving the transmissions from the line current sensors. A capacitor bank control uses measurements of voltage and current on the distribution lines of an electric utility to determine if the distribution of electric power can be made more efficient by connecting a capacitor from the phase to the neutral conductors of the distribution system. Based on user-selectable settings, the SEL-734W will drive the capacitor bank switches to connect/disconnect the capacitors from the power lines of the distribution system. Operation of the SEL-734W is the same as the operation of the SEL-734B with the exception of how the line currents are read.

The SEL-734B accepts wires carrying low-level voltages that are an analog representation of the current in each of the power system conductors. These wires are connected to sensors attached to the power lines, with the sensors converting the current to low-level voltages known as low-energy analog (LEA) signals. For information that is common to both the SEL-734B and the SEL-734W including installation, operation, and settings, refer to the documents found at www.selinc.com/products/734B. For information on how the SEL-734W and the SEL-734B differ, refer to the sections below.

SEL Wireless Current Sensor (SEL-WCS)

Overview

The SEL-WCS provides measurement of power line current both for the fundamental frequency and harmonic frequencies (up to the 15th). This sensor is provided in a package that is easy to mount using a hot stick and requires no wiring to the capacitor bank control or to a power source. Power is harvested from the magnetic field surrounding the power line when current is flowing. The SEL-WCS operates without the use of a battery, eliminating that maintenance concern while allowing for a smaller, simpler device. The SEL-WCS measures the current and updates the SEL-734W periodically, making sure that it has enough stored energy to complete the measurement and transmit the information to the SEL-734W before beginning the measurement process. The SEL-734W provides a measurement range of 2 A to 1000 A. The SEL-WCS is paired to an SEL-734W by settings selections made on both devices.

Current Measurements

Measurements are made by the sensor and sent to the SEL-734W about once every 1.1 seconds or as harvested energy allows, whichever is slower. The SEL-734W will use the last value transmitted in all reporting, calculations, and actions involving the current until the next update of the current. If the SEL-734W has not received a recognizable update within a certain timeframe, the current value is set to zero and stays at zero until the next successful update. A switch-selectable setting for the SEL-WCS tells the sensor whether it should calculate the magnitude and phase values of the harmonics. By selecting the

option for no calculation of the harmonics, the sensor will send updates more frequently (for line currents below 200 A). *Table 1* compares typical update periods with and without harmonics calculation for certain values of line current.

Table 1 WCS Typical Update Period Versus Line Current

Line Current (amps rms)	No-Harmonics Update Period (seconds)	Harmonics Update Period (seconds)
2	20	64
5	4.1	12.5
10	2.0	5.7
20	1.1	2.0
50	1.1	1.4
100	1.1	1.3

Product Overview

SEL-WCS

Figure 1 depicts the key components of the SEL-WCS. Each SEL-WCS mounts onto and monitors the line current on one phase. The SEL-WCS periodically sends the load data information including the harmonics to a SEL-734W.

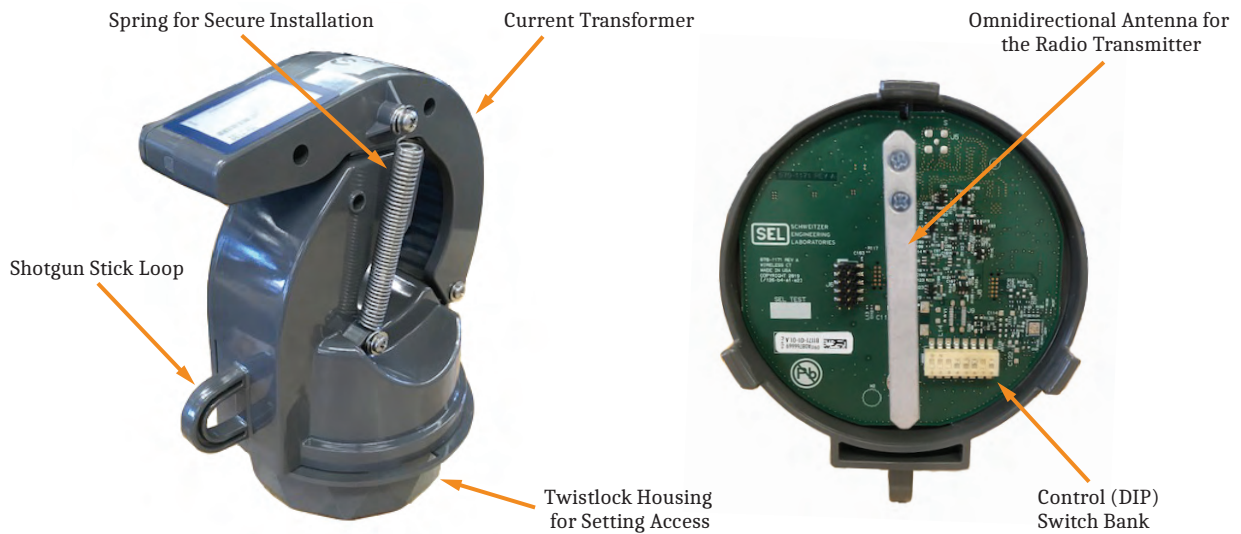


Figure 1 SEL-WCS Key Components

Shotgun Stick Loop and Spring

The shotgun stick loop allows the SEL-WCS to be mounted on the line or removed from the line using only a shotgun stick. The springs simplify installation on overhead lines and hold the SEL-WCS in position. See *SEL-WCS Installation* for more information.

Current Transformer (CT)

The SEL-WCS split-core CT harvests energy to power the device and accurately measure load current and harmonics of the current.

Integrated Radio

The 900 MHz radio module is mounted inside the SEL-WCS cone for environmental protection. The radio communicates to a single SEL-734W to transmit load data.

Dip Switches

The control DIP switches inside the housing allow easy selection of the identification of each sensor. An SEL-WCS has a set of four DIP switches for a Network ID, two DIP switches for a phase ID, and a single DIP switch that determines whether an SEL-WSC sends the harmonic content information to the SEL-734W.

SEL-734W

Figure 2 shows an SEL-734W. The orange rectangle in the figure indicates the switches where you make the different settings from those on the SEL-734B.



Figure 2 SEL-734W

Settings

Settings are made on both the SEL-WCS and the SEL-734W to make the information sent by the SEL-WCS available and correct for use in the SEL-734W. The Network ID setting is common to both devices. To use other settings, refer to the information provided below on settings specific to each device.

For the SEL-734W to use the information from the SEL-WCS, the value selected on the SEL-734W must match the value selected on the SEL-WCS. This setting allows an SEL-734W to operate within the range of many SEL-WCSs, yet be able to listen to the one(s) that are intended to be used with that SEL-734W.

SEL-WCS Settings

Network ID settings

The SEL-WCS has a 4-bit DIP switch that allows it to configure the Network ID. *Table 2* shows the frequency associated with each Network ID. DIP switches SW1–SW4 shown in *Figure 2* are for the Network ID.

Table 2

Network ID	Frequency (MHz)
0	906
1	907
2	908
3	909
4	910
5	911
6	912
7	913
8	914
9	915
10	916
11	923
12	924
13	925
14	926
15	927

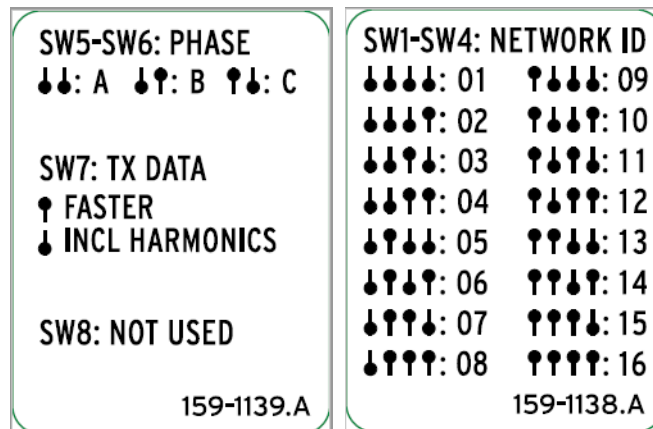


Figure 3 DIP Switch Configurations

Harmonic Content DIP Switch Setting

DIP switch SW7 configures the SEL-WCS, whether it calculates and sends harmonic contents of the current to the SEL-734W.

Phase identification Settings

The SEL-WCS uses two DIP switches to configure the phase information. *Table 3* shows the phase identification settings.

Table 3 Phase Identification Configuration

Switch Settings	Phase
00	A
01	B
10	C
11	Reserved

SEL-734W Settings

The Network ID must match the Network ID setting for the SEL-WCSs used with this SEL-734W. The other settings on the 734W are explained below.

Voltage Phases

The Voltage Phases setting is used to allow the SEL-734W to calculate power, VAs, and VARs for all three phases when the SEL-734W is only sensing a single-phase voltage. This is done by reusing the magnitude of the measured voltage phase, but rotating by ± 120 degrees to get the two missing voltage phases. SW1 of the system setting DIP switches sets this option. When the switch is moved to the down position, the SEL-734W only has single-phase data available.

Distance to Sensor

The Distance to Sensor setting is used to ensure that an SEL-734W does not hear data from an SEL-WCS on the system that has reused the Network ID of the SEL-WCS associated with this SEL-734W. This happens where there are more SEL-734Ws in a limited area than the 16 available Network IDs. Although unlikely, under ideal conditions, an SEL-734W can receive data from an SEL-WCS that is farther than a mile away. This setting reduces the sensitivity of the SEL-734W radio receiver so it will not receive data from distant SEL-WCSs.

Line Current Range

The Line Current Range setting refers to the maximum current expected to flow in the line during normal (non-fault) conditions. It is used to increase the resolution of the current reported to the SEL-734W. When in the > 200 A range, the resolution is approximately 0.25 A. For the lower range setting, the resolution is approximately 0.05 A.

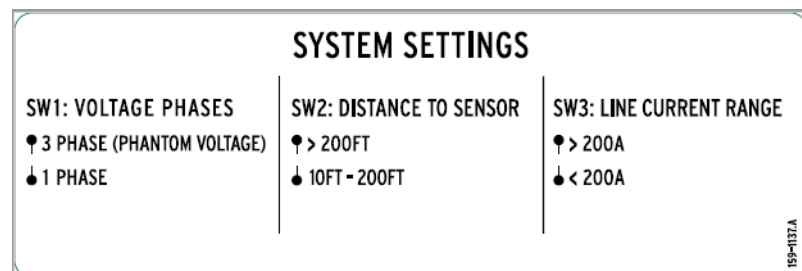


Figure 4 SEL-734W DIP Switch Settings

SEL-WCS Installation

Install the SEL-WCS on a distribution line by using an industry-standard shotgun stick.

- Step 1. Use a shotgun stick to grasp the hook eye on the side of the SEL-WCS and place the device on the line so that the opening hangs over the line.



Figure 5

- Step 2. Apply slight downward and sideways pressure until the device is closed around the line. The spring mechanism should be pushed in so that it wraps around the line.



Figure 6

- Step 3. Apply slight upward pressure until the device is secured around the line as shown in *Figure 7*.



Figure 7

- Step 4. Use the shotgun stick to adjust the transmitter orientation so that it is directly vertical. This is important to ensure the best propagation characteristics for the internal antenna.

SEL-734W Installation

The SEL-734W cabinet is made to mount to a four-jaw meter mount socket. Refer to the SEL-734B literature on selinc.com for instructions on mounting this unit.

Safety Information

Regulatory Information

DANGER

Install fault transmitters and sensors in accordance with normal safe operating procedures. These instructions are not intended to replace or supersede existing safety or operating requirements. Only trained qualified personnel with knowledge of high voltage safety should install or operate fault transmitters.

CAUTION

Although the power level is low, concentrated energy from a directional antenna may pose a health hazard. Do not allow users to come closer than 23 cm (9 in) to the transmitter when it is operating.

DANGER

To ensure proper safety and operation, the equipment ratings, installation instructions, and operating instructions must be checked before commissioning or maintenance of the equipment. The integrity of any protective conductor connection must be checked before carrying out any other actions. It is the responsibility of the user to ensure that the equipment is installed, operated, and used for its intended function in the manner specified in this manual. If misused, any safety protection provided by the equipment may be impaired.

The SEL-WCS is approved for use only with specific output power configurations that have been tested and approved. Modifications to the SEL-WCS, the antenna system, and the power output that have not been explicitly specified by the manufacturer are not permitted and may render the radio noncompliant with applicable regulatory authorities. The radio equipment described in this manual emits radio frequency energy. Professional installation is required.

United States (FCC)

Per FCC 15.19(a)(3) and (a)(4) 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.

Per FCC 15.21, changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Canada

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.	Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage ; (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.
Per RSS-Gen, Radio apparatus shall comply with the requirements to include required notices or statements to the user of equipment with each unit of equipment model offered for sale.	Selon RSS-Gen, un appareil radio doit être conforme avec les exigences d'inclure requis avis ou déclarations à l'utilisateur de l'équipement avec chaque unité de modèle d'équipement offert pour vente.
These statements are required regarding antennas and for certain types of equipment. Please see the specified sections of RSS-Gen for details and suggested verbiage: Transmitter Antenna -Section 6.8	Ces déclarations sont obligatoires concernant antennes et pour certains types d'équipement. Veuillez consulter les sections spécifiées de RSS-Gen pour plus de détails et le verbiage suggéré: Emetteur Antenne - Section 6.8
Devices operating in the 5250 - 5350 MHz band shall be labeled "for indoor use only". Alternatively, that text can be included in the user manual and not on the device. Note however the user manual is the only option available for devices operating in the 5150 - 5250 MHz band. In all cases the user manual shall contain instructions "for indoor use only".	Périphériques fonctionnant dans la bande 5250 - 5350 MHz la bande doit porter la mention "pour utilisation à l'intérieur uniquement". Alternativement, ce texte peut être inclus dans le manuel de l'utilisateur et non sur l'appareil. Notez cependant le manuel d'utilisation est la seule option disponible pour les appareils fonctionnant dans le 5150 – 5250 Bande MHz. Dans tous les cas, le manuel d'utilisation doit contenir des instructions "pour une utilisation en intérieur uniquement".

Dangers, Warnings, and Cautions

This manual uses three kinds of hazard statements, defined as follows:

DANGER

Indicates an imminently hazardous situation that, if not avoided, **will** result in death or serious injury.

WARNING







Indicates a potentially hazardous situation that, if not avoided, **could** result in death or serious injury.

CAUTION

Indicates a potentially hazardous situation that, if not avoided, **may** result in minor or moderate injury or equipment damage.









Safety Symbols

The following symbols apply to this device.

	 CAUTION Refer to accompanying documents.	 ATTENTION Se reporter à la documentation.
	Protective earth (ground)	Terre de protection
	Direct current	Courant continu
	Instruction manual	Manuel d'instructions

Safety Marks

The following statements apply to this device.

 DANGER Disconnect or de-energize all external connections before opening this device. Contact with hazardous voltages and currents inside this device can cause electrical shock resulting in injury or death.	 DANGER Débrancher tous les raccordements externes avant d'ouvrir cet appareil. Tout contact avec des tensions ou courants internes à l'appareil peut causer un choc électrique pouvant entraîner des blessures ou la mort.
 DANGER Contact with instrument terminals can cause electrical shock that can result in injury or death.	 DANGER Tout contact avec les bornes de l'appareil peut causer un choc électrique pouvant entraîner des blessures ou la mort.
 WARNING Use of this equipment in a manner other than specified in this manual can impair operator safety safeguards provided by this equipment.	 AVERTISSEMENT L'utilisation de cet appareil suivant des procédures différentes de celles indiquées dans ce manuel peut désarmer les dispositifs de protection d'opérateur normalement actifs sur cet équipement.
 WARNING Have only qualified personnel service this equipment. If you are not qualified to service this equipment, you can injure yourself or others, or cause equipment damage.	 AVERTISSEMENT Seules des personnes qualifiées peuvent travailler sur cet appareil. Si vous n'êtes pas qualifiés pour ce travail, vous pourriez vous blesser avec d'autres personnes ou endommager l'équipement.

⚠ WARNING

Do not perform any procedures or adjustments that this instruction manual does not describe.

⚠ AVERTISSEMENT

Ne pas appliquer une procédure ou un ajustement qui n'est pas décrit explicitement dans ce manuel d'instruction.

⚠ CAUTION

Equipment components are sensitive to electrostatic discharge (ESD). Undetectable permanent damage can result if you do not use proper ESD procedures. Ground yourself, your work surface, and this equipment before removing any cover from this equipment. If your facility is not equipped to work with these components, contact SEL about returning this device and related SEL equipment for service.

⚠ ATTENTION

Les composants de cet équipement sont sensibles aux décharges électrostatiques (DES). Des dommages permanents non-décelables peuvent résulter de l'absence de précautions contre les DES. Raccordez-vous correctement à la terre, ainsi que la surface de travail et l'appareil avant d'en retirer un panneau. Si vous n'êtes pas équipés pour travailler avec ce type de composants, contacter SEL afin de retourner l'appareil pour un service en usine.

SEL-WCS Specifications

Compliance

Designed and manufactured under an ISO 9001 certified quality management system

General

Operating Temperature

−40° to +85°C (−40° to +185°F)

Storage Temperature

−40° to +85°C (−40° to +185°F)

Operating Environment

Pollution Degree: 2
Relative Humidity: 5%–95%, noncondensing
Maximum Altitude: 2000 m

Ingress Protection

IP67

Clamp Range (SEL WCS)

6.35 mm to 31.75 mm (0.25 in to 1.25 in)

Dimensions

141.7 mm diameter x 177.0 mm height
(5.58 in. diameter x 6.97 in. height)

Weight

Wireless Current Sensor: 0.85 kg (1.9 lb)

Overtoltage

Category III

Insulation Class

Class III

System

Power System Frequency Range

45–65 Hz

Load Magnitude Accuracy

1% (preliminary)

Phase Measurement Accuracy

~3 degrees

Maximum Voltage

38 kV (L-L)

Maximum Steady-State Load Current

1000 A (Thermal Rating preliminary)

Maximum Fault Current

25 kA for 10 cycles

Power

Minimum Load Current

2 A

Radio System

Frequency Band

902–928 MHz ISM band (U.S.A, Canada)

SEL WCS

TX Power (Effective Isotropic Radiated Power)

50 mW (17 dBm) peak,
40 mW (16 dBm) typical

SEL-WCS Receiver Card

Antenna Connector: SMA, 50 Ω

RX Sensitivity (1% Error Rate): TBD

Modulation

FSK

Link Range

TBD

Type Tests

Electromagnetic Compatibility Emissions

Radiated: 47 CFR Part 15.109
Class A

Conducted: 47 CFR Part 15.107
Class A

Electromagnetic Compatibility Immunity

Electrostatic Discharge: IEC 61000-4-2:2008
IEEE C37.90.3-2001

Discharges:
Indirect: ±8 kV
Contact: ±8 kV
Air: ±15 kV

Radiated: IEEE C37.90.2-2004
20 V/m_{rms}; 80 MHz to 1 GHz
>35 V/m_{rms} with 80% 1 kHz sine wave modulation

Surge: IEC 61000-4-5:2005
PT: ±0.5; 1.0; 2.0 kV; line-to-line
PT: ±0.5; 1.0; 2.0; 4.0 kV; line-to-earth

Conducted: IEC 61000-4-6:2008
10 V_{rms}; 150 kHz to 80 MHz
80% 1 kHz sine wave modulation

Power Frequency Magnetic Field: IEC 61000-4-8:2009
100 A/m; 50/60 Hz; ≥60 s
1000 A/m; 50/60 Hz; 1–3 s

IEEE Surge Withstand Capability: IEEE C37.90.1-2012
Damped Oscillatory (1 MHz)—
(CM & DM)
Power Input: ±2.5 kV
Communications Ports: ±2.5 kV
(CM only)
Fast Transient (5 kHz)—(CM & DM)
Power Input: ±4.0 kV
Communications Ports: ±4.0 kV
(CM only)

Environmental

Cold: IEC 60068-2-1:2007
Cold Profile Ad; −40°C; ≥16 hours;
operational

Dry Heat: IEC 60068-2-2:2007
Dry Heat Profile Bd; +85°C; ≥16 hours;
operational

Damp Heat; Cyclic: IEC 60068-2-30:2005
Damp Heat Profile Db; +25° to +55°C;
relative humidity ≥93%; 6 cycles

Vibration: IEC 60255-21-1:1988
Class 1 Vibration Endurance
Class 2 Vibration Response

Shock and Bump: IEC 60255-21-2:1988
Class 1 Shock Withstand
Class 1 Bump
Class 2 Shock Response

Seismic: IEC 60255-21-3:1993
Class 2 Quake Response

Table 2 Certifications by Country

Country	Part Number	Authority	Reference
U.S.A. and Colombia	TBD	FCC	TBD
Canada	TBD	IC	TBD