Swift Sensors SS3-617 Wireless AC Current Sensors
User Guide and Application Note

AN617: For SS3-617-30, SS3-617-100, and SS3-617-200

SS3-617 Wireless AC Current Sensor Overview

The SS3-617 is a family of wireless high-quality, pre-calibrated current transformer (CT) sensors that measure single-phase AC RMS current consumption, offered in the ranges of 0-30, 0-100, and 0-200Arms. The physical configuration is a "split-core" transformer attached to a 1-2 meter cable protruding from the wireless sensor. "Split-core" refers to the minimally invasive process of measuring current with the transformer's ability to open and close with a latch. When using split-core transformers, you do not need to cut or disconnect any wires to install the CT clamp. Current may be measured in a 2 or 3-wire system, with the CT clamped around a "Live"(hot) or "Neutral" wire.

Figure 1.1 Shows CT latch Open

Figure 1.2 Shows CT Latch Closed

1. SS3-617 Features

- Measures RMS Current every 1-30 minutes (1-minute default) of any single-phase AC power system, generally within +/-1.5% (see Datasheet for measurement specifics).
- Min, Max, Average, and Amp Hours may be determined with the Swift Sensors Console reporting.
- Power consumption (Watts) may be estimated by multiplying current consumption with mains RMS Voltage.
    - Mains voltage is generally stable (within 2%) and may be assumed depending on territory. For example, in the US mains Voltage is 120VACrms +/-2%. Therefore, a current reading of 5A would allow one to determine a power consumption of 5Arms * 120VACrms = 600Wrms. Power (RMS Watts) = VACrms * Irms, where Irms = Current Consumption Reading, and VACrms = RMS AC voltage on the lines being measured (usually mains). Instructions for applying this multiplication factor to your measurements to estimate power consumption are included later in this application note.

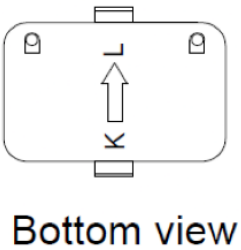
- You can accurately measure system power consumption (Watts) if you know the exact mains voltage. You can This can achieve this by using a Swift Sensors SS3-610 0-500VACrms Voltage Meter to measure the mains voltage for an accurate calculation of system power consumption.
- If Amp-Hour values are known from multiplying the current consumption (Irms) by the AC RMS Voltage (Vrms), then Watt-Hours may also be calculated with Swift Sensors Console reporting.

2. Basic Use and Maintenance

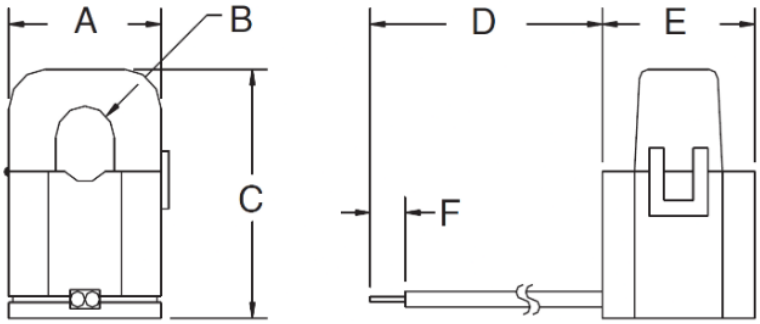
2.1 SS3-617 Use Indications: Latch the CT clamp around a single wire "Hot" (Live) or "Netural," in a 2 or 3-wire single-phase power system. Do NOT clamp the CT around an entire mains bundle, as the current flow from Live + Neutral will cancel out, shown in *Figure 2.1*. Ideal measurements will be made when the "K->L" diagram on the CT bottom matches the direction of the current flowing, however, measurements may be achieved in either orientation. See *Figure 2.2* for the "K->L" diagram on the bottom of each CT clamp type. For best results, install the CT in a "hanging" configuration. Smaller wires, if not hanging, may cause a measurement deviation of up to 1% in the worst case.

Figure 2.1: Incorrect CT Clamping, Clamping must be around a single current-carrying wire

Figure 2.2



2.2 SS3-617 Dimension Table for Wire Size Reference: Dimension "B" determines the Maximum Wire Thickness, shown in *Figure 2.3 below. Figure 2.3 is the dimensional picture + table for reference.*



	A	B	C	D	E
SS3-617-30	19.2mm (0.76")	4.9mm (0.19")	31.5mm (1.24")	1-Meter (3.25')	20.8mm (0.82")
SS3-617-100	31.4mm (1.24")	15.7mm (0.62")	45mm (1.77")	1-Meter (3.25')	31mm (1.22")
SS3-617-200	45.2mm (1.78")	23.6mm (0.93")	65.5mm (2.58")	1-Meter (6.5')	34.7mm (1.37")

2.3 SS3-617 Model-Specific Guidance

1. **SS3-617-30 (0-30Arms):** Connected to its sensor with a 1-meter cable, the SS3-617-30 is best suited for lower current monitoring. The maximum wire diameter allowed is 8-10AWG. If the wire is too thick for the CT clamp, do not attempt to force the wire into the CT cavity. *Figures 2.4 and 2.5* show the maximum wire diameter installation on an SS3-617-30 (pictured is 10AWG with thick jacket insulation).

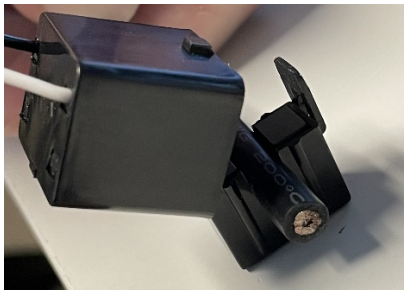


Figure 2.4 Latch Open

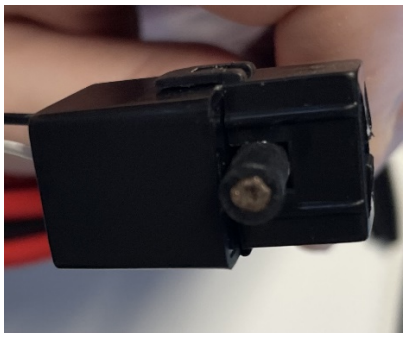


Figure 2.5 Latch Closed, Ready for Measurement

2. **SS3-617-100 (0-100Arms):** Connected to its sensor with a 1-meter cable, the SS3-617-100 can be used to accurately measure AC current up to 100Arms. The maximum suitable wire gauge if generally 00AWG, although dimension "B" in *Figure 2.3* for the best determination.
3. **SS3-617-200 (0-200Arms):** Connected to its sensor with a 2-meter cable, the SS3-617-100 can be used to accurately measure AC current up to 200Arms. The maximum suitable wire gauge if generally 000AWG+, although dimension "B" in *Figure 2.3* for the best determination.

2.4 Maintenance:

- Keep the SS3-617 CT latch closed whenever possible to prevent corrosion from developing over time. Make sure the CT latch is closed during use to get accurate current measurements, as the latch completes the circuit.
- The CT should also be kept in room-temperature, in a low-humidity environment whenever possible.
- All CT ranges can tolerate current 20% above their maximum rating without danger.
- CTs are separated from galvanic contact to mains and are very safe to use.
- Sensor environment shall not exceed +60C, and CT environment shall not exceed +105C.

3. SS3-617 CT Clamp Response and Calibration

3.1 CT Clamp Response: Unlike many inexpensive CTs, which are non-linear and have very low accuracy. The SS3-617 CT clamps are made of a high-quality alloy with corrosion resistance. Therefore, SS3-617 CT clamps are extremely linear in their operation even before factory calibration. Below, *Figures 3.1, 3.2, and 3.3* show the CT clamp response curves before calibration (raw CT output). SS3-617-30 has minor saturation from 25-30A, but SS3-617-100, SS3-617-200 are Linear to <1% in their entire range.

Figure 3.1: SS3-617-30 Raw CT Output vs. RMS Amps

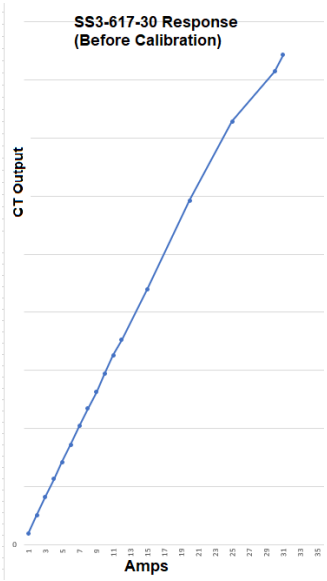


Figure 3.2: SS3-617-100 Raw CT Output vs. RMS Amps

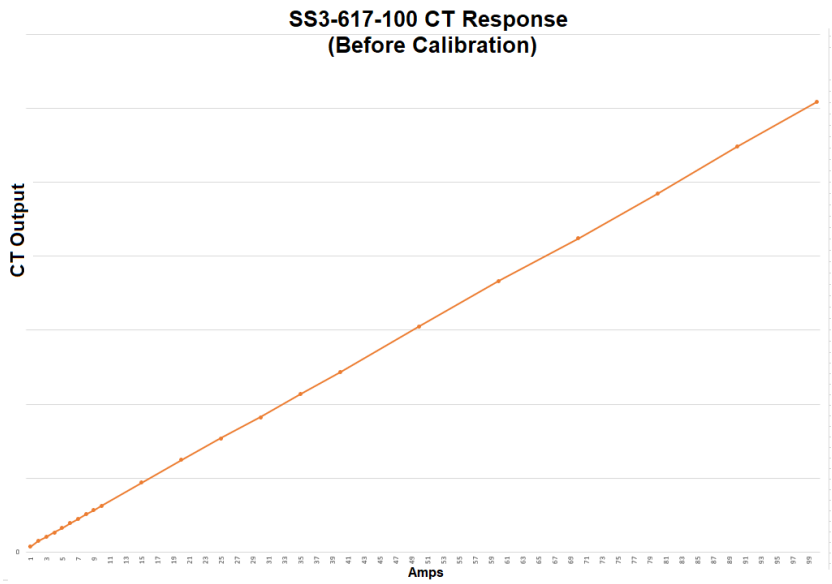
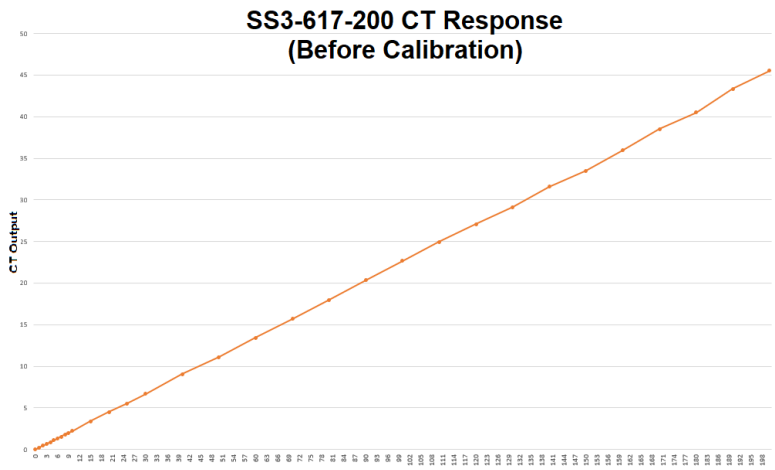


Figure 3.3: SS3-617-200 Raw CT Output vs. RMS Amps



3.2 SS3-617 CT Clamp Calibration

Although the SS3-617 CT Clamps are linear, two measures are taken to ensure the highest accuracy measurements.

3.2.1: Due the premium quality of the SS3-617 CTs, unit tolerance variation is <1%. This means, all SS3-617 CTs follow the curves shown in *Figures 3.1-3.3* follow those same curves to within <1%. Proprietary encoding ensures that any non-linearity is properly compensated for with 30-50 datapoints.

3.2.2: In addition to high-resolution compensation, every unit undergoes a 5-point calibration for even better accuracy. Please refer to the SS3-617-XXX datasheet for accuracy numbers- most measurements are within +/-1% accuracy.

4. Accurate Power Estimates with SS3-617

Assuming mains voltage based on region, you may use the SS3-617 CT sensors to calculate instantaneous power consumption, and average power consumption in RMS "Watts." To calculate power consumption, you may create a simple linear conversion from "Amperes" to "Watts" in the Swift Sensors Console (shown below in *Figure 4.1*). These conversion accuracies rely on stable mains voltage and is usually around 2%. If the precise value of the mains voltage is known and is stable, this may also be used as a multiplier instead of the standard mains voltage for the region.

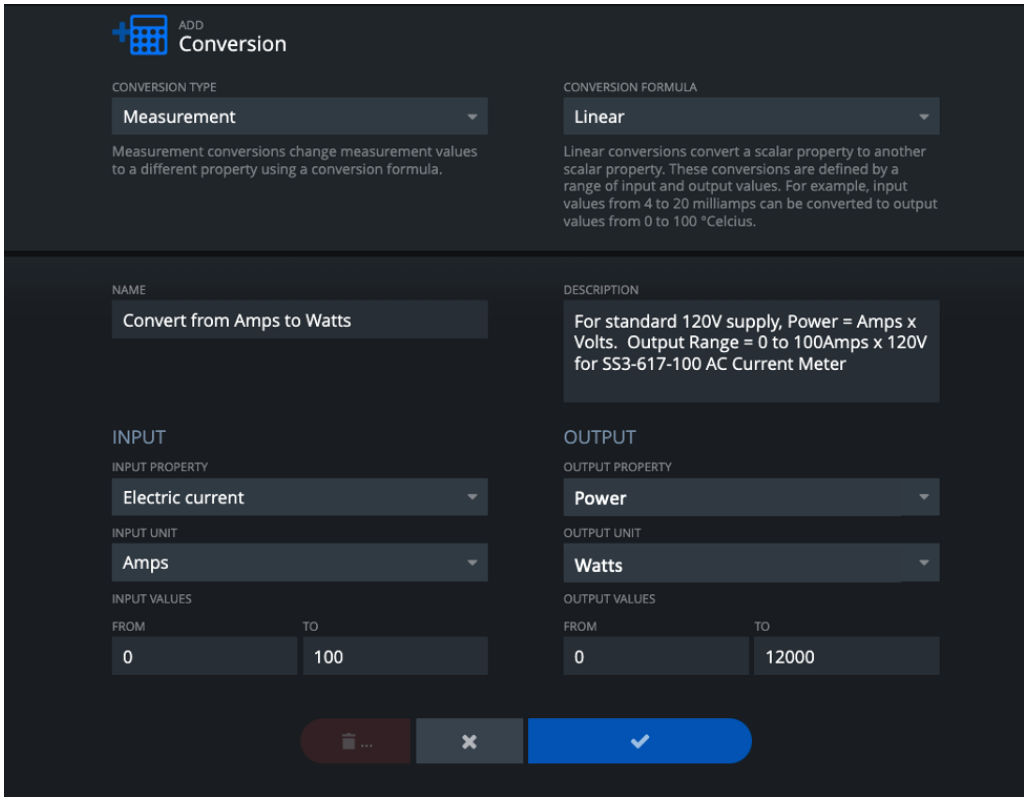


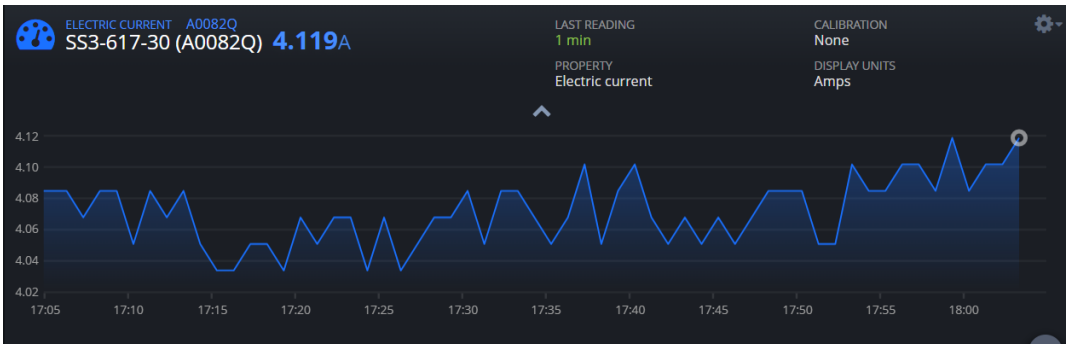
Figure 4.1

- As shown in *Figure 4.1*, you must know your region's mains voltage, and multiply the SS3-617 Current Range * Mains Voltage.
- The example in *Figure 4.1* is a SS3-617-100, therefore the current range is 100A. The region's mains voltage is 120VACrms. Therefore, you may convert 0-100A, to 0-12kW(0-12000 Watts).
- If using an SS3-617-30, the Input would be 0-30A, and Output would be 0 – (30*120) = 0-3.6kW(3600W).
- Or if your region uses 240VACrms on mains lines, "Output Power" would be Amps *240. SS3-617-100 would have an output of 100*240 = 24kW (24000W).

5. Additional Measurement Information

Below is an example of data collected from a 30A CT (SS3-617-30). You will notice that the measurement deviates by ~1.5% within the given timeframe. When a power system is under load, current variations are constantly happening- current drawn from any AC power system will always fluctuate ~1% even

under consistent operation. Every measurement being made per 1-minute interval is <1% accurate, and current fluctuations are shown accurately. This data is shown in *Figure 5.1.*



6. Effects on Performance

Certain physical and electrical attributes can significantly affect the measurement accuracy when using a SS3-617.

- **Waveform Quality:** Waveform quality may have the largest effect on measurement accuracy. SS3-617 CTs are designed to operate best in AC power systems from 40-100Hz, with a Sine Wave. Mains power generally provides a sine waveform of sufficient quality to make accurate current measurements. However, if the AC wave is deformed, or is not a Sinusoid, reading accuracy may falter. For example, a triangle wave will undershoot current measurements, as there is less time spent near the peak of the waveform.
- **Conductor Size and Position:** Wire (Conductor) size and its position within the CT clamp may affect measurements up to 1% in combination. If the conductor size is smaller than recommended for the current flowing through it- the effects may be larger (this would be misuse, however). An example with SS3-617-100: If 30A are flowing through a 12AWG conductor, measurements may be affected up to 0.5% vs. using an 00AWG size conductor with the same current. SS3-617 CTs are again designed to be used in a "hanging" configuration (shown below in *Figure 5.1*). Using the sample example with an SS3-617-100, a 12AWG wire positioned at the bottom of the CT may affect measurement accuracy up to 0.5% vs. a "hanging" configuration.
    - If the conductor is close in size to dimension "B" in *Figure 3.2,* there will be no concerns about conductor size or position, as there will not be much room for the conductor to move. Using the largest possible conductor accommodated by the CT in an SS3-617-XXX is always recommended for optimal performance.
- **Optimal Performance Review:** To summarize the previous points, the most accurate measurements will be made with SS3-617-XXX CTs if the largest conductor possible for the CT to accommodate is used, with the CT facing the proper direction (shown in *Figure 2.2*). Swift Sensors makes the process of using a CT as simple as possible, calibrating the CT before shipment.

Figure 6.1: Hanging Configuration of CT