Delta PQC Series APF and SVG

CT Configuration Guide

Version 1.5

Menu

1. Firmware Version Requirements

Delta PQC series APF & SVG CT configuration is related to the firmware inside APF & SVG module and HMI. To use this CT Configuration Guide document, please make sure that APF or SVG are using firmware version shown in *Table 1-1* or above.

Table 1-1 APF and SVG Firmware Version Requirements for This CT Configuration Guide

Module	Master DSP Firmware Version	Slave DSP Firmware Version
50A	V01.02.190	V01.02.110
75A	V01.02.400	V01.02.180
100A (Rear Connect)	V01.02.280	V01.02.210
100A (Front Connect)	V01.02.390	V01.02.350
50kvar (Rear Connect)	V01.02.220	V01.02.120
100kvar Gen. I	V01.02.240	V01.02.190
100kvar Gen. II	V01.02.390	V01.02.350
HMI	V2.1.20	

2. Internal CT Connection of SVG or APF Cabinet

2.1 Pin Definition on CT Terminal of SVG or APF Cabinet

CT terminal board of SVG or APF cabinet is shown as *Figure 2-1,* indicated as ①. In total, 20 pins are related to CT connection (from XT_PIN1 to XT_PIN20).

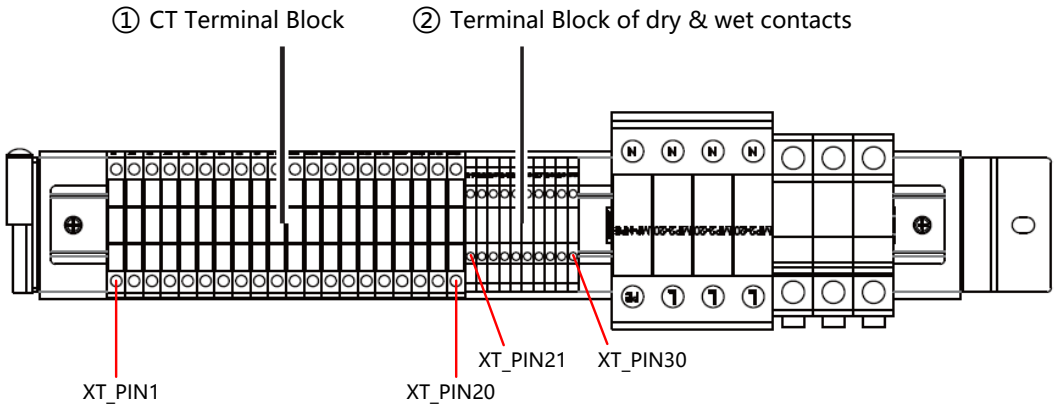


Figure 2-1 Pin Position on CT Terminal Block of SVG or APF cabinet

Refer to *Table 2-1* for SVG or APF cabinet CT terminal definition.

Table 2-1 Pin Definition on CT Terminal Bock of SVG or APF Cabinet

Position of terminal board	**CT Secondary side**	**Function**	**Electrical specification**
XT_PIN1	R-CT-S1	R-phase positive output	5A
XT_PIN2	R-CT-S1		
XT_PIN3	R-CT-S1		
XT_PIN4	R-CT-S2	R-phase negative output	
XT_PIN5	R-CT-S2		

XT_PIN6	R-CT-S2		
XT_PIN7	S-CT-S1	S-phase positive output	
XT_PIN8	S-CT-S1		
XT_PIN9	S-CT-S1		
XT_PIN10	S-CT-S2	S-phase negative output	
XT_PIN11	S-CT-S2		
XT_PIN12	S-CT-S2		
XT_PIN13	T-CT-S1	T-phase positive output	
XT_PIN14	T-CT-S1		
XT_PIN15	T-CT-S1		
XT_PIN16	T-CT-S2	T-phase negative output	
XT_PIN17	T-CT-S2		
XT_PIN18	T-CT-S2		
XT_PIN19	Reserved	/	/
XT_PIN20	Reserved	/	/

2.2 Detailed CT Connection inside SVG or APF Cabinet

Delta SVG or APF module and cabinet are packed and delivered separately, SVG or APF modules will be installed in the cabinet. Inside each SVG or APF cabinet, the CT connection wires have been pre-cabled from cabinet CT terminal block to the proper location, where SVG or APF modules are about to be placed. After putting SVG or APF modules in the cabinet, the engineer at site needs to plug module CT terminals into each module and fasten them, to complete the CT connection.

2.2.1 Single Module SVG or APF Cabinet Internal CT Connection

Single module cabinet means the cabinet is able to house maximum one SVG or APF module, this is not a common scenario, but it is an easy way to understand what internal CT connection is.

Refer to *Figure 2-2* for detailed connection inside single SVG or APF module cabinet.

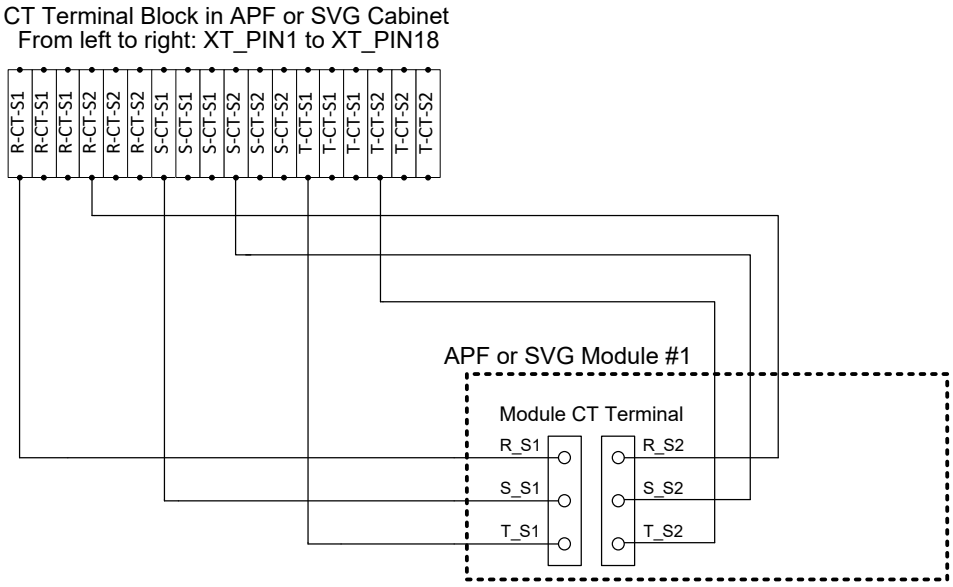


Figure 2-2 Single Module SVG/ APF Cabinet Internal CT Connection

2.2.2 Double Modules SVG or APF Cabinet Internal CT Connection

Double modules cabinet means the cabinet is able to house maximum two modules, multiple modules cabinet's internal CT connection is similar to this scenario.

Refer to *Figure 2-3* for detailed connection inside double SVG or APF modules cabinet.

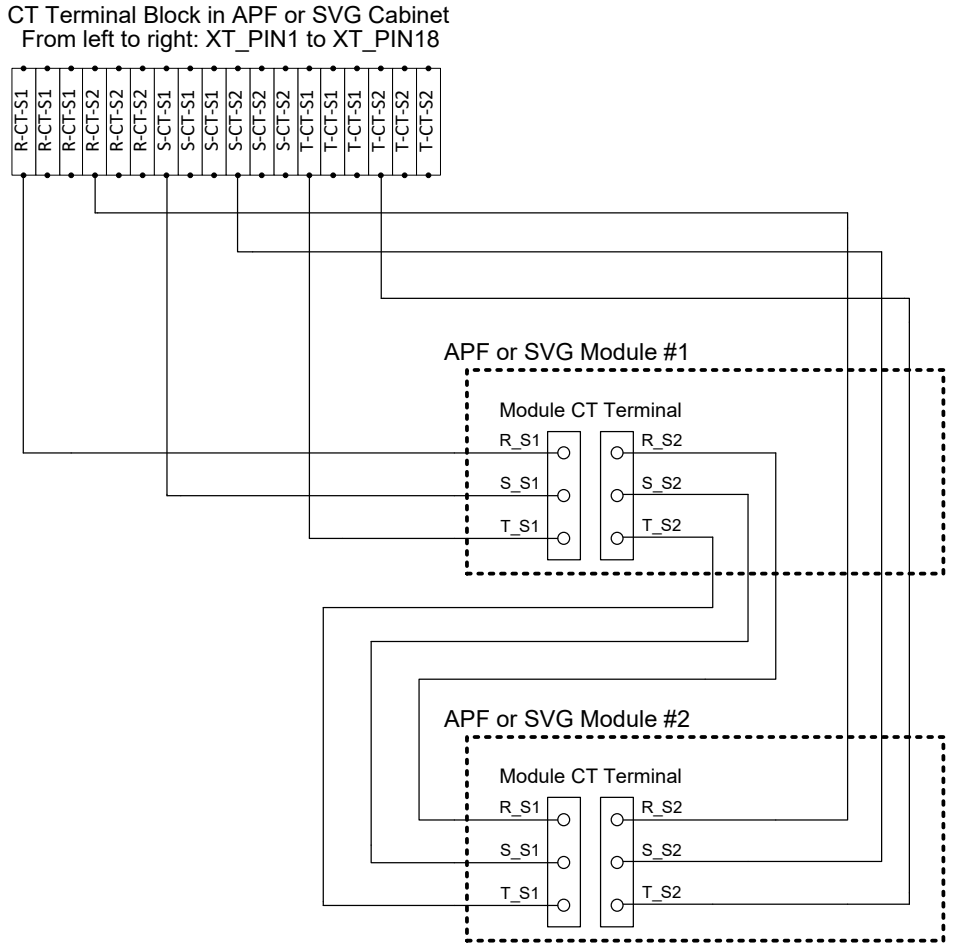


Figure 2-3 Double Modules SVG/ APF Cabinet Internal CT Connection

3. SVG CT Configuration

This chapter explains how to select proper CT for Delta SVG and how to connect CT for SVG cabinet and wall-mounted system.

3.1 SVG CT Selection

Proper CT must be selected according to electric condition of installing site, requirements about CT selection for SVG are shown in *Table 3-1*.

Table 3-1 Requirements for SVG CT Selection

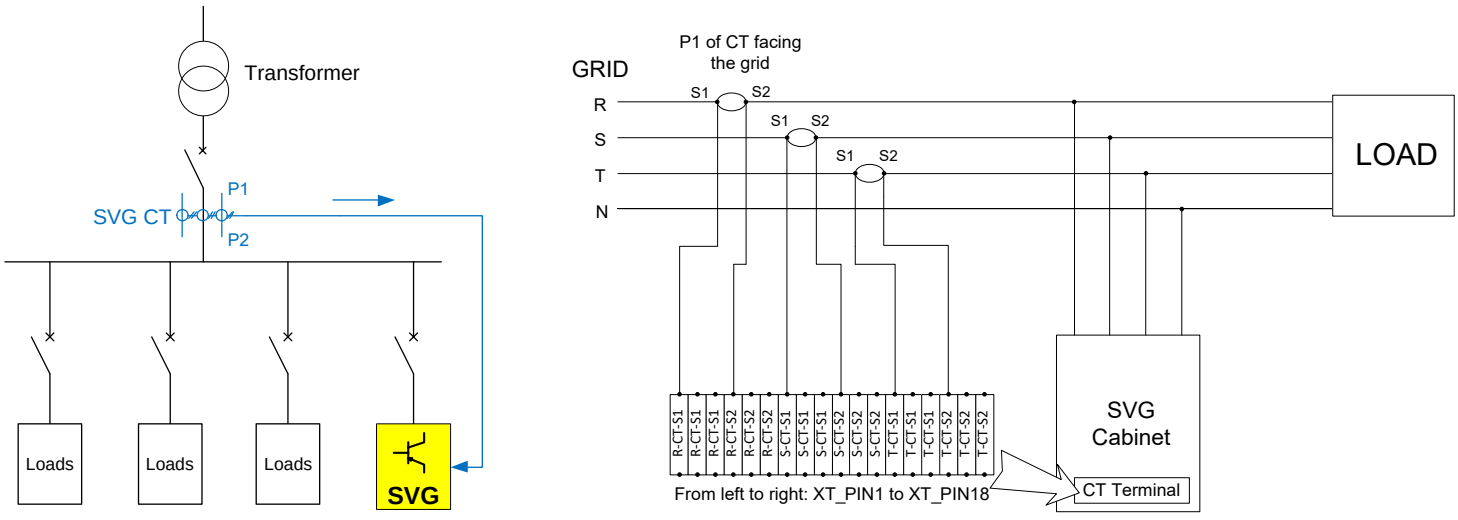
Specification	Requirement
CT Ratio	CT Secondary Current: 5A CT Primary Current ≥ 1.5* Maximum Load Current
CT Accuracy	Class 0.5 or 1.0
CT Secondary Capacity (VA)	1~2 modules ≥10VA 3~4 modules ≥15VA 5~7 modules ≥20VA >7 modules, consult Delta or Delta distributor.

Note: recommended secondary current of CT is 5A, when actual CT secondary current is 1A, CT ratio setting should be changed accordingly, e.g., if actual CT ratio is 500:1A, the CT ratio setting Touch Screen HMI should be 2500:5A.

3.2 CT Connection for SVG Cabinet System

3.2.1 Closed loop, Unbalanced phases, Single SVG Cabinet External CT Connection

In this scenario, 3 pieces of CT shall be installed at grid side (R/S/T phases), P1 of which should be facing the grid side, refer to *Figure 3-1* for single line diagram (SLD) and detailed connection.



A) Single Line Diagram *B) Detailed CT Connection*

Figure 3-1 CT Connection for closed loop, unbalanced phases, single SVG cabinet scenario

If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

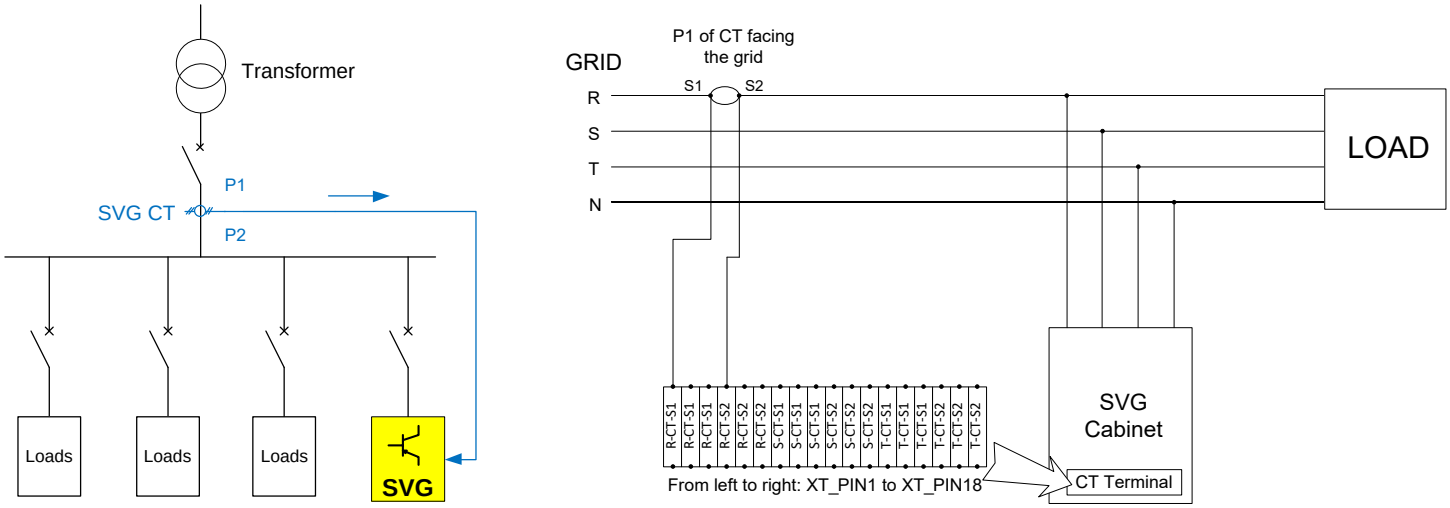
- Corresponding CT settings in Touch Screen HMI

Setting Location	Setting Value

General Setting → CT Position	Grid Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
Adv Setting→ CT Number	3-CT
Adv Setting→ 1-CT Location	No need to set

3.2.2 Closed loop, Balanced phases, Single SVG Cabinet External CT Connection

In this scenario, customer can use 3 pieces of CT and follow the same CT connection shown in *Figure 3-1*. Or only 1 piece of CT can be installed at grid side (R phase), P1 of which should be facing the grid side, refer to *Figure 3-2* for single line diagram (SLD) and detailed connection.



A) Single Line Diagram *B) Detailed CT Connection*

Figure 3-2 CT Connection for closed loop, balanced phases, single SVG cabinet scenario

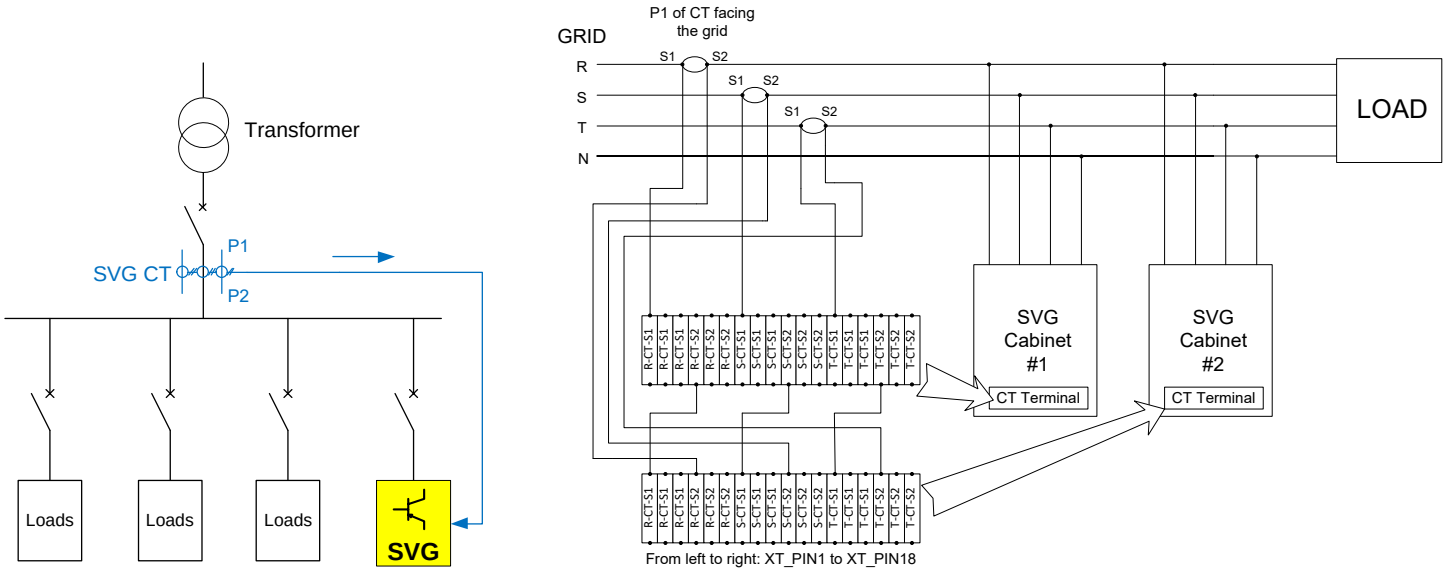
If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

- Corresponding CT settings in Touch Screen HMI

Setting Location	Setting Value
General Setting → CT Position	Grid Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
Adv Setting→ CT Number	1-CT
Adv Setting→ 1-CT Location	Phase-A

3.2.3 Closed loop, Unbalanced phases, Double SVG Cabinets External CT Connection

In this scenario, 3 pieces of CT shall be installed at grid side (R/S/T phases), P1 of which should be facing the grid side, all these CT will be shared by two SVG cabinets, refer to *Figure 3-3* single line diagram (SLD) and detailed connection.



A) Single Line Diagram *B) Detailed CT Connection*

Figure 3-3 CT Connection for closed loop, unbalanced phases, double SVG cabinets scenario

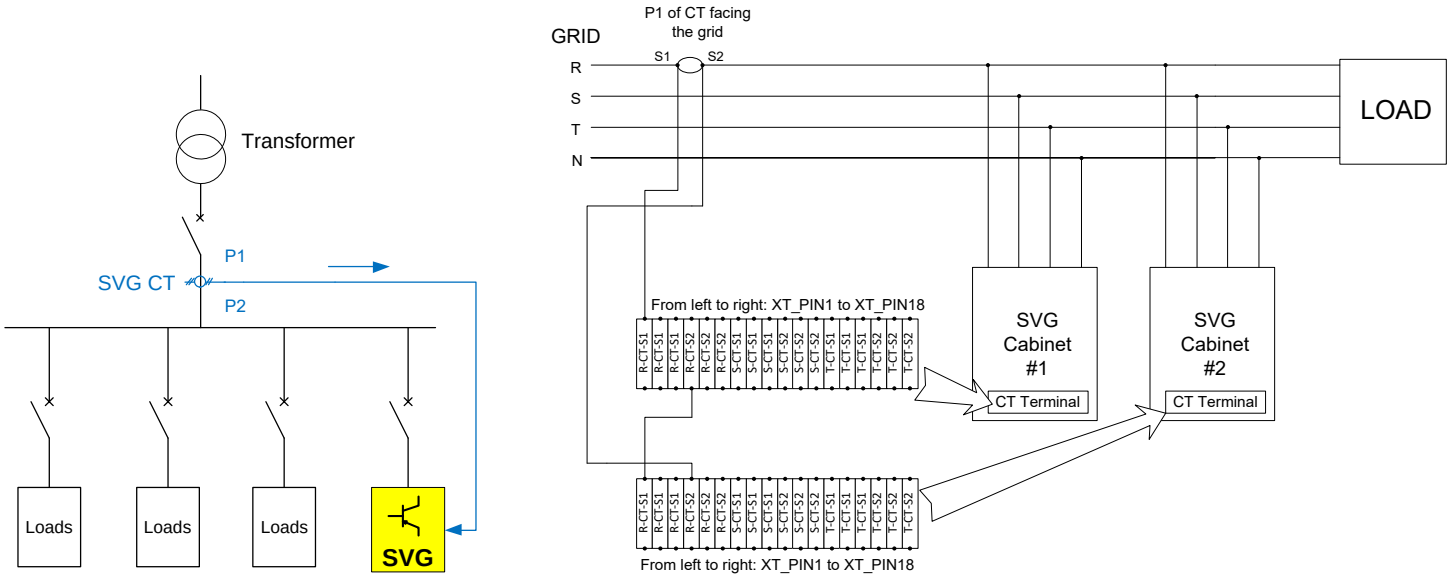
If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

- Corresponding CT settings in Touch Screen HMI

Setting Location	Setting Value
General Setting → CT Position	Grid Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
General Setting→ System Percent	50% for same capacity, if different capacity Cabinet#1: Cabinet#1 capacity/whole capacity Cabinet#2: Cabinet#2 capacity/whole capacity
Adv Setting→ CT Number	3-CT
Adv Setting→ 1-CT Location	No need to set

3.2.4 Closed loop, Balanced phases, Double SVG Cabinets External CT Connection

In this scenario, customer can use 3 pieces of CT and follow the same CT connection shown in *Figure 3-3*. Or only 1 piece of CT can be installed at grid side (R phase), P1 of which should be facing the grid side, refer to *Figure 3-4* for single line diagram (SLD) and detailed connection.



A) Single Line Diagram *B) Detailed CT Connection*

Figure 3-4 CT Connection for closed loop, balanced phases, double SVG cabinets scenario

If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

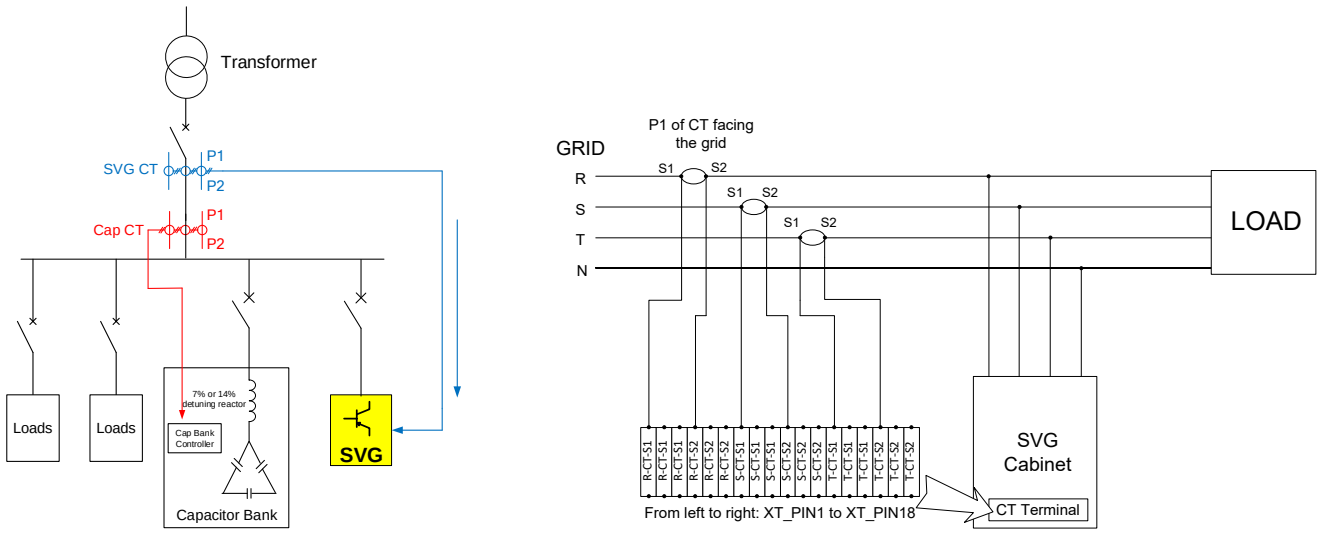
- Corresponding CT settings in Touch Screen HMI

Setting Location	Setting Value
General Setting → CT Position	Grid Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
General Setting→ System Percent	50% for same capacity, if different capacity Cabinet#1: Cabinet#1 capacity/whole capacity Cabinet#2: Cabinet#2 capacity/whole capacity
Adv Setting→ CT Number	1-CT
Adv Setting→ 1-CT Location	Phase-A

3.2.5 Closed loop, Unbalanced phases, With Cap Bank, Single SVG Cabinet before Cap Bank

In this scenario, there is existing Cap Bank at customer site, an SVG unit is added to improve power factor correction performance. Capacitor Bank and SVG are connected to the same bus bar, and they are using separate CT and controller. SVG CT installation point shall be before Capacitor Bank CT installation point, in such way, Capacitor Bank will compensate first, the left reactive power is compensated by SVG.

3 pieces of SVG CT shall be connected at grid side, P1 of which should be facing the grid side, refer to *Figure 3-5* for single line diagram (SLD) and detailed connection.



A) Single Line Diagram *B) Detailed CT Connection*

Figure 3-5 CT Connection for closed loop, unbalanced phases, with cap bank, single SVG cabinet scenario

If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

- Corresponding CT settings in Touch Screen HMI

Setting Location	Setting Value
General Setting → CT Position	Grid Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
Adv Setting→ CT Number	3-CT
Adv Setting→ 1-CT Location	No need to set

3.2.6 Closed loop, Unbalanced phases, With Cap Bank, Common Bus Bar, Single SVG Cabinet

In this scenario, there is existing Cap Bank at customer site, an SVG unit is added to improve power factor correction performance. Capacitor Bank and SVG are connected to the same bus bar, and they are using separate CT and controller. SVG CT installation point shall be after Capacitor Bank CT installation point, in such way, SVG will compensate first, the left reactive power is compensated by Capacitor Bank.

Refer to *Figure 3-6* for single line diagram (SLD) and detailed CT connection for SVG in this scenario.

Refer to *Figure 3-7* for Cap Bank CT connection.

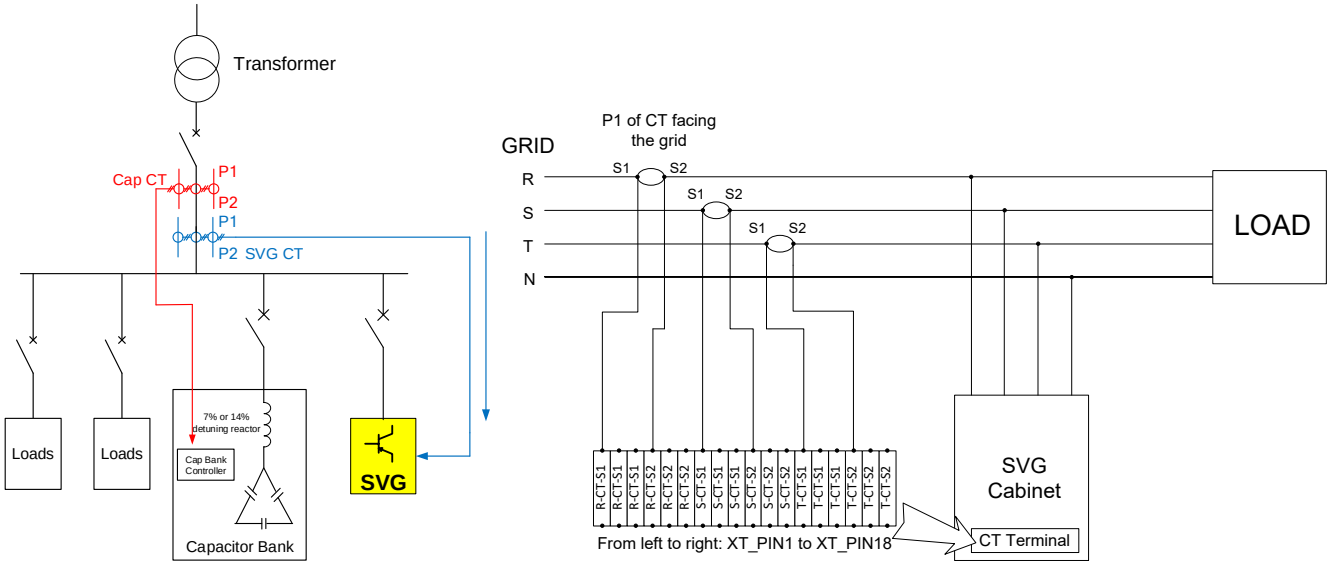


Figure 3-6 CT Connection for closed loop, unbalanced phases, with cap bank, common bus bar, single SVG cabinet scenario

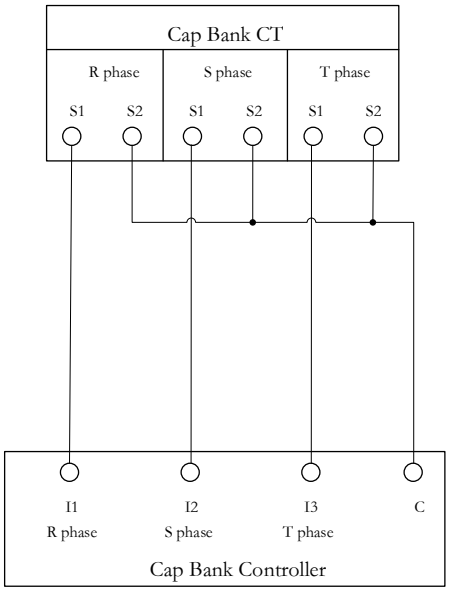


Figure 3-7 Cap Bank CT Connection after adding SVG for Power Factor Correction

If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

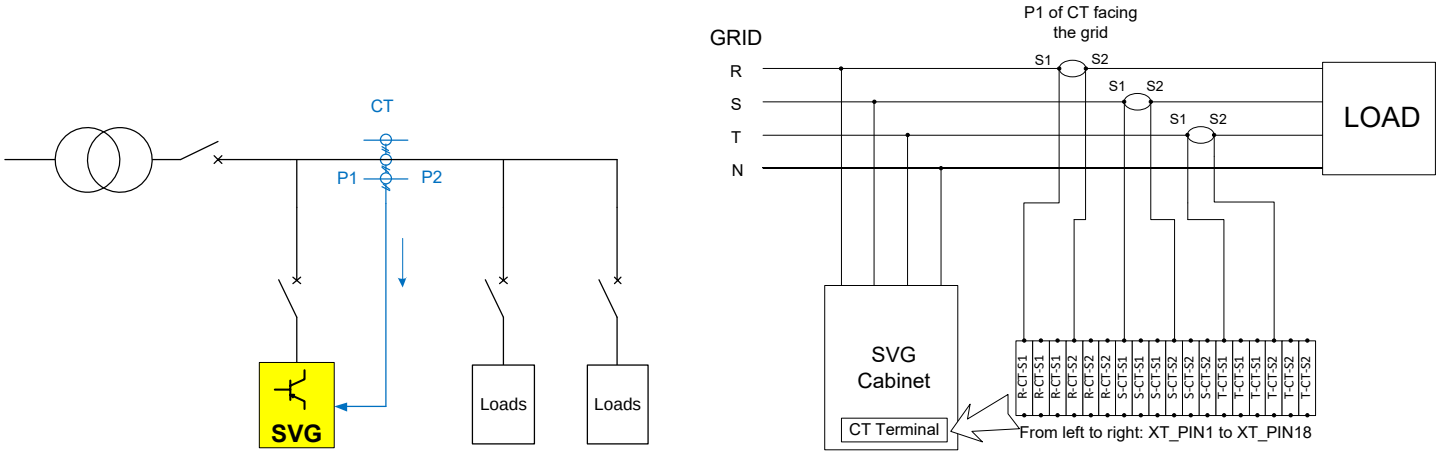
- Corresponding CT settings in Touch Screen HMI

Setting Location	Setting Value
General Setting → CT Position	Grid Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
Adv Setting→ CT Number	3-CT
Adv Setting→ 1-CT Location	No need to set

3.2.7 Open loop, Unbalanced phases, Single SVG Cabinet External CT Connection

In this scenario, 3 pieces of CT shall be installed at load side (R/S/T phases), P1 of which should be facing the grid side,

refer to *Figure 3-8* for single line diagram (SLD) and detailed connection.



A) Single Line Diagram *B) Detailed CT Connection*

Figure 3-8 CT Connection for open loop, unbalanced phases, single SVG cabinet scenario

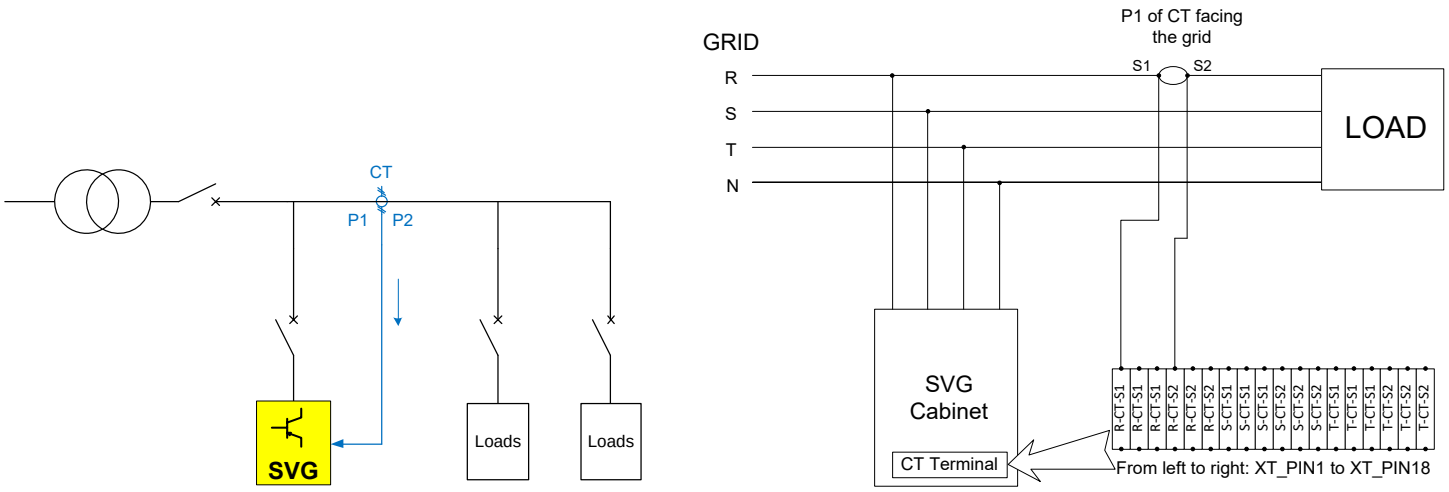
If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

- Corresponding CT settings in Touch Screen HMI

Setting Location	Setting Value
General Setting → CT Position	Load Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
Adv Setting→ CT Number	3-CT
Adv Setting→ 1-CT Location	No need to set

3.2.8 Open loop, Balanced phases, Single SVG Cabinet External CT Connection

In this scenario, customer can use 3 pieces of CT and follow the same CT connection shown in *Figure 3-8*. Or only 1 piece of CT can be installed at grid side (R phase), P1 of which should be facing the grid side, refer to *Figure 3-9* for single line diagram (SLD) and detailed connection.



A) Single Line Diagram *B) Detailed CT Connection*

Figure 3-9 CT Connection for open loop, balanced phases, single SVG cabinet scenario

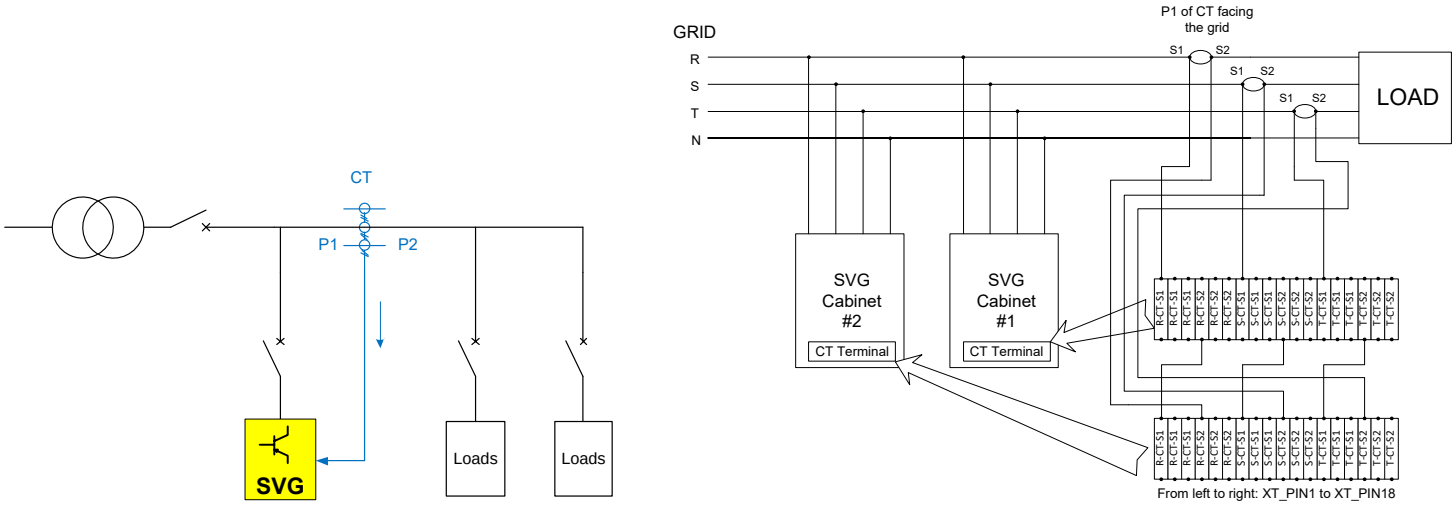
If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

- Corresponding CT settings in Touch Screen HMI

Setting Location	Setting Value
General Setting → CT Position	Load Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
Adv Setting→ CT Number	1-CT
Adv Setting→ 1-CT Location	Phase-A

3.2.9 Open loop, Unbalanced phases, Double SVG Cabinets External CT Connection

In this scenario, 3 pieces of CT shall be installed at load side (R/S/T phases), P1 of which should be facing the grid side, all these CT will be shared by two SVG cabinets, refer to *Figure 3-10* for single line diagram (SLD) and detailed connection.



A) Single Line Diagram *B) Detailed CT Connection*

Figure 3-10 CT Connection for open loop, unbalanced phases, double SVG cabinet scenario

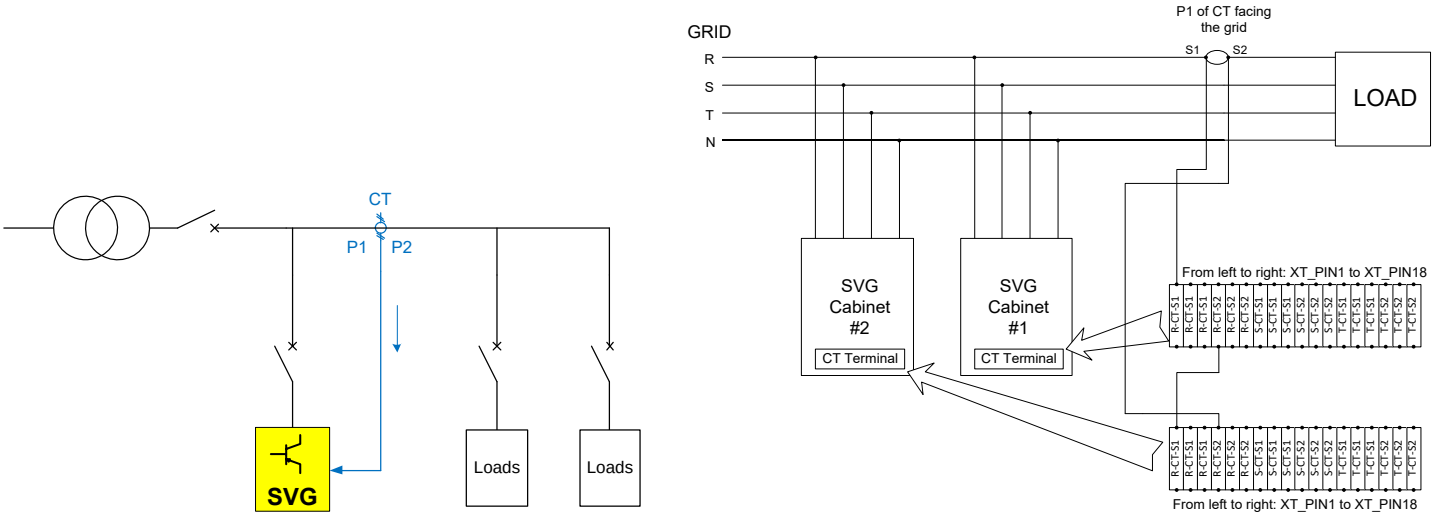
If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

- Corresponding CT settings in Touch Screen HMI

Setting Location	Setting Value
General Setting → CT Position	Load Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
General Setting→ System Percent	50% for same capacity, if different capacity Cabinet#1: Cabinet#1 capacity/whole capacity Cabinet#2: Cabinet#2 capacity/whole capacity
Adv Setting→ CT Number	3-CT
Adv Setting→ 1-CT Location	No need to set

3.2.10 Open loop, Balanced phases, Double SVG Cabinets External CT Connection

In this scenario, customer can use 3 pieces of CT and follow the same CT connection shown in Figure 3-10. Or only 1 piece of CT can be installed at load side (R phase), P1 of which should be facing the grid side, refer to Figure 3-11 for single line diagram (SLD) and detailed connection.



A) Single Line Diagram *B) Detailed CT Connection*

Figure 3-11 CT Connection for open loop, balanced phases, double SVG cabinets scenario

If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

- Corresponding CT settings in Touch Screen HMI

Setting Location	Setting Value
General Setting → CT Position	Load Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
General Setting→ System Percent	50% for same capacity, if different capacity Cabinet#1: Cabinet#1 capacity/whole capacity Cabinet#2: Cabinet#2 capacity/whole capacity
Adv Setting→ CT Number	1-CT
Adv Setting→ 1-CT Location	Phase-A

3.2.11 Closed loop, Double Transformers System, Double SVG Cabinets External CT Connection

In this scenario, two transformers are working in parallel, with a bus coupler switch. When both transformer #1 and #2 are working, the bus Coupler Switch will be OFF status, when all loads are powered by any one of two transformers, the Bus Coupler Switch will be ON status.

Two SVG cabinets are connected in closed loop to transformer #1 and #2 separately, and these SVG cabinets shall coordinate with each other based on different status of bus coupler switch.

In this scenario, 3 pieces of CT shall be installed at transformer #1 and #2 grid side (R/S/T phases), P1 of which should be facing the grid side, and another 3 pieces of CT shall be installed at bus coupler, with P1 facing transformer #1 grid side. All these CT should be same ratio.

Refer to *Figure 3-12* for single line diagram (SLD) and *Figure 3-13* detailed connection.

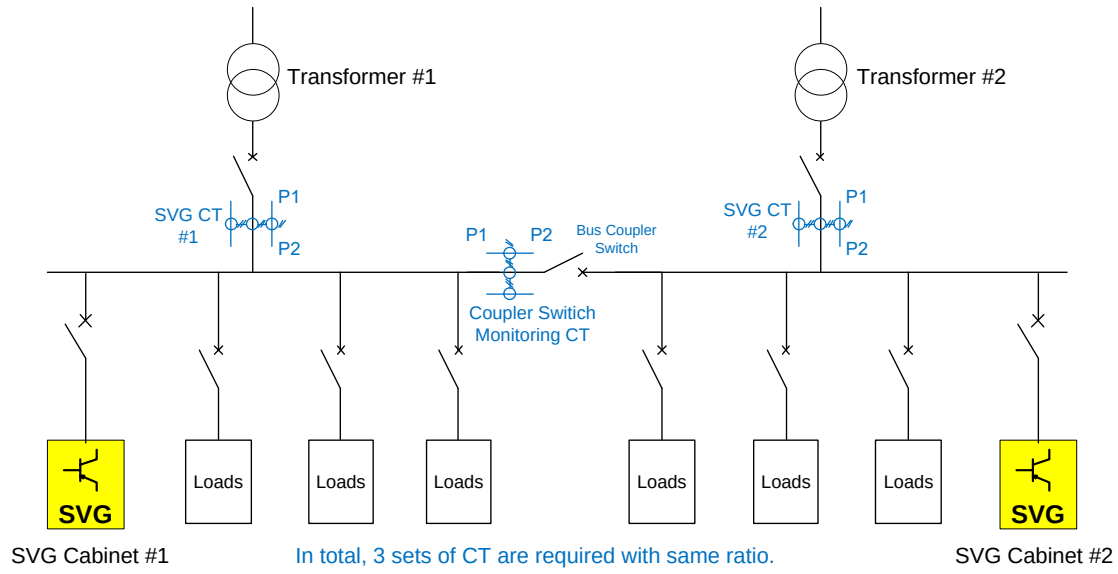


Figure 3-12 CT Connection for closed loop, double transformers, double SVG cabinets scenario - SLD

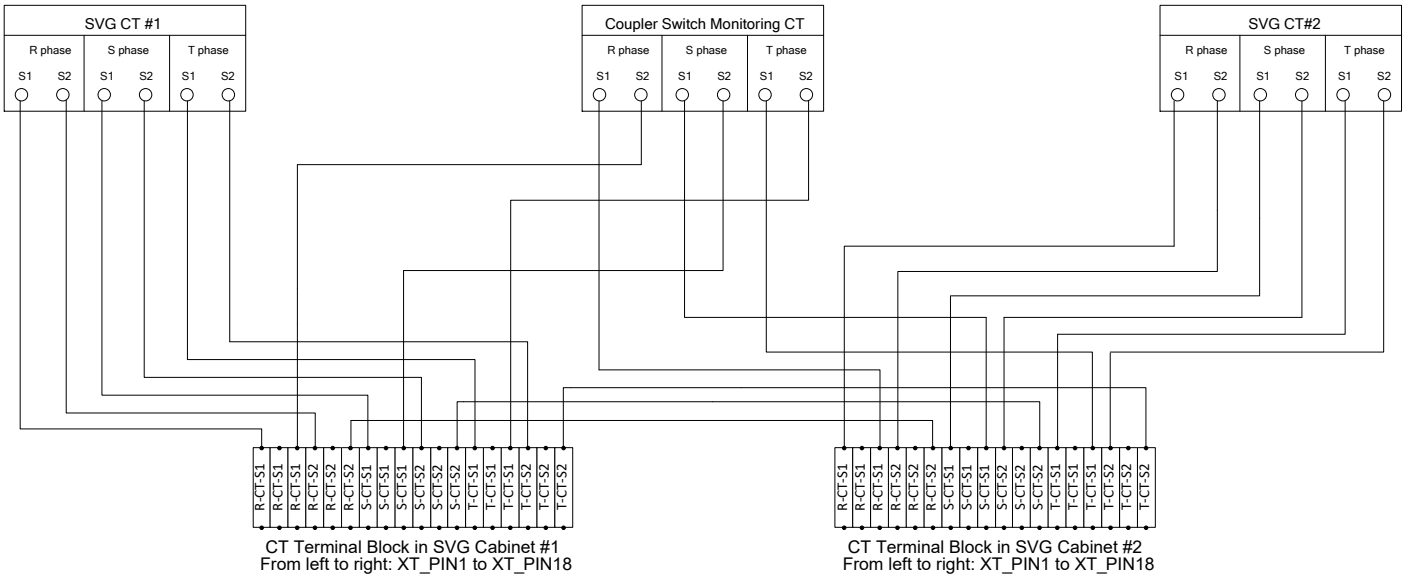


Figure 3-13 CT connection for closed loop, double transformers, double SVG cabinets scenario- details

If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

- Corresponding CT settings in Touch Screen HMI

Setting Location	Setting Value
General Setting → CT Position	Grid Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
Adv Setting→ CT Number	3-CT
Adv Setting→ 1-CT Location	No need to set

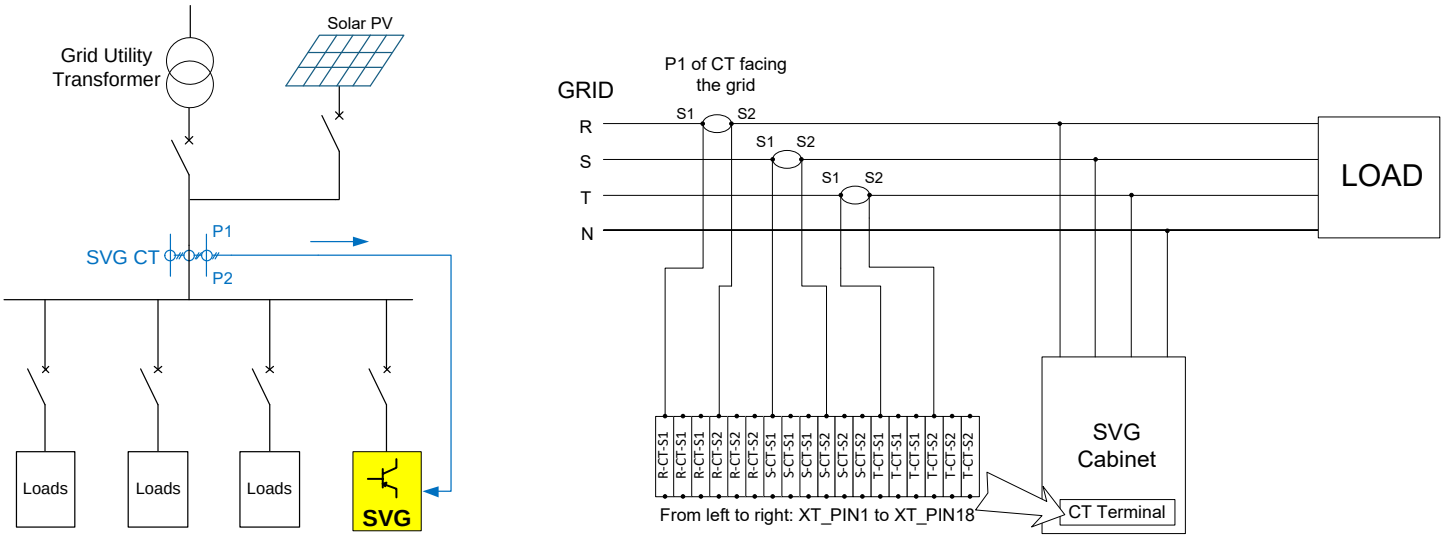
3.3 Delta SVG Cabinet Application along with Solar PV System

There are 2 options for SVG CT connection when it is co-working with solar PV system.

3.3.1 Option #1 (Treat solar PV as second power supply)

In this scenario, 3 pieces of CT shall be installed at grid side (R/S/T phases), downstream of solar PV injection point, with P1 facing the grid side.

Refer to Figure 3-14 for single line diagram (SLD) and detailed connection.



A) Single Line Diagram *B) Detailed CT Connection*

Figure 3-14 CT Connection for SVG cabinet in solar PV scenario Option 2

If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

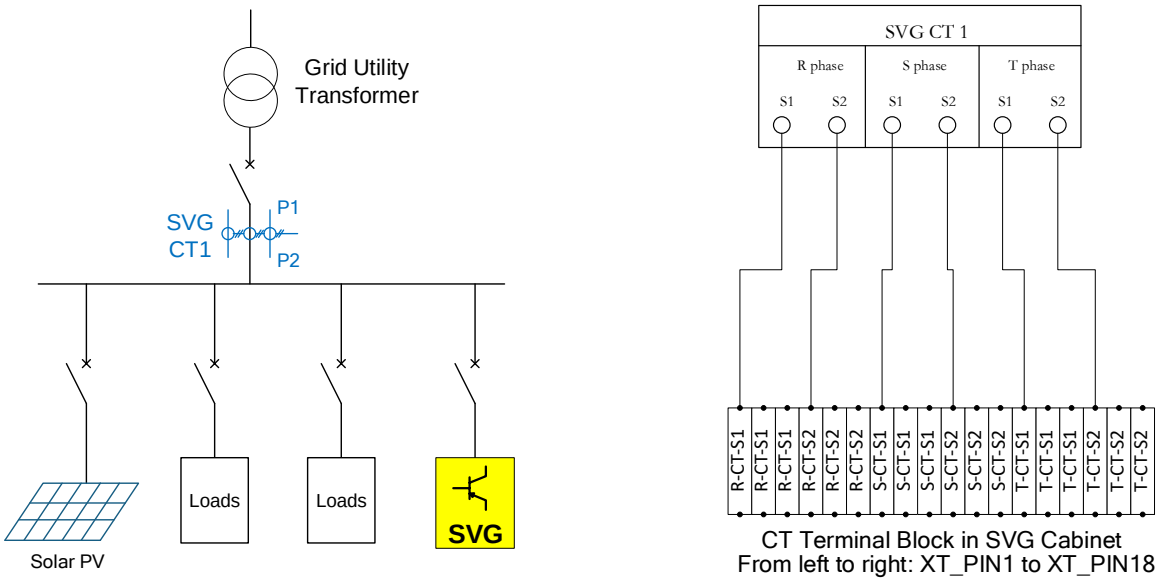
- Corresponding settings in Touch Screen HMI

Setting Location	Setting Value
General Setting → CT Position	Grid Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
General Setting→ Target cosϕ	1.0, 0.99, 0.98 or any other value
Adv Setting→ CT Number	3-CT
Adv Setting→ 1-CT Location	No need to set

3.3.2 Option #2 (Treat Solar PV as second power supply, Solar locates at downstream)

In this scenario, 3 pieces of CT shall be installed at grid side (R/S/T phases), with P1 facing the grid side.

Refer to Figure 3-15 for single line diagram (SLD) and detailed connections.



A) Single Line Diagram *B) Detailed CT Connection*

Figure 3-15 CT Connection for SVG cabinet in solar PV scenario Option 2

If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

- Corresponding settings in Touch Screen HMI

Setting Location	Setting Value
General Setting → CT Position	Grid Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
General Setting→ Target cosϕ	1.0, 0.99, 0.98 or any other value
Adv Setting→ CT Number	3-CT
Adv Setting→ 1-CT Location	No need to set

3.4 Delta SVG Cabinet Application in High Voltage PF Correction

3.4.1 Closed loop, 4 SVG Cabinets in parallel, 11kV PF Correction

In this scenario, Delta SVG is connected to high voltage (1kV~33kV) via a step-up transformer, to improve high voltage Power Factor (PF). Usually, voltage higher than 33kV is not suitable for Delta SVG to connect.

Take 11kV application for example, 3 pieces of high voltage CT shall be installed at 11kV grid side (R/S/T phases), P1 of which should be facing the grid side. As the CT is shared by multiple SVG cabinets, take 4 cabinets for instance, CT's secondary capacity should be sufficient (VA), and step-up transformer capacity shall be at least 1.2 times of SVG capacity, with impedance < 4.5%.

Refer to *Figure 3-16* for single line diagram (SLD) and *Figure 3-17* for detailed connection.

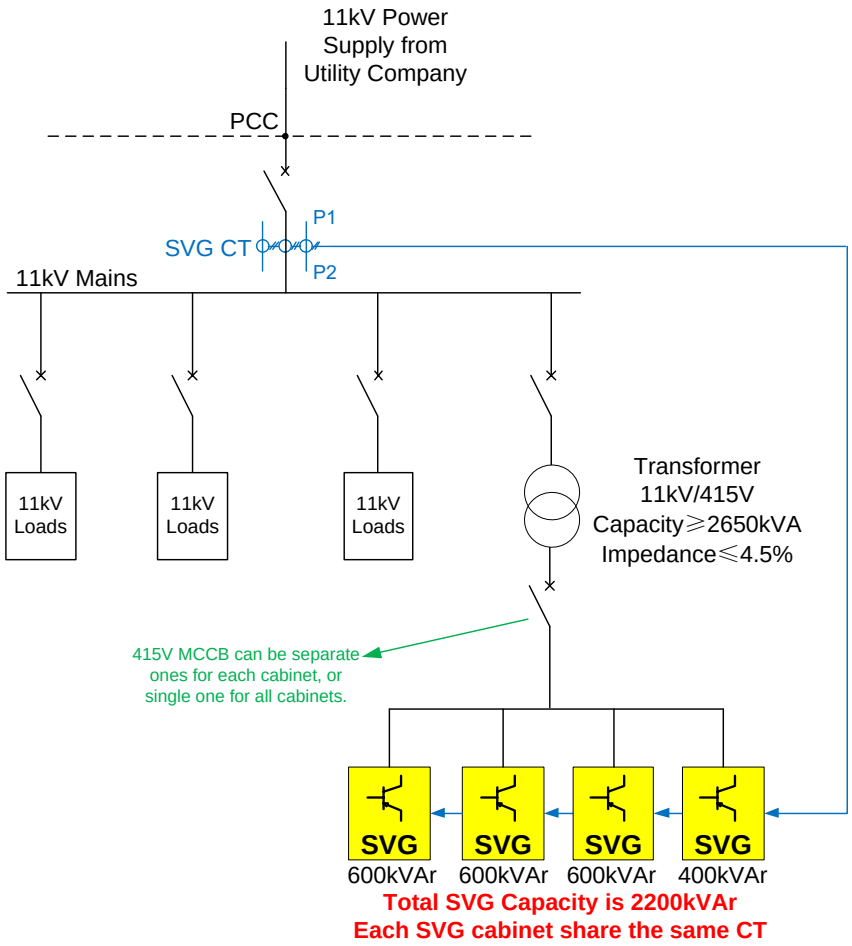


Figure 3-16 CT connection for closed loop, 11kV PF correction, multiple SVG cabinets scenario - SLD

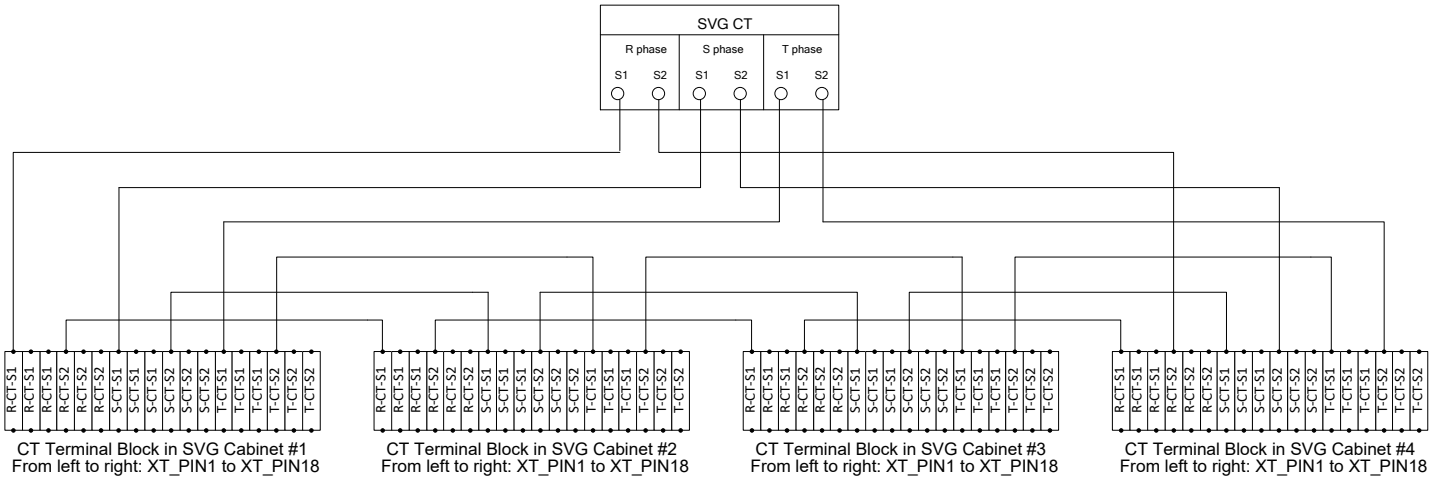


Figure 3-17 CT connection for closed loop, 11kV PF correction, multiple SVG cabinets scenario - details

If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

- Corresponding settings in Touch Screen HMI

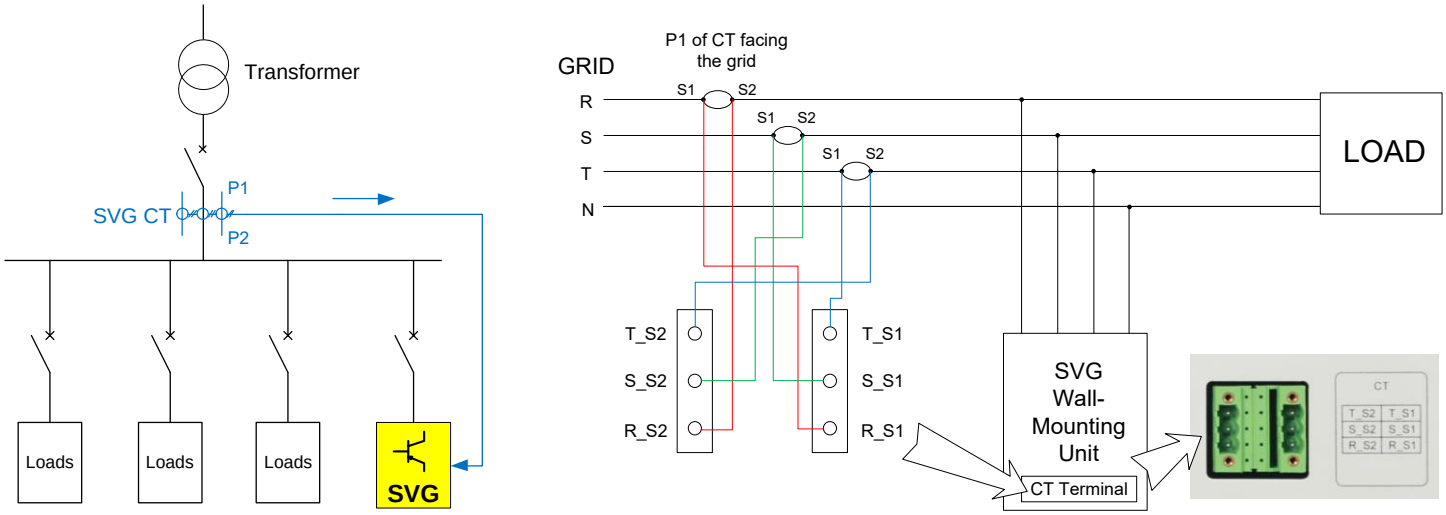
Setting Location	Setting Value
General Setting→ CT Position	Grid Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio

General Setting→ Target cosϕ	1.0, 0.99, 0.98 or any other value
General Setting → System Percent	27% in SVG cabinet #1~#3 (600kvar) 19% in SVG cabinet #4 (400kvar)
Adv Setting→ CT Number	3-CT
Adv Setting→ 1-CT Location	No need to set
Xformer Setting → Transformer	Available
Xformer Setting → Connect-Type	Actual step-up transformer wiring type
Xformer Setting → Primary Volt	**Actual** transformer primary voltage (not the labelled voltage)
Xformer Setting → Secondary Volt	**Actual** transformer secondary voltage (not the labelled voltage)

3.5 CT Connection for SVG Wall-mounted System

3.5.1 Closed loop, Unbalanced phases, Single Wall-mounted SVG unit External CT Connection

In this scenario, 3 pieces of CT shall be installed at grid side (R/S/T phases), P1 of which should be facing the grid side, refer to *Figure 3-18* for single line diagram (SLD) and detailed connection.



A) Single Line Diagram *B) Detailed CT Connection*

Figure 3-18 CT Connection for closed loop, unbalanced phases, single wall-mounted SVG unit scenario

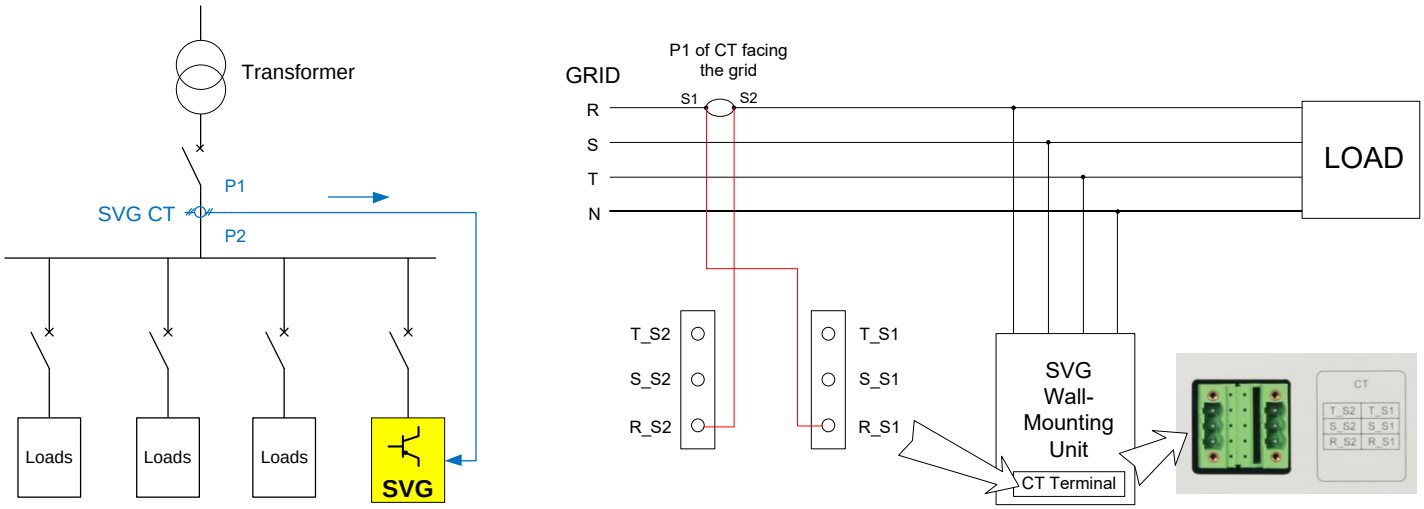
If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

- Corresponding CT settings in Touch Screen HMI

Setting Location	Setting Value
General Setting→ CT Position	Grid Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
Adv Setting→ CT Number	3-CT
Adv Setting→ 1-CT Location	No need to set

3.5.2 Closed loop, Balanced phases, Single Wall-mounted SVG unit External CT Connection

In this scenario, customer can use 3 pieces of CT and follow the same CT connection shown in *Figure 3-18*. Or only 1 piece of CT can be installed at grid side (R phase), P1 of which should be facing the grid side, refer to *Figure 3-19* for single line diagram (SLD) and detailed connection.



A) Single Line Diagram *B) Detailed CT Connection*

Figure 3-19 CT Connection for closed loop, balanced phases, single wall-mounted SVG unit scenario

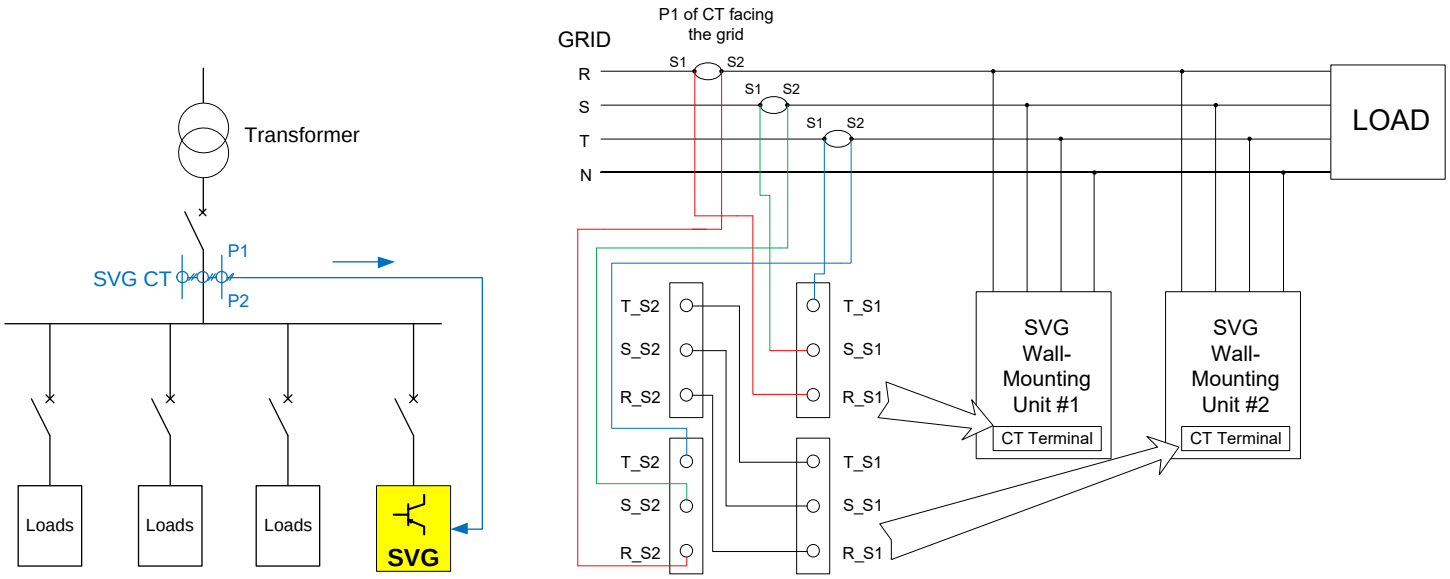
If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

- Corresponding CT settings in Touch Screen HMI

Setting Location	Setting Value
General Setting→ CT Position	Grid Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
Adv Setting→ CT Number	1-CT
Adv Setting→ 1-CT Location	Phase-A

3.5.3 Closed loop, Unbalanced phases, Double Wall-mounted SVG units External CT Connection

In this scenario, 3 pieces of CT shall be installed at grid side (R/S/T phases), P1 of which should be facing the grid side, CT shall be shared by two wall-mounted SVG units, refer to *Figure 3-20* for single line diagram (SLD) and detailed connection.



A) Single Line Diagram *B) Detailed CT Connection*

Figure 3-20 CT Connection for closed loop, unbalanced phases, double wall-mounted SVG units scenario

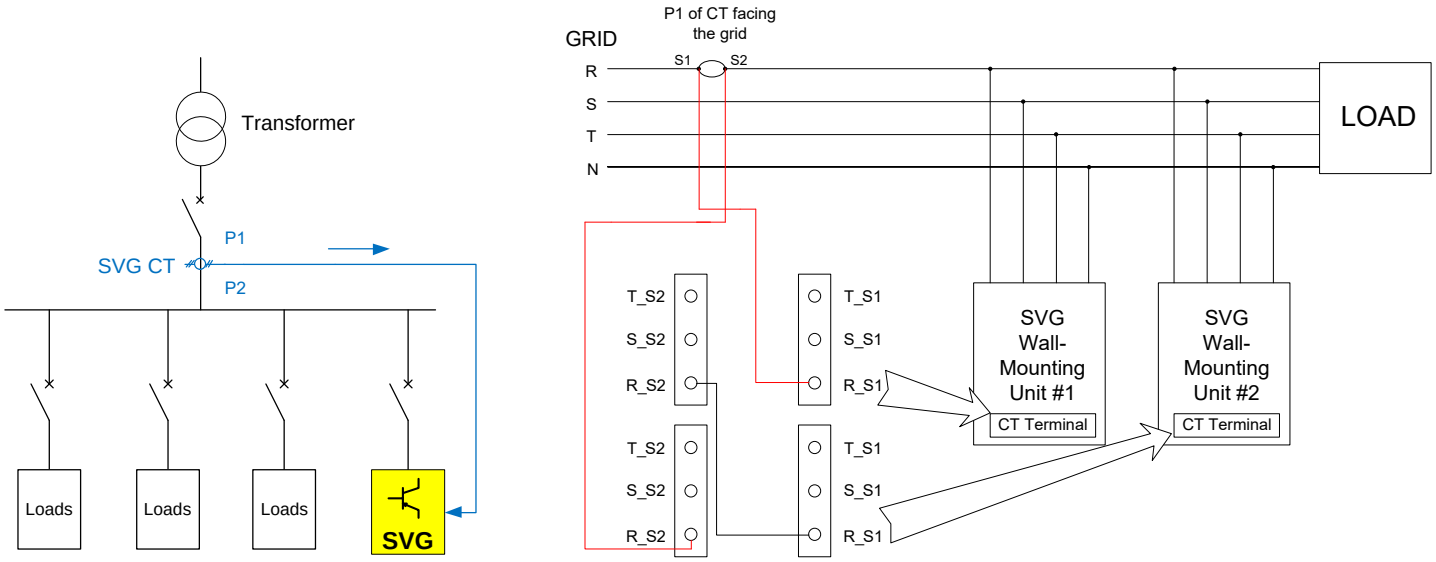
If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

- Corresponding CT settings in Touch Screen HMI

Setting Location	Setting Value
General Setting→ CT Position	Grid Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
General Setting→ System Percent	50% for same capacity, if different capacity Cabinet#1: Cabinet#1 capacity/whole capacity Cabinet#2: Cabinet#2 capacity/whole capacity
Adv Setting→ CT Number	3-CT
Adv Setting→ 1-CT Location	No need to set

3.5.4 Closed loop, Balanced phases, Double Wall-mounted SVG units External CT Connection

In this scenario, customer can use 3 pieces of CT and follow the same CT connection shown in *Figure 3-20*. Or only 1 piece of CT can be installed at grid side (R phase), P1 of which should be facing the grid side, refer to *Figure 3-21* for single line diagram (SLD) and detailed connection.



A) Single Line Diagram *B) Detailed CT Connection*

Figure 3-21 CT Connection for closed loop, balanced phases, double wall-mounted SVG units scenario

If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

- Corresponding CT settings in Touch Screen HMI

Setting Location	Setting Value
General Setting→ CT Position	Grid Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
General Setting→ System Percent	50% for same capacity, if different capacity Cabinet#1: Cabinet#1 capacity/whole capacity Cabinet#2: Cabinet#2 capacity/whole capacity
Adv Setting→ CT Number	1-CT
Adv Setting→ 1-CT Location	Phase-A

4. APF CT Configuration

This chapter explains how to select proper CT for Delta APF and how to connect CT for APF cabinet and wall-mounted systems.

4.1 APF CT Selection

Proper CT must be selected according to electric condition of installing site, requirements about CT selection for APF are shown in *Table 4-1*.

Table 4-1 Requirements for APF CT Selection

Specification	Requirement
CT Ratio	CT Secondary Current: 5A CT Primary Current ≥ 1.7* Maximum Load Current
CT Accuracy	Class 0.5
CT Secondary Capacity (VA)	1~2 modules ≥10VA

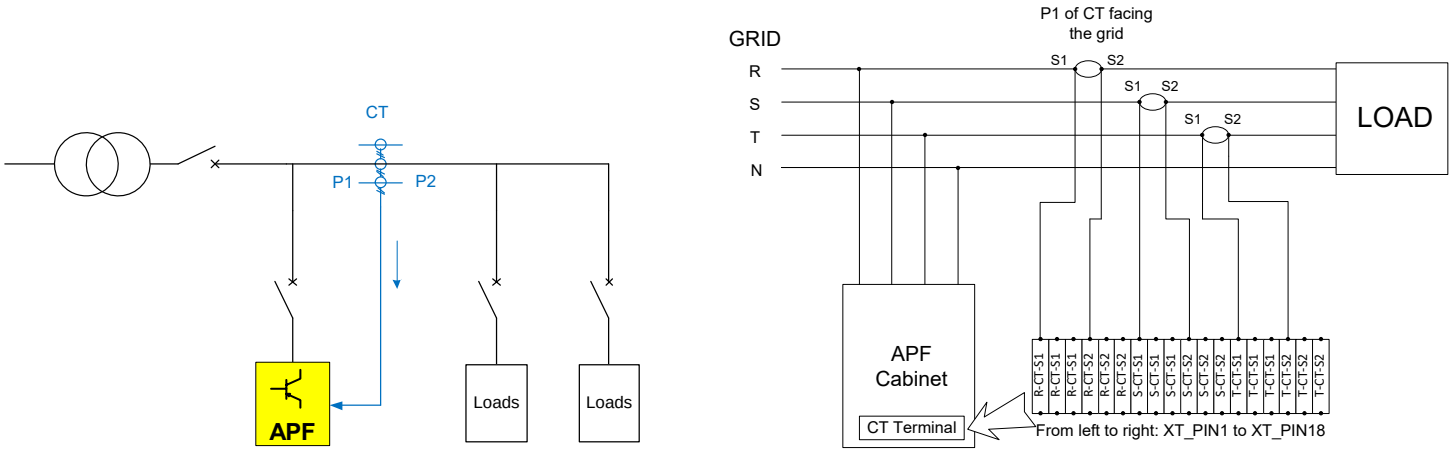
	3~4 modules ≥15VA 5~7 modules ≥20VA >7 modules, consult Delta or Delta distributor.

Note: recommended secondary current of CT is 5A, when actual CT secondary current is 1A, CT ratio setting should be changed accordingly, for example, if the actual CT ratio is 500:1A, the CT ratio setting in SVG Touch Panel HMI should be 2500:5A.

4.2 CT Connection for APF Cabinet System

4.2.1 Open loop, Without Cap Bank, Single APF Cabinet External CT Connection

In this scenario, 3 pieces of CT shall be installed at load side (R/S/T phases), P1 of which should be facing the grid side, refer to *Figure 4-1* for single line diagram (SLD) and detailed connection.



A) Single Line Diagram *B) Detailed CT Connection*

Figure 4-1 CT Connection for open loop, without cap bank, single APF cabinet scenario

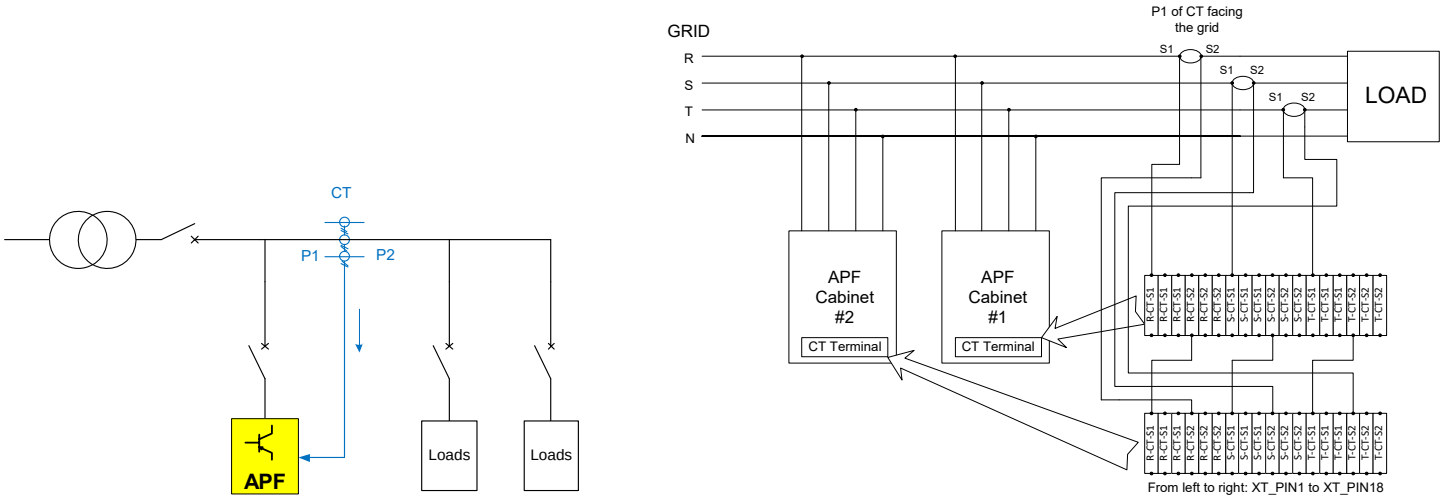
If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

- Corresponding CT settings in Touch Screen HMI

Setting Location	Setting Value
General Setting→ CT Position	Load Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
Adv Setting→ CT Number	3-CT
Adv Setting→ 1-CT Location	No need to set

4.2.2 Open loop, Without Cap Bank, Double APF Cabinets External CT Connection

In this scenario, 3 pieces of CT shall be installed at load side (R/S/T phases), P1 of which should be facing the grid side, the CT shall be shared by two APF cabinets, refer to *Figure 4-2* for single line diagram (SLD) and detailed connection.



A) Single Line Diagram *B) Detailed CT Connection*

Figure 4-2 CT Connection for open loop, without cap bank, double APF cabinets scenario

If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

- Corresponding CT settings in Touch Screen HMI

Setting Location	Setting Value
General Setting→ CT Position	Load Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
General Setting→ System Percent	50% for same capacity, if different capacity Cabinet#1: Cabinet#1 capacity/whole capacity Cabinet#2: Cabinet#2 capacity/whole capacity
Adv Setting→ CT Number	3-CT
Adv Setting→ 1-CT Location	No need to set

4.2.3 Open loop, Along with Cap Bank, Single APF Cabinet External CT Connection

In this scenario, 3 pieces of CT shall be installed at load side (R/S/T phases), P1 of which should be facing the grid side.

Capacitor Bank should be connected at upstream of APF, and reactors need to be added to detune the Capacitor Bank.

APF and Capacitor Bank are using separately CT and working independently.

In this scenario, APF is for harmonics mitigation purpose only, and reactive power compensation is achieved by Capacitor Bank.

Refer to *Figure 4-3* for single line diagram (SLD) and *Figure 4-4* for detailed connection.

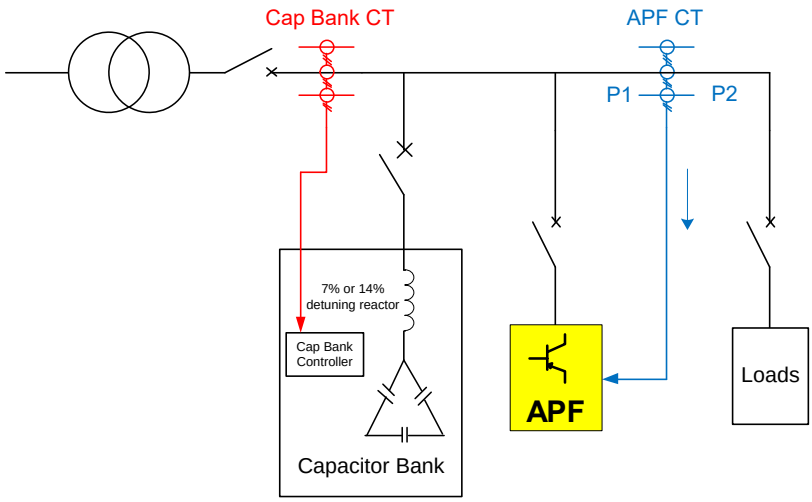


Figure 4-3 CT Connection for open loop, along with cap bank, single APF cabinet scenario-SLD

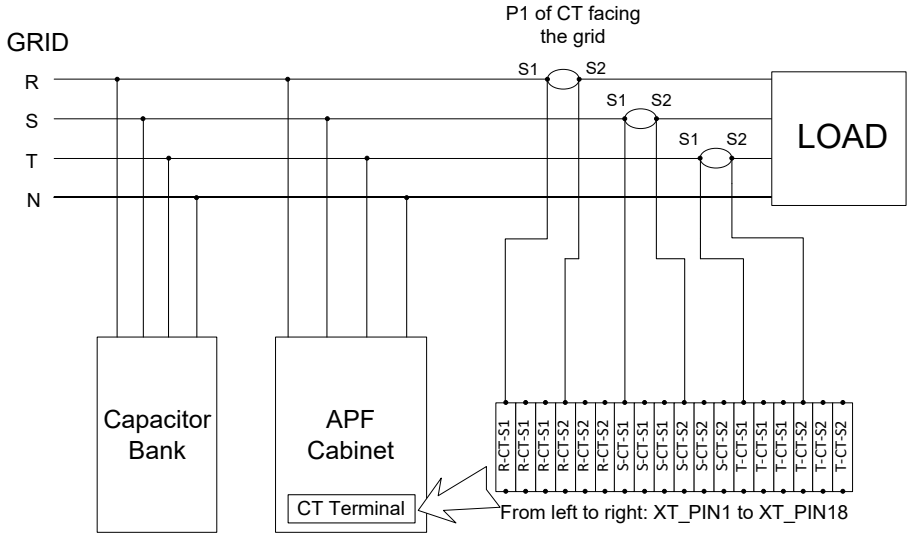


Figure 4-4 CT Connection for open loop, along with cap bank, single APF cabinet scenario-details

If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

- Corresponding CT settings in Touch Screen HMI

Setting Location	Setting Value
General Setting→ CT Position	Load Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
Adv Setting→ CT Number	3-CT
Adv Setting→ 1-CT Location	No need to set

4.2.4 Open loop, Along with Cap Bank, Double APF Cabinets External CT Connection

In this scenario, 3 pieces of CT shall be installed at load side (R/S/T phases), P1 of which should be facing the grid side, APF CT is shared by the two APF cabinets. Capacitor Bank should be connected at upstream of APF, and reactors need to be added to detune the Capacitor Bank.

APF and Capacitor Bank are using separately CT and working independently.

In this scenario, APF is for harmonics mitigation purpose only, and reactive power compensation is achieved by Capacitor Bank.

Refer to *Figure 4-5* for single line diagram (SLD) and *Figure 4-6* for detailed connection.

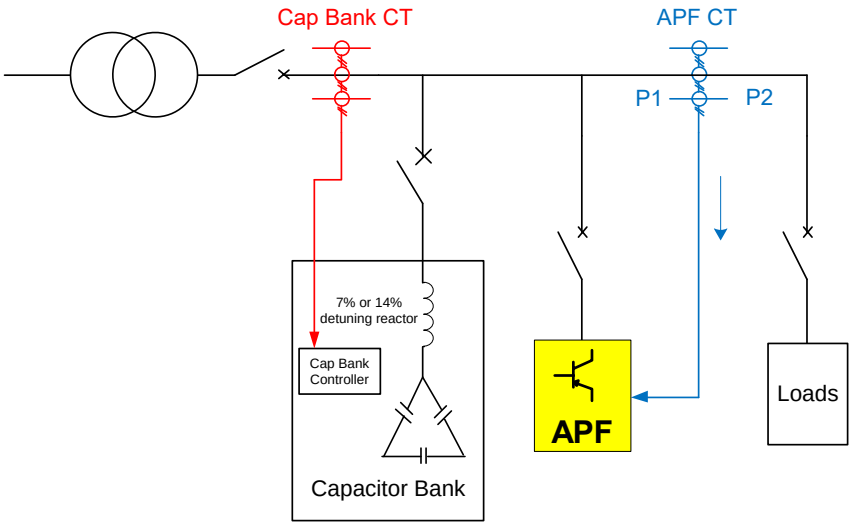


Figure 4-5 CT Connection for open loop, along with cap bank, double APF cabinets scenario-SLD

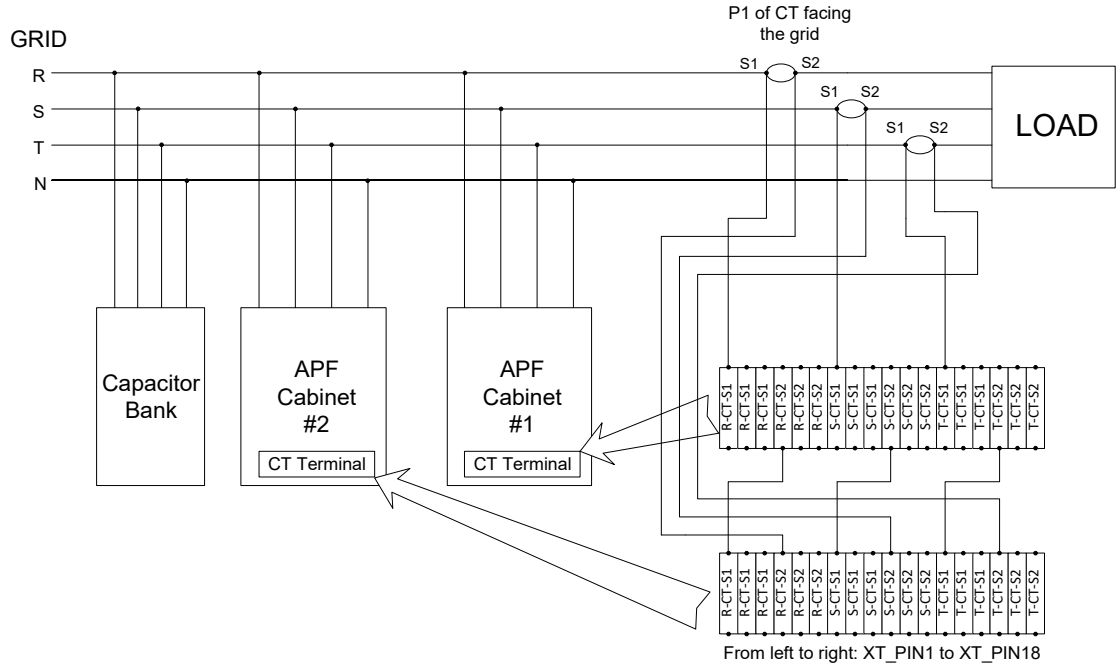


Figure 4-6 CT Connection for open loop, along with cap bank, double APF cabinets scenario-details

If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

- Corresponding CT settings in Touch Screen HMI

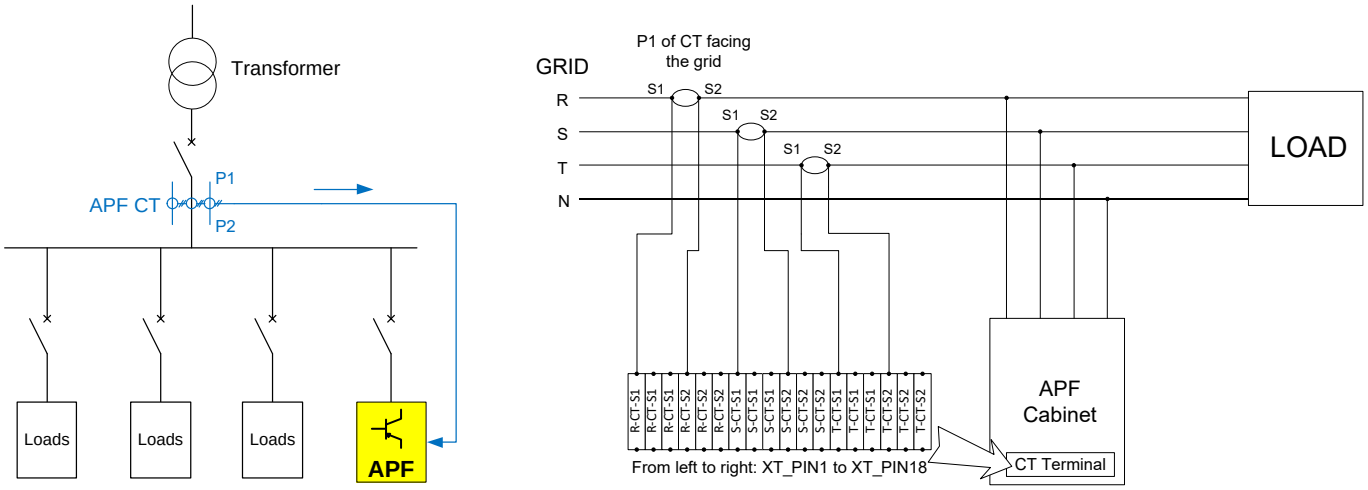
Setting Location	Setting Value
General Setting→ CT Position	Load Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio

General Setting→ System Percent	50% for same capacity, if different capacity Cabinet#1: Cabinet#1 capacity/whole capacity Cabinet#2: Cabinet#2 capacity/whole capacity
Adv Setting→ CT Number	3-CT
Adv Setting→ 1-CT Location	No need to set

4.2.5 Closed loop, Without Device CT, Without Cap Bank, Single APF Cabinet External CT Connection

In this scenario, 3 pieces of CT shall be installed at grid side (R/S/T phases), all the CT's P1 should be facing grid side, with same CT ratio.

Refer to *Figure 4-7* for single line diagram (SLD) and detailed connection.



A) Single Line Diagram *B) Detailed CT Connection*

Figure 4-7 CT connection for closed loop, without Device CT, without cap bank, single APF cabinet scenario

If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

- Corresponding CT settings in Touch Screen HMI

Setting Location	Setting Value
General Setting→ CT Position	Grid Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
Adv Setting→ CT Number	3-CT
Adv Setting→ 1-CT Location	No need to set

4.2.6 Closed loop, With Device CT, Without Cap Bank, Single APF Cabinet External CT Connection

In this scenario, 3 pieces of CT shall be installed at grid side (R/S/T phases), and another 3 pieces of CT shall be installed at APF input side, all the CT's P1 should be facing grid side, with same CT ratio.

Refer to *Figure 4-8* for single line diagram (SLD) and *Figure 4-9* for detailed connection.

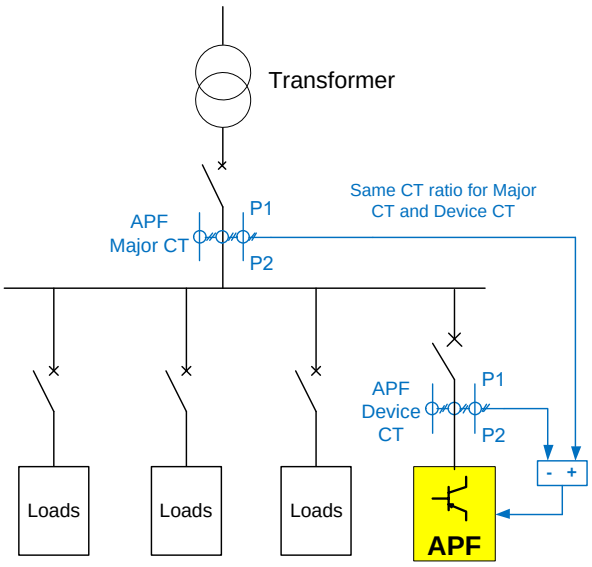


Figure 4-8 CT Connection for closed loop, with Device CT, without cap bank, single APF cabinet scenario - SLD

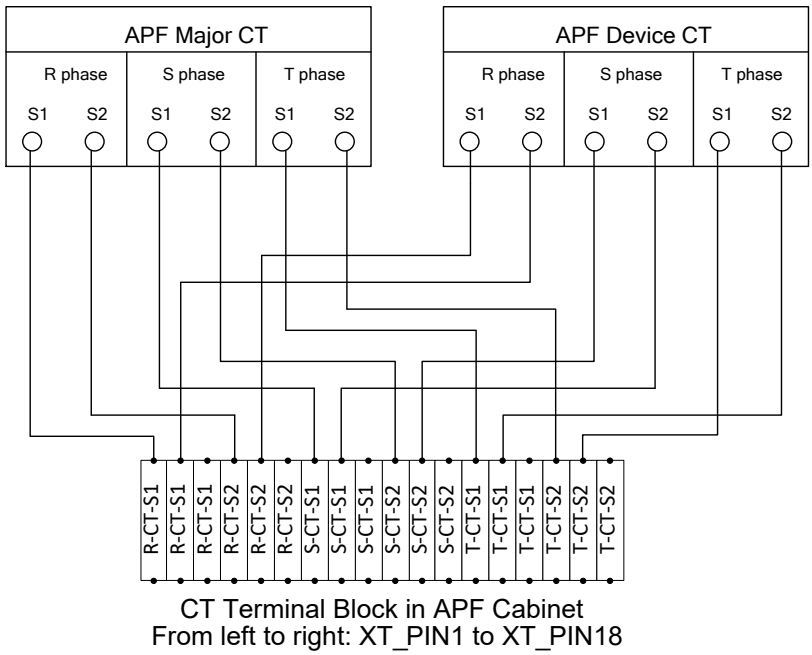


Figure 4-9 CT Connection for closed loop, with Device CT, without cap bank, single APF cabinet scenario – details

If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

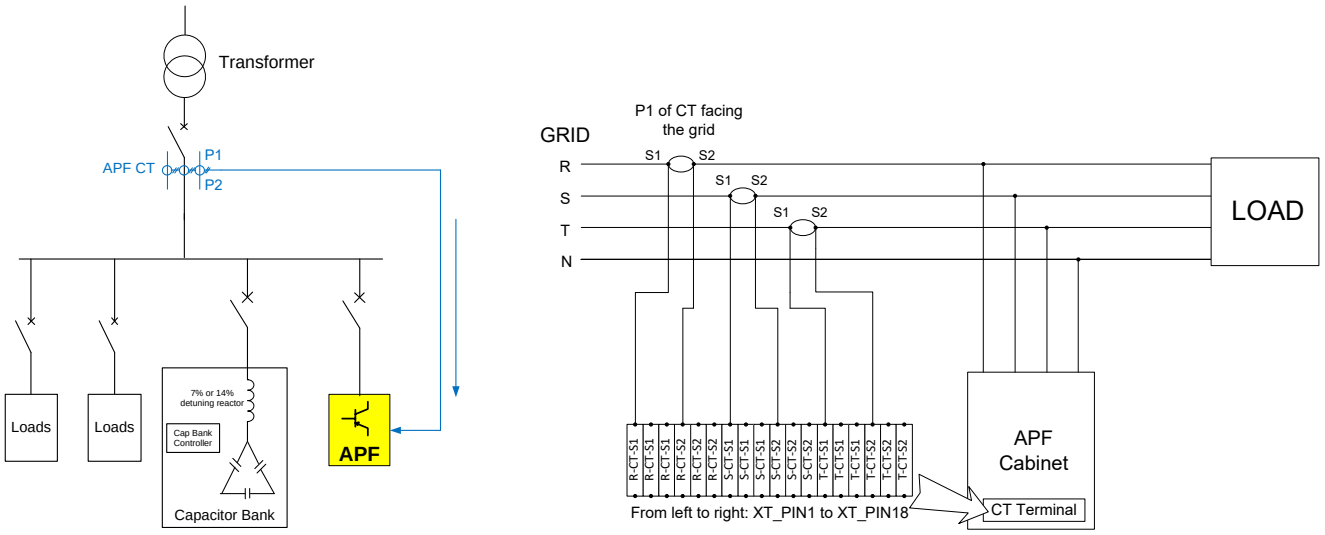
- Corresponding CT settings in Touch Screen HMI

Setting Location	Setting Value
General Setting→ CT Position	Load Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
Adv Setting→ CT Number	3-CT
Adv Setting→ 1-CT Location	No need to set

4.2.7 Closed loop, Without Device CT, Along with Cap Bank, Single APF Cabinet External CT Connection

In this scenario, 3 pieces of CT are required, which shall be installed at grid side (R/S/T phases), all the CT's P1 should be facing grid side, with same CT ratio. In this case, the Cap Bank should be detuned with 7% or 14% line reactor for this APF CT connection, and APF should be used for harmonics or imbalance correction only, while reactive power compensation shouldn't be enabled in APF.

Refer to *Figure 4-10* for single line diagram (SLD) and detailed connection.



A) Single Line Diagram *B) Detailed CT Connection*

Figure 4-10 CT Connection for closed loop, without Device CT, along with cap bank, single APF cabinet scenario

If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

- Corresponding CT settings in Touch Screen HMI

Setting Location	Setting Value
General Setting→ CT Position	Grid Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
Adv Setting→ CT Number	3-CT
Adv Setting→ 1-CT Location	No need to set

4.2.8 Closed loop, With Device CT, Along with Cap Bank, Single APF Cabinet External CT Connection

In this scenario, in total, 9 pieces of CT are required, out of which, 3 pieces of CT shall be installed at grid side (R/S/T phases), another 3 pieces of CT shall be installed at APF input side, and the other 3 pieces of CT shall be installed at Capacitor Bank input side, all the CT's P1 should be facing grid side, with same CT ratio.

Refer to *Figure 4-11* for single line diagram (SLD) and *Figure 4-12* for detailed connection.

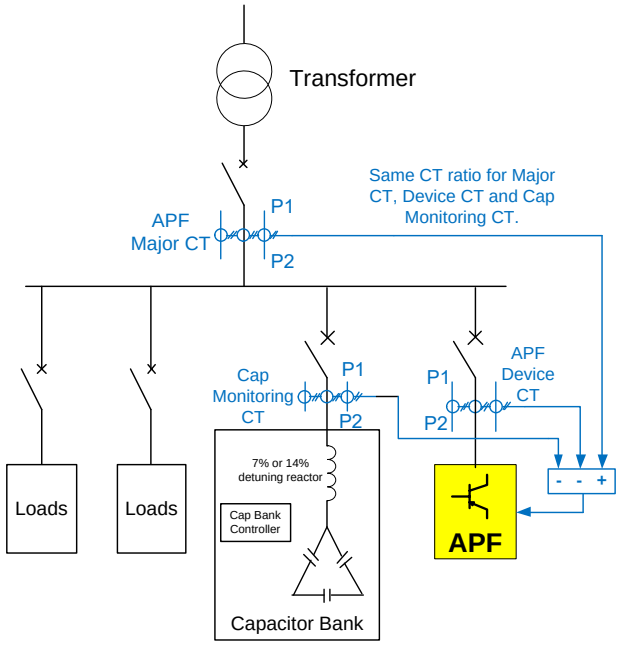


Figure 4-11 CT Connection for closed loop, with Device CT, along with cap bank, single APF cabinet scenario - SLD

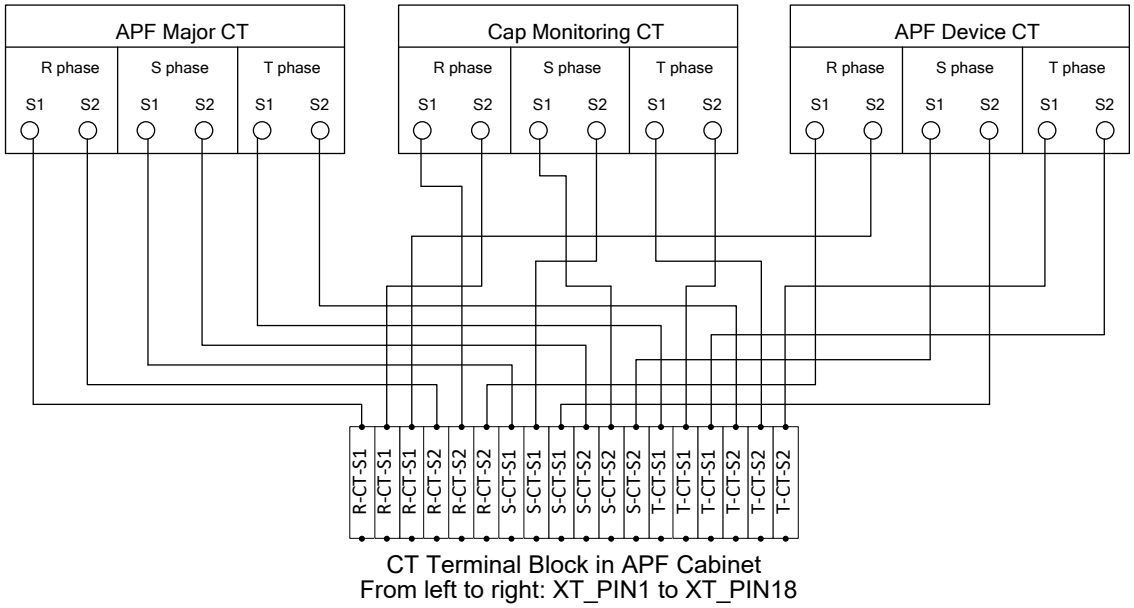


Figure 4-12 CT Connection for closed loop, with Device CT, along with cap bank, single APF cabinet scenario – details

If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

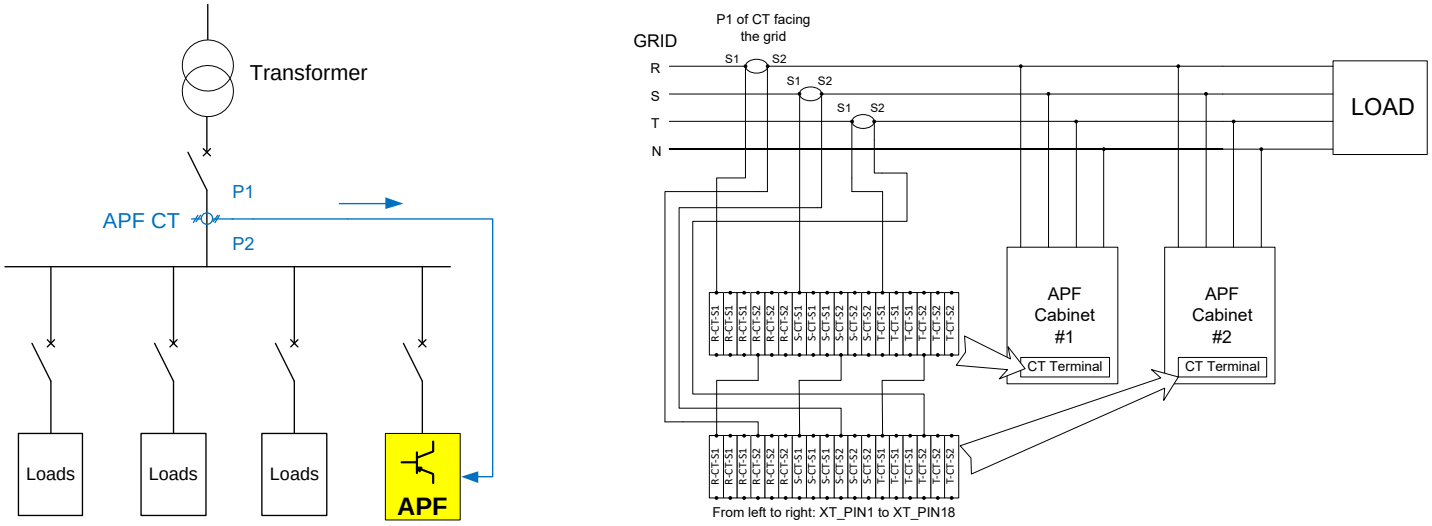
- Corresponding CT settings in Touch Screen HMI

Setting Location	Setting Value
General Setting→ CT Position	Load Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
Adv Setting→ CT Number	3-CT
Adv Setting→ 1-CT Location	No need to set

4.2.9 Closed loop, Without Device CT, Without Cap Bank, Double APF Cabinets External CT Connection

In this scenario, 3 pieces of CT are required, which shall be installed at grid side (R/S/T phases), all the CT's P1 should be facing grid side, with same CT ratio.

Refer to *Figure 4-13* for single line diagram (SLD) and detailed connection.



A) Single Line Diagram *B) Detailed CT Connection*

Figure 4-13 CT Connection for closed loop, without Device CT, double APF cabinets scenario

If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

- Corresponding CT settings in Touch Screen HMI

Setting Location	Setting Value
General Setting→ CT Position	Grid Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
General Setting→ System Percent	50% for same capacity, if different capacity Cabinet#1: Cabinet#1 capacity/whole capacity Cabinet#2: Cabinet#2 capacity/whole capacity
Adv Setting→ CT Number	3-CT
Adv Setting→ 1-CT Location	No need to set

4.2.10 Closed loop, With Device CT, Without Cap Bank, Double APF Cabinets External CT Connection

In this scenario, in total, 9 pieces of CT are required, out of which, 3 pieces of CT shall be installed at grid side (R/S/T phases), another 3 pieces of CT shall be installed at APF#1 input side, and the other 3 pieces of CT shall be installed at APF#2 input side, all the CT's P1 should be facing grid side, with same CT ratio.

Refer to *Figure 4-11* for single line diagram (SLD) and *Figure 4-12* for detailed connection.

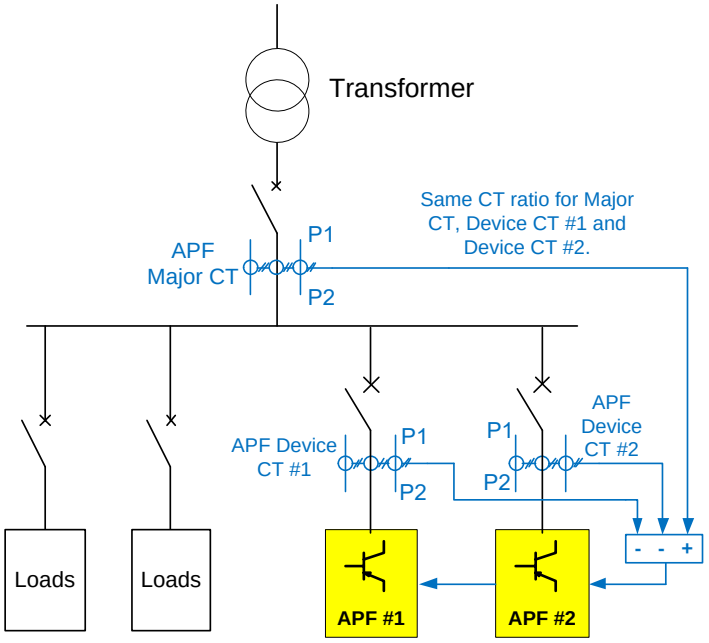


Figure 4-14 CT Connection for closed loop, with Device CT, without cap bank, double APF cabinets scenario - SLD

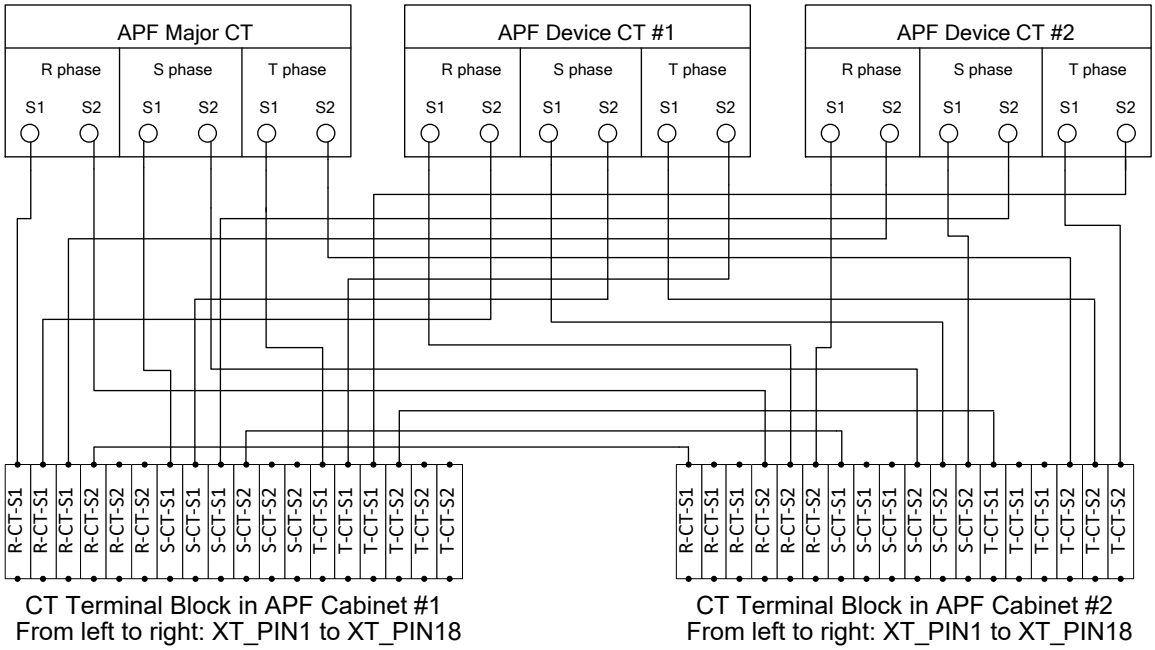


Figure 4-15 CT Connection for closed loop, with Device CT, without cap bank, double APF cabinets scenario – details

If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

- Corresponding CT settings in Touch Screen HMI

Setting Location	Setting Value
General Setting→ CT Position	Load Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
General Setting→ System Percent	100%
Adv Setting→ CT Number	3-CT

Adv Setting→ 1-CT Location	No need to set

4.2.11 Closed loop, Without Device CT, Without Cap Bank, Double Transformers System, Double APF Cabinets External CT Connection

In this scenario, two transformers are working in parallel, with a bus coupler switch. When both transformer #1 and #2 are working, the bus Coupler Switch will be OFF status, when all loads are powered by any one of the transformers, the Bus Coupler Switch will be ON status.

Two APF cabinets are connected in closed loop to transformer #1 and #2 separately, and these APF cabinets shall coordinate with each other based on different status of bus coupler switch.

In this scenario, 3 pieces of CT shall be installed at transformer #1 and #2 grid side (R/S/T phases), with P1 facing grid side, another 3 pieces of CT shall be installed at bus coupler, with P1 facing transformer #1 grid side.

All the CT should be with same ratio.

Refer to *Figure 4-16* for single line diagram (SLD) and *Figure 4-17* detailed connection.

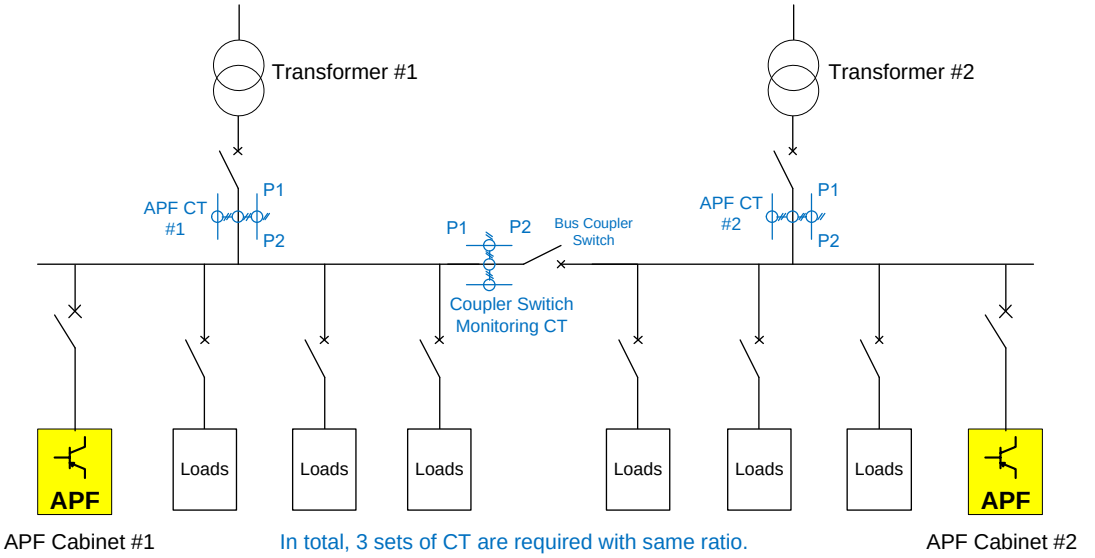


Figure 4-16 CT Connection for closed loop, without Device CT, double transformers, double APF cabinets scenario - SLD

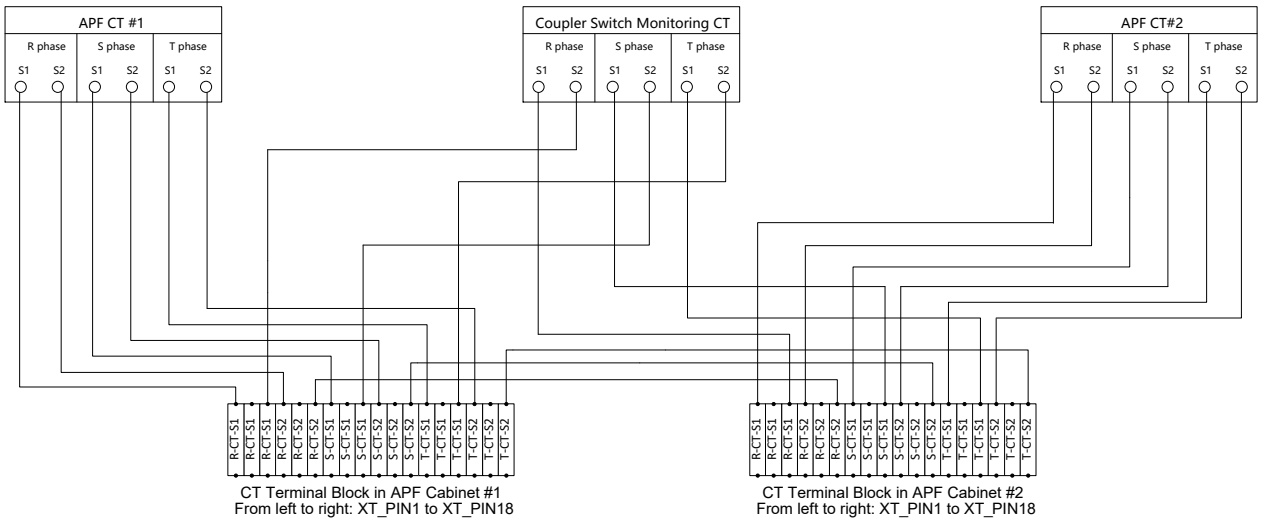


Figure 4-17 CT Connection for closed loop, without Device CT, double transformers, double APF cabinets scenario – details

If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen

HMI.

- Corresponding CT settings in Touch Screen HMI

Setting Location	Setting Value
General Setting→ CT Position	Grid Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
General Setting→ System Percent	100%
Adv Setting→ CT Number	3-CT
Adv Setting→ 1-CT Location	No need to set

4.2.12 Closed loop, With Device CT, Without Cap Bank, Double Transformers System, Double APF Cabinets External CT Connection

In this scenario, two transformers are working in parallel, with a bus coupler switch. When both transformer #1 and #2 are working, the bus Coupler Switch will be OFF status, when all loads are powered by any one of the transformers, the Bus Coupler Switch will be ON status.

Two APF cabinets are connected in closed loop to transformer #1 and #2 separately, and these APF cabinets shall coordinate with each other based on different status of bus coupler switch.

In this scenario, 3 pieces of CT shall be installed at transformer #1 and #2 grid side (R/S/T phases), with P1 facing grid side, another 3 pieces of CT shall be installed at bus coupler, with P1 facing transformer #1 grid side, and 3 pieces of CT shall be installed at APF Cabinet #1 and #2 input side separately, with P1 facing grid side.

All the CT should be with same ratio.

Refer to *Figure 4-18* for single line diagram (SLD) and *Figure 4-19* detailed connection.

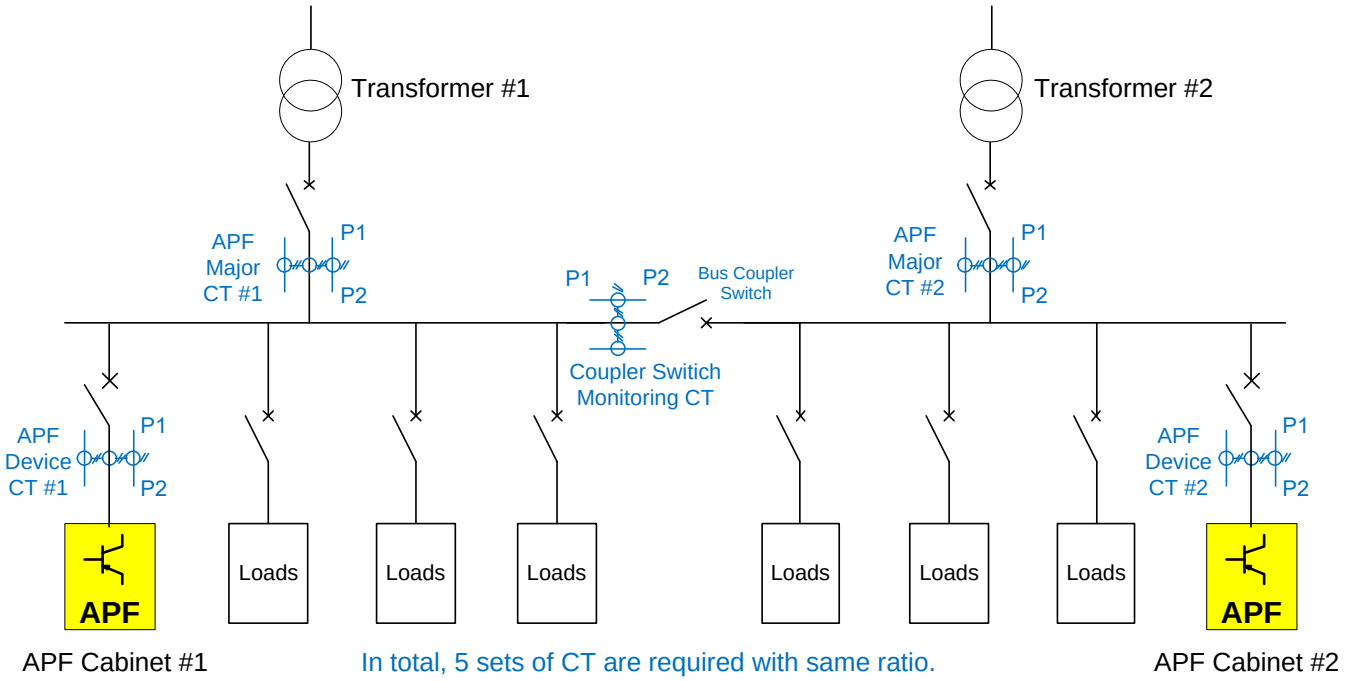


Figure 4-18 CT Connection for closed loop, with Device CT, double transformers, double APF cabinets scenario - SLD

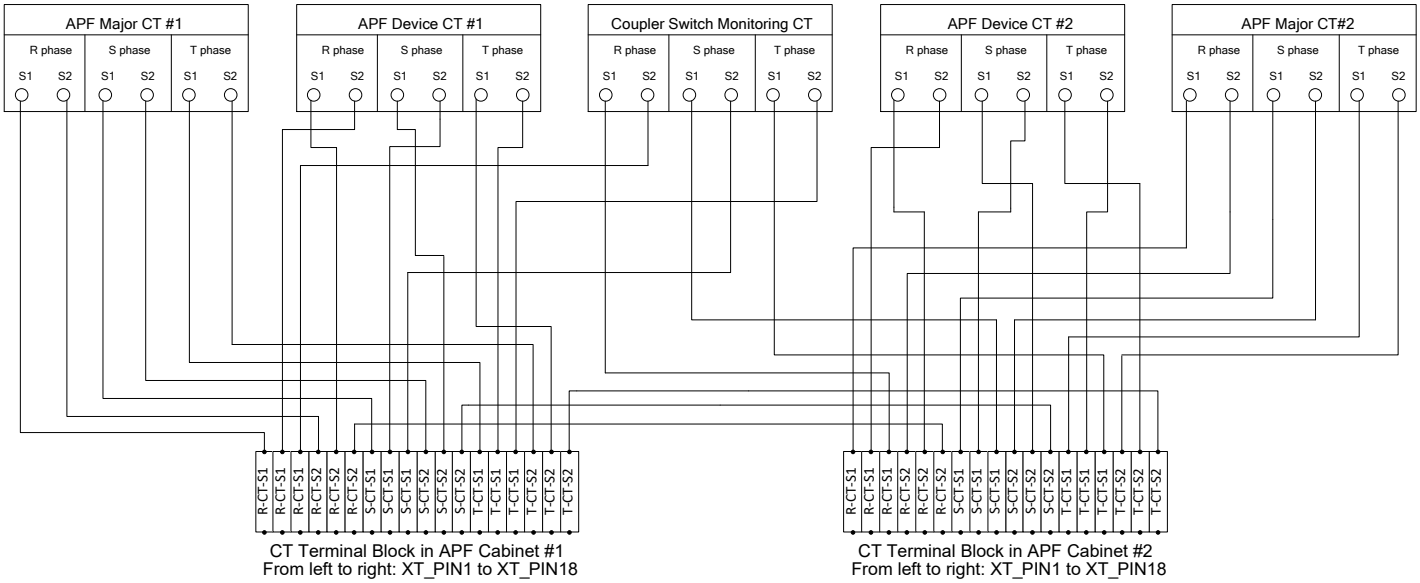


Figure 4-19 CT Connection for closed loop, with Device CT, double transformers, double APF cabinets scenario – details

If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

- Corresponding CT settings in Touch Screen HMI

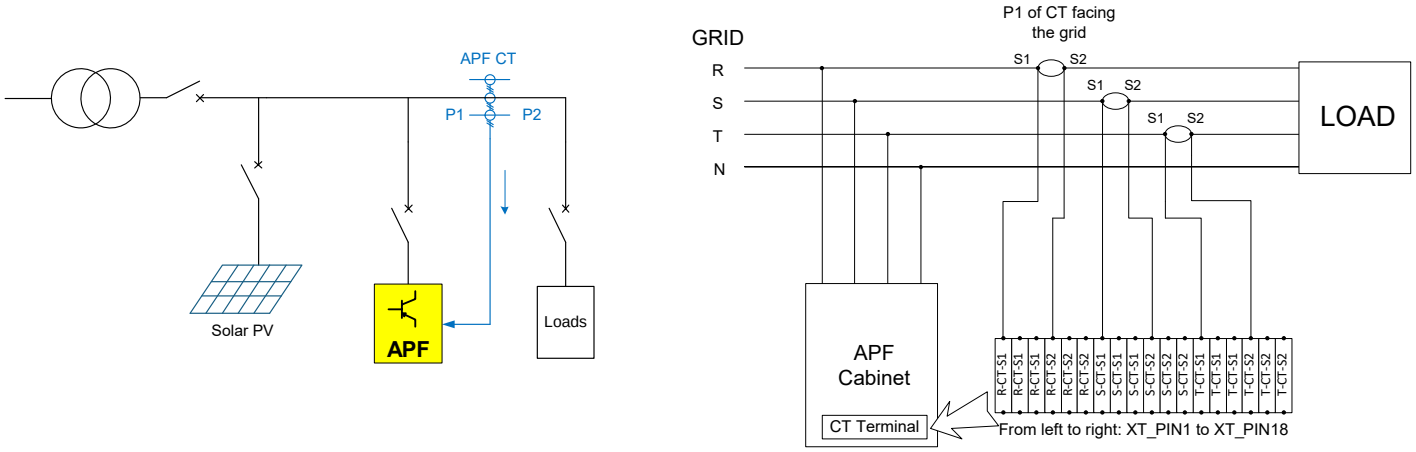
Setting Location	Setting Value
General Setting→ CT Position	Load Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
General Setting→ System Percent	50% for same capacity, if different capacity Cabinet#1: Cabinet#1 capacity/whole capacity Cabinet#2: Cabinet#2 capacity/whole capacity
Adv Setting→ CT Number	3-CT
Adv Setting→ 1-CT Location	No need to set

4.3 Delta APF Cabinet Application along with solar PV system

When there is a solar PV system working along with Delta APF, ensure the utility power supply is always connection, and Delta APF cannot work under a PV off-grid condition. There are two options for APF CT connection in a system with solar PV.

4.3.1 Open loop, Along with Solar PV System

In this scenario, solar PV system should be installed at upstream of APF and loads, 3 pieces of APF CT shall be installed at load side (R/S/T phases), P1 of which should be facing the grid side, refer to *Figure 4-20* for single line diagram (SLD) and detailed connection.



A) Single Line Diagram *B) Detailed CT Connection*

Figure 4-20 CT Connection for APF cabinet in solar PV scenario Option 1

If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

- Corresponding CT settings in Touch Screen HMI

Setting Location	Setting Value
General Setting→ CT Position	Load Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
Adv Setting→ CT Number	3-CT
Adv Setting→ 1-CT Location	No need to set

4.3.2 Closed loop, with Device CT, Along with Solar PV System

In this scenario, in total, 6 pieces of CT are required, out of which, 3 pieces of CT shall be installed at grid side (R/S/T phases), another 3 pieces of CT shall be installed at APF input side, all the CT's P1 should be facing grid side, with same CT ratio.

Refer to *Figure 4-23* for single line diagram (SLD) and *Figure 4-24* for detailed connection.

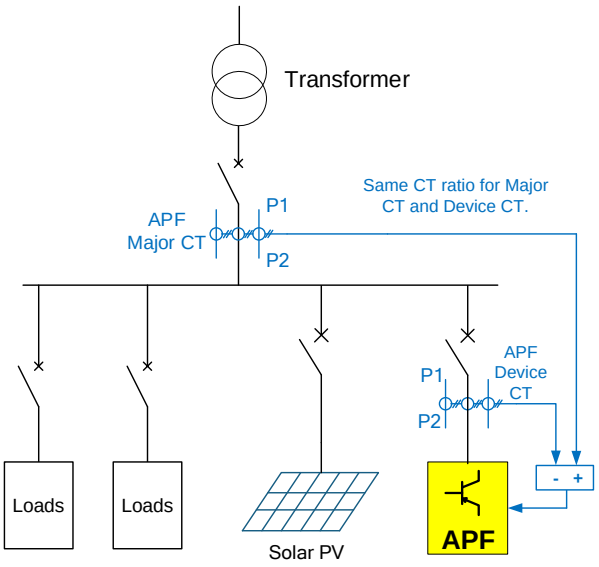


Figure 4-21 CT Connection for closed loop, with Device CT, along with cap bank, single APF cabinet scenario - SLD

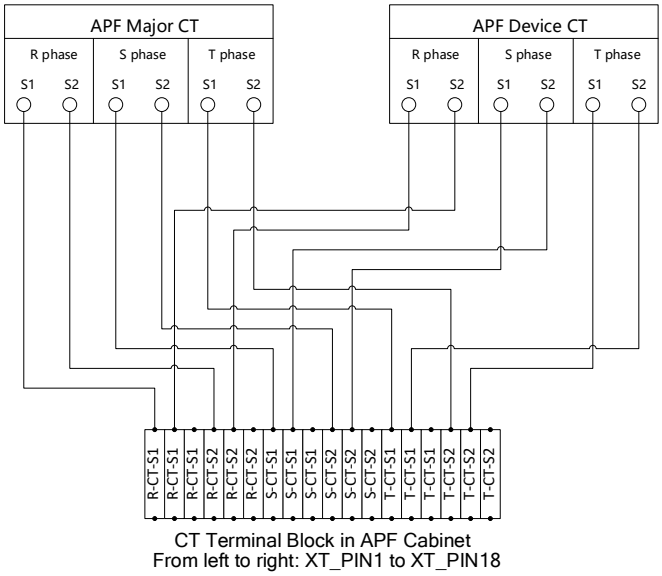


Figure 4-22 CT Connection for closed loop, with Device CT, along with PV, single APF cabinet scenario – details

If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

- Corresponding CT settings in Touch Screen HMI

Setting Location	Setting Value
General Setting→ CT Position	Load Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
Adv Setting→ CT Number	3-CT
Adv Setting→ 1-CT Location	No need to set

4.3.3 Closed loop, without Device CT, Along with Solar PV System

In this scenario, 3 pieces of CT shall be installed at grid side (R/S/T phases), all the CT's P1 should be facing grid side,

with same CT ratio.

Refer to *Figure 4-23* for single line diagram (SLD) and *Figure 4-24* for detailed connection.

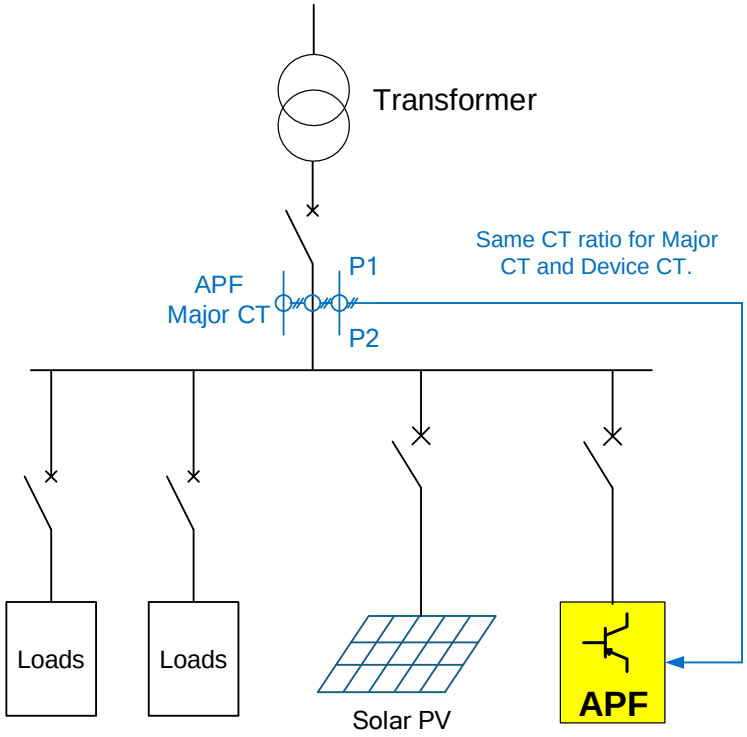


Figure 4-23 CT Connection for closed loop, without Device CT, along with cap bank, single APF cabinet scenario - SLD

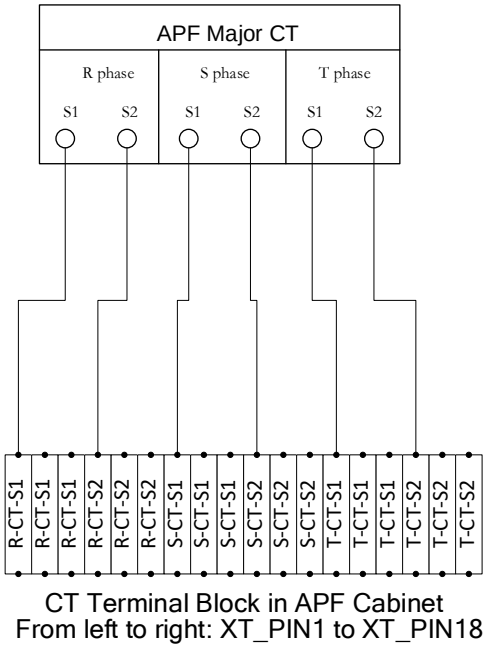


Figure 4-24 CT Connection for closed loop, without Device CT, along with PV, single APF cabinet scenario – details

If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

- Corresponding CT settings in Touch Screen HMI

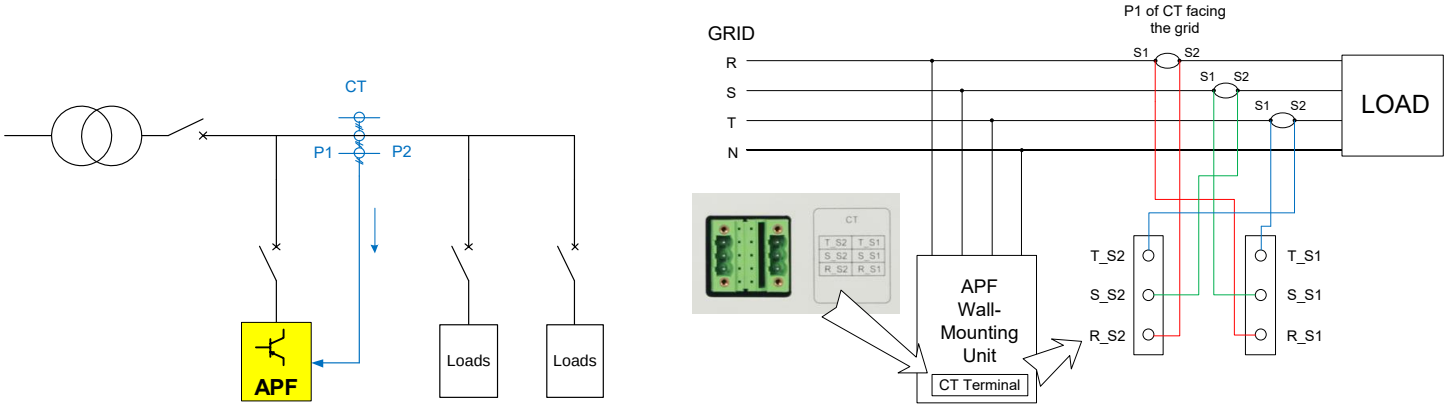
Setting Location	Setting Value
General Setting→ CT Position	Grid Side

General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
Adv Setting→ CT Number	3-CT
Adv Setting→ 1-CT Location	No need to set

4.4 CT Connection for APF Wall-mounted System

4.4.1 Open loop, Without Cap Bank, Single Wall-mounted APF unit External CT Connection

In this scenario, 3 pieces of CT shall be installed at load side (R/S/T phases), P1 of which should be facing the grid side, refer to *Figure 4-25* for single line diagram (SLD) and detailed connection.



A) Single Line Diagram *B) Detailed CT Connection*

Figure 4-25 CT Connection for open loop, without cap bank, single wall-mounted APF unit scenario

If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

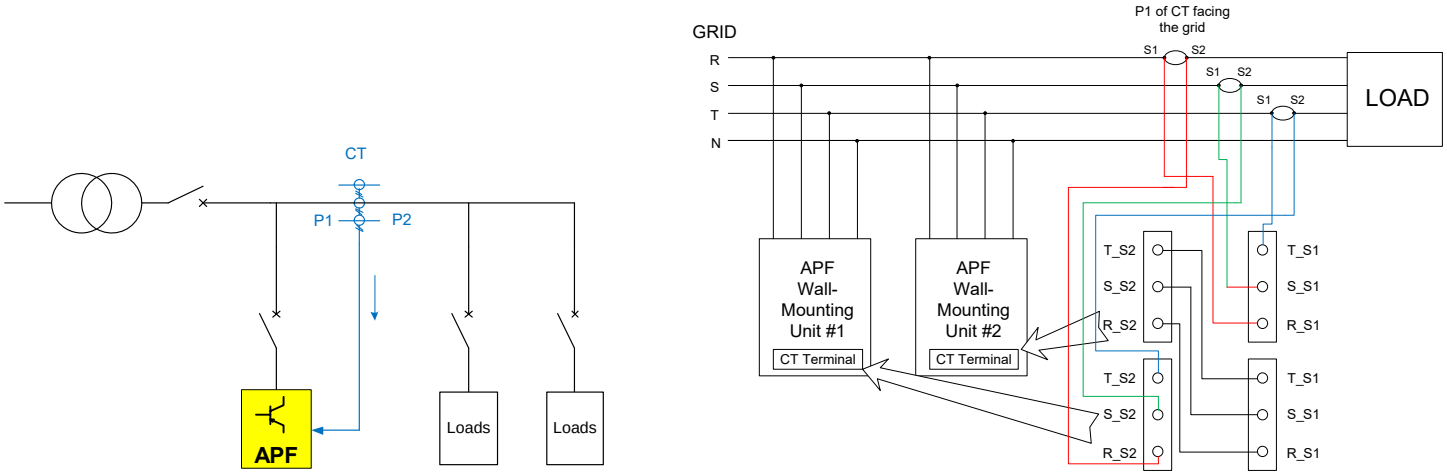
- Corresponding CT settings in Touch Screen HMI

Setting Location	Setting Value
General Setting→ CT Position	Load Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
Adv Setting→ CT Number	3-CT
Adv Setting→ 1-CT Location	No need to set

4.4.2 Open loop, Without Cap Bank, Double Wall-mounted APF units External CT Connection

In this scenario, 3 pieces of CT shall be installed at load side (R/S/T phases), P1 of which should be facing the grid side, the CT is shared by two wall-mounted APF units.

Refer to *Figure 4-26* for single line diagram (SLD) and detailed connection.



A) Single Line Diagram *B) Detailed CT Connection*

Figure 4-26 CT Connection for open loop, without cap bank, double wall-mounted APF units scenario

If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

- Corresponding CT settings in Touch Screen HMI

Setting Location	Setting Value
General Setting→ CT Position	Load Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
General Setting→ System Percent	50% for same capacity, if different capacity Cabinet#1: Cabinet#1 capacity/whole capacity Cabinet#2: Cabinet#2 capacity/whole capacity
Adv Setting→ CT Number	3-CT
Adv Setting→ 1-CT Location	No need to set

4.4.3 Open loop, Along with Cap Bank, Single Wall-mounted APF unit External CT Connection

In this scenario, 3 pieces of CT shall be installed at load side (R/S/T phases), P1 of which should be facing the grid side. Capacitor Bank should be connected at upstream of APF, and reactors need to be added to detune the Capacitor Bank. APF and Capacitor Bank are using separately CT and working independently, in this scenario, APF is for harmonics mitigation purpose only, and reactive power compensation is achieved by Capacitor Bank.

Refer to *Figure 4-27* for single line diagram (SLD) and *Figure 4-28* for detailed connection.

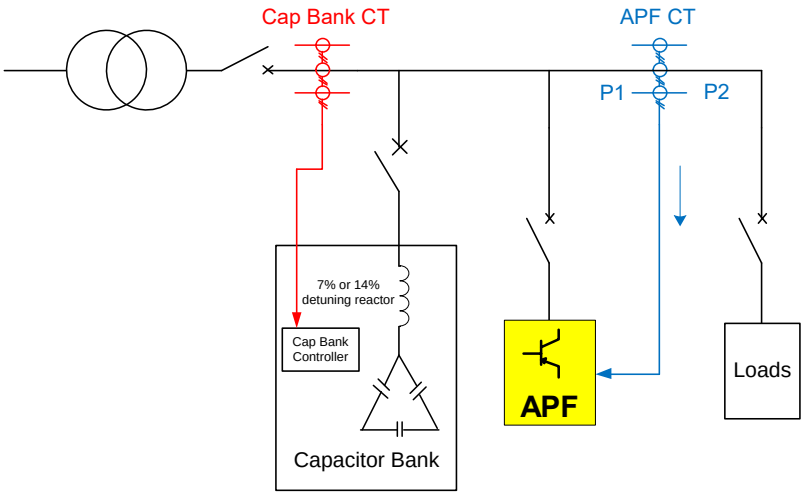


Figure 4-27 CT Connection for open loop, along with cap bank, single wall-mounted APF unit scenario-SLD

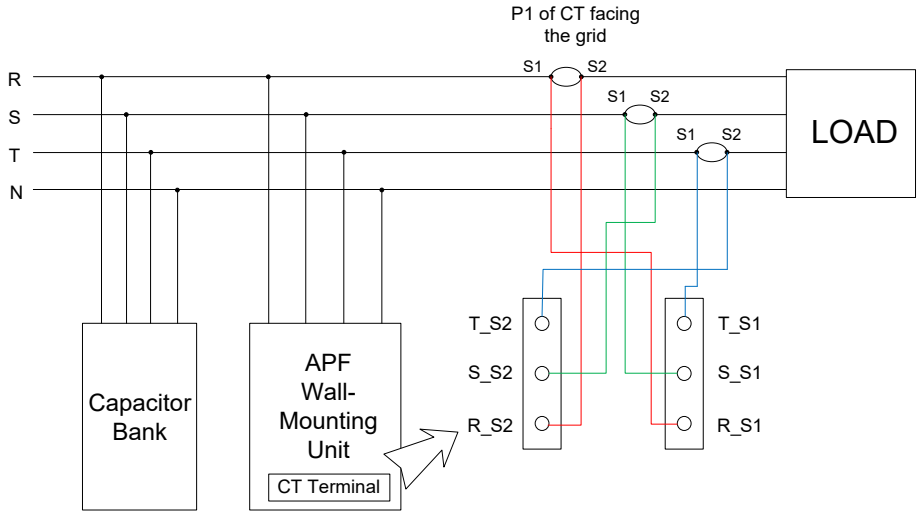


Figure 4-28 CT Connection for open loop, along with cap bank, single wall-mounted APF unit scenario-details

If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

- Corresponding CT settings in Touch Screen HMI

Setting Location	Setting Value
General Setting→ CT Position	Load Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
Adv Setting→ CT Number	3-CT
Adv Setting→ 1-CT Location	No need to set

4.4.4 Open loop, Along with Cap Bank, Double Wall-mounted APF units External CT Connection

In this scenario, 3 pieces of CT shall be installed at load side (R/S/T phases), P1 of which should be facing the grid side, CT is shared by the two wall-mounted APF units. Capacitor Bank should be connected at upstream of APF, and reactors need to be added to detune the Capacitor Bank.

APF and Capacitor Bank are using separately CT and working independently, in this scenario, APF is for harmonics mitigation purpose only, and reactive power compensation is achieved by Capacitor Bank.

Refer to *Figure 4-29* for single line diagram (SLD) and *Figure 4-30* for detailed connection.

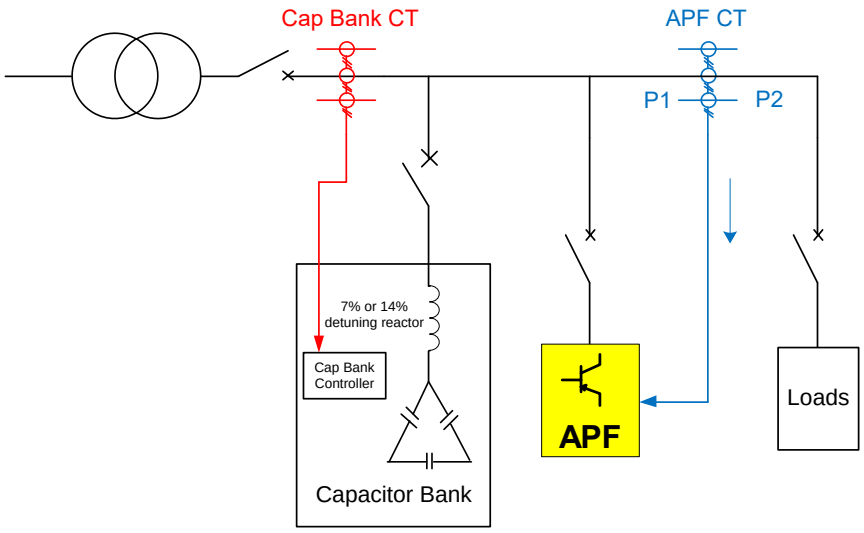


Figure 4-29 CT Connection for open loop, along with cap bank, double wall-mounted APF units scenario-SLD

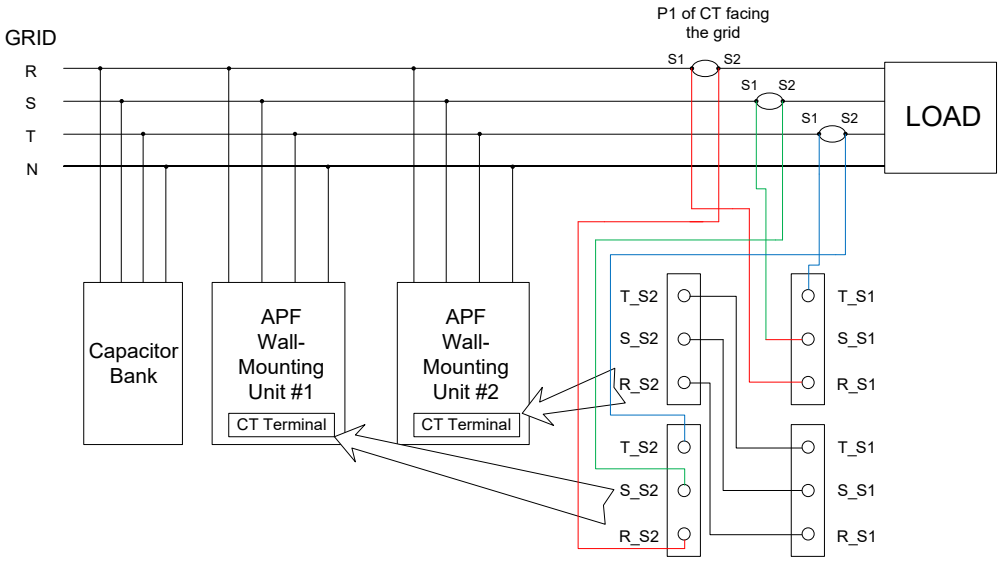


Figure 4-30 CT Connection for open loop, along with cap bank, double wall-mounted APF units scenario-details

If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

- Corresponding CT settings in Touch Screen HMI

Setting Location	Setting Value
General Setting→ CT Position	Load Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
General Setting→ System Percent	50% for same capacity, if different capacity Cabinet#1: Cabinet#1 capacity/whole capacity Cabinet#2: Cabinet#2 capacity/whole capacity
Adv Setting→ CT Number	3-CT
Adv Setting→ 1-CT Location	No need to set

4.4.5 Closed loop, Without Device CT, Without Cap Bank, Single Wall-mounted APF unit External CT Connection

In this scenario, 3 pieces of CT shall be installed at grid side (R/S/T phases), all the CT's P1 should be facing grid side, with same CT ratio.

Refer to *Figure 4-31* for single line diagram (SLD) and detailed connection.

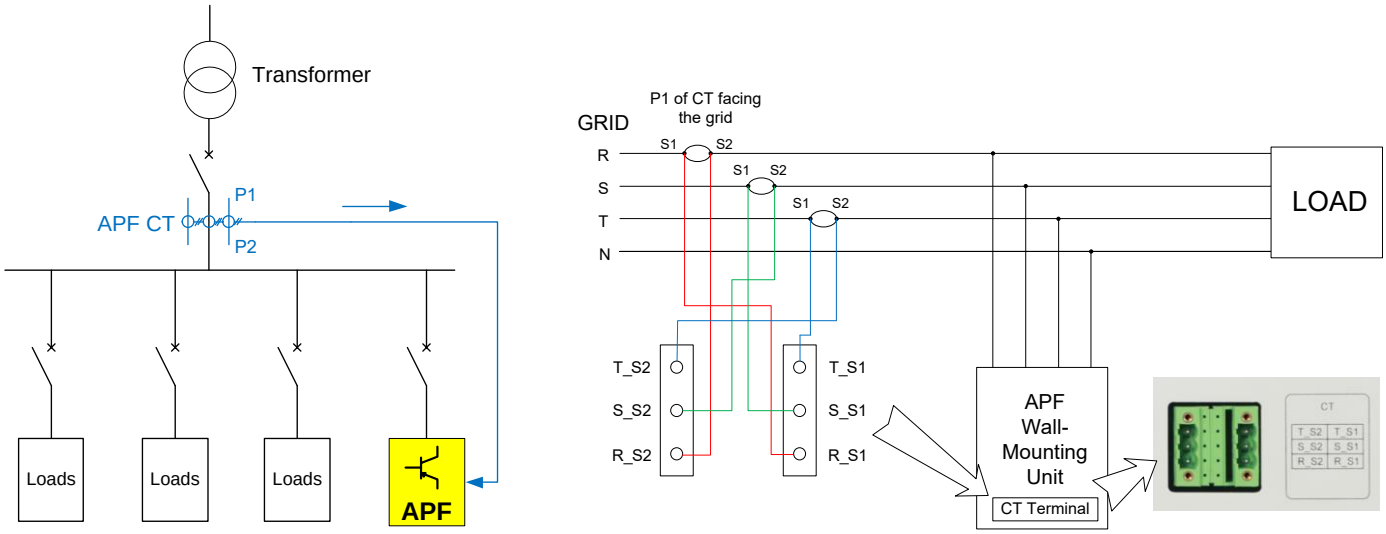


Figure 4-31 CT Connection for closed loop, without Device CT, without cap bank, single APF wall-mounted units scenario

If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

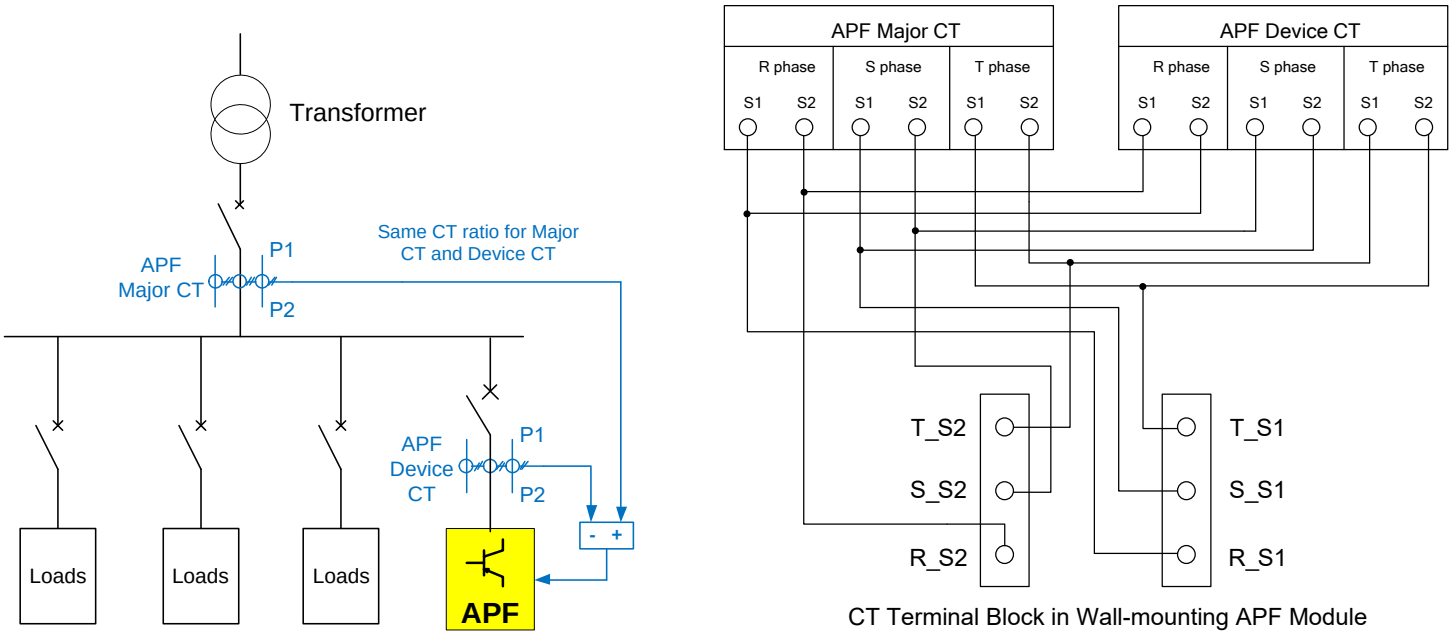
- Corresponding CT settings in Touch Screen HMI

Setting Location	Setting Value
General Setting→ CT Position	Grid Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
Adv Setting→ CT Number	3-CT
Adv Setting→ 1-CT Location	No need to set

4.4.6 Closed loop, With Device CT, Without Cap Bank, Single Wall-mounted APF unit External CT Connection

In this scenario, 3 pieces of CT shall be installed at grid side (R/S/T phases), and another 3 pieces of CT shall be installed at APF input side, all the CT's P1 should be facing grid side, with same CT ratio.

Refer to *Figure 4-32* for single line diagram (SLD) and detailed connection.



A) Single Line Diagram *B) Detailed CT Connection*

Figure 4-32 CT Connection for closed loop, with Device CT, without cap bank, single APF wall-mounted units scenario

If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

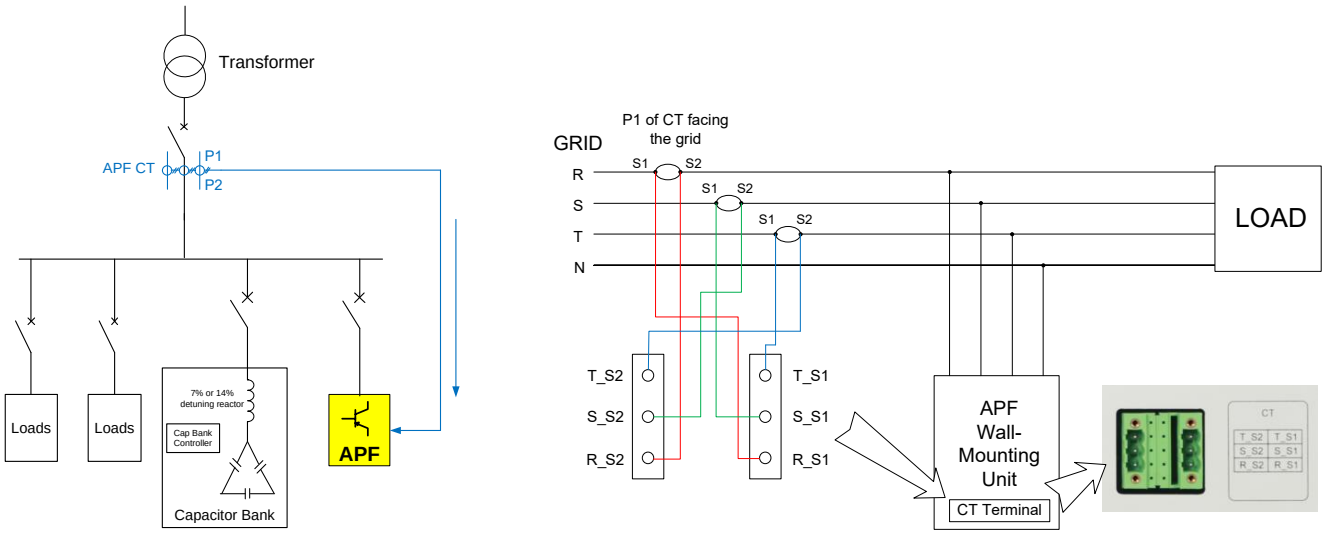
- Corresponding CT settings in Touch Screen HMI

Setting Location	Setting Value
General Setting→ CT Position	Load Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
Adv Setting→ CT Number	3-CT
Adv Setting→ 1-CT Location	No need to set

4.4.7 Closed loop, Without Device CT, Along with Cap Bank, Single Wall-mounted APF unit External CT Connection

In this scenario, in total, 3 pieces of CT are required, which shall be installed at grid side (R/S/T phases, all the CT's P1 should be facing grid side, with same CT ratio. In this case, the Cap Bank should be detuned with 7% or 14% line reactor for this APF CT connection, and APF should be used for harmonics or imbalance correction only, while reactive power compensation shouldn't be enabled in APF.

Refer to *Figure 4-33* for single line diagram (SLD) and detailed connection.



A) Single Line Diagram *B) Detailed CT Connection*

Figure 4-33 CT Connection for closed loop, without Device CT, along with cap bank, single wall-mounted APF unit

If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

- Corresponding CT settings in Touch Screen HMI

Setting Location	Setting Value
General Setting→ CT Position	Grid Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
Adv Setting→ CT Number	3-CT
Adv Setting→ 1-CT Location	No need to set

4.4.8 Closed loop, With Device CT, Along with Cap Bank, Single Wall-mounted APF unit External CT Connection

In this scenario, in total, 9 pieces of CT are required, out of which, 3 pieces of CT shall be installed at grid side (R/S/T phases), another 3 pieces of CT shall be installed at APF input side, and the other 3 pieces of CT shall be installed at Capacitor Bank input side, all the CT's P1 should be facing grid side, with same CT ratio.

Refer to *Figure 4-34* for single line diagram (SLD) and *Figure 4-35* for detailed connection.

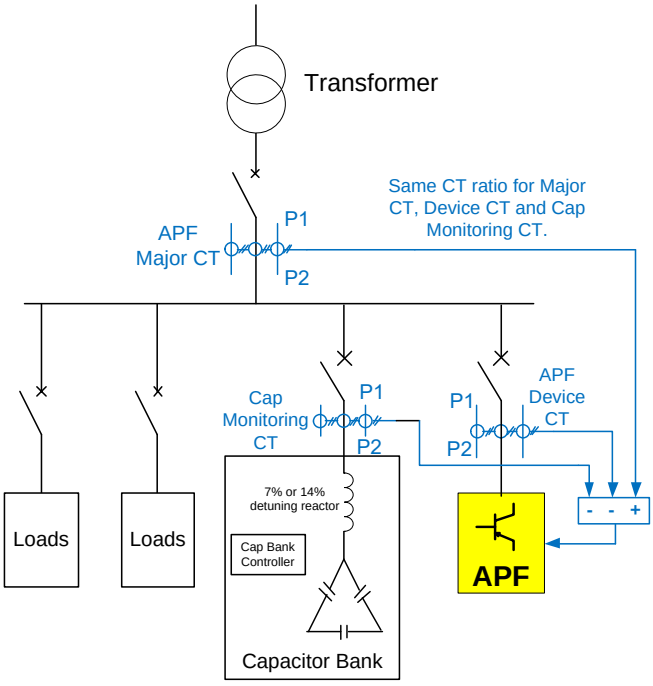


Figure 4-34 CT Connection for closed loop, with Device CT, along with cap bank, single wall-mounted APF unit - SLD

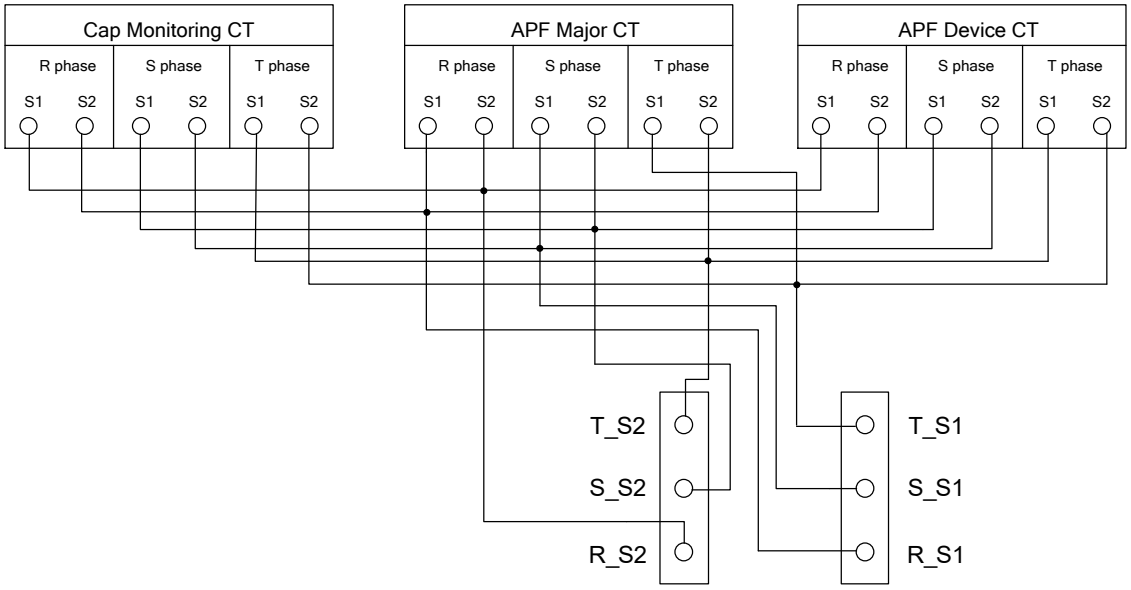


Figure 4-35 CT Connection for closed loop, with Device CT, along with cap bank, single wall-mounted APF unit - details

If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

- Corresponding CT settings in Touch Screen HMI

Setting Location	Setting Value
General Setting→ CT Position	Load Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
Adv Setting→ CT Number	3-CT
Adv Setting→ 1-CT Location	No need to set

4.4.9 Closed loop, Without Device CT, Along with Cap Bank, Double Wall-mounted APF units CT Connection

In this scenario, in total, 3 pieces of CT are required, which shall be installed at grid side (R/S/T phases, all the CT's P1 should be facing grid side, with same CT ratio. In this case, the Cap Bank should be detuned with 7% or 14% line reactor for this APF CT connection, and APF should be used for harmonics or imbalance correction only, while reactive power compensation shouldn't be enabled in APF.

Refer to *Figure 4-36* for single line diagram (SLD) and *Figure 4-37* for detailed connection.

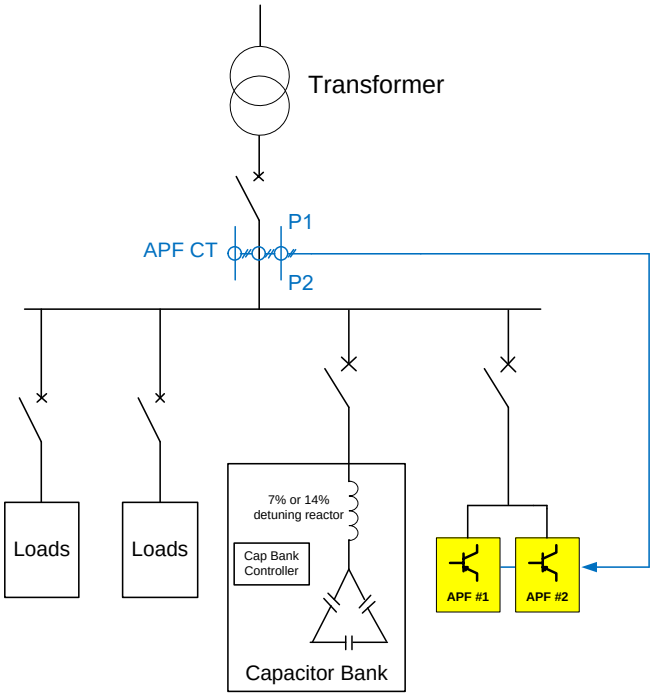


Figure 4-36 CT Connection for closed loop, without Device CT, along with cap bank, double wall-mounted APF units– SLD

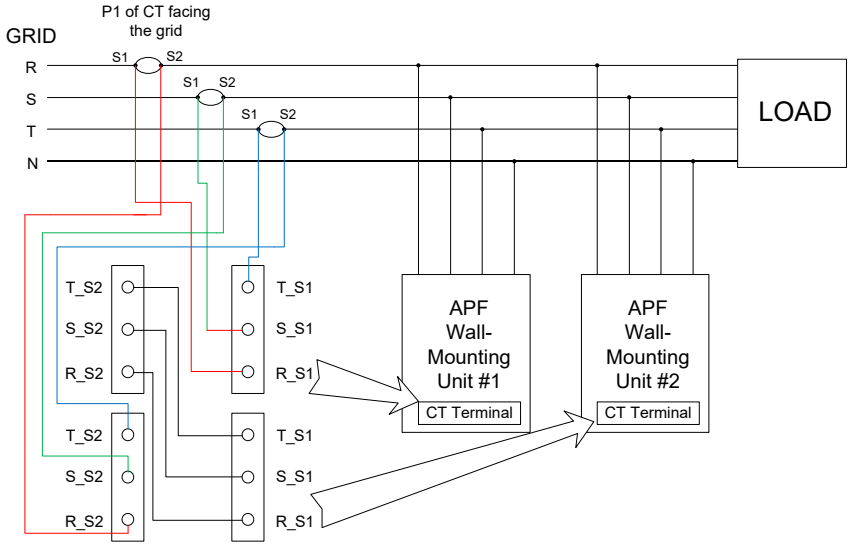


Figure 4-37 CT Connection for closed loop, without Device CT, along with cap bank, double wall-mounted APF units– details

If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

- Corresponding CT settings in Touch Screen HMI

Setting Location	Setting Value

General Setting→ CT Position	Grid Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
General Setting→ System Percent	50% for same capacity, if different capacity Cabinet#1: Cabinet#1 capacity/whole capacity Cabinet#2: Cabinet#2 capacity/whole capacity
Adv Setting→ CT Number	3-CT
Adv Setting→ 1-CT Location	No need to set

4.4.10 Closed loop, With Device CT, Along with Cap Bank, Double Wall-mounted APF units CT Connection

In this scenario, in total, 9 pieces of CT are required, out of which, 3 pieces of CT shall be installed at grid side (R/S/T phases), another 3 pieces of CT shall be installed at two APF common input side, and the other 3 pieces of CT shall be installed at Capacitor Bank input side, all the CT's P1 should be facing grid side, with same CT ratio.

Refer to *Figure 4-38* for single line diagram (SLD) and *Figure 4-39* for detailed connection.

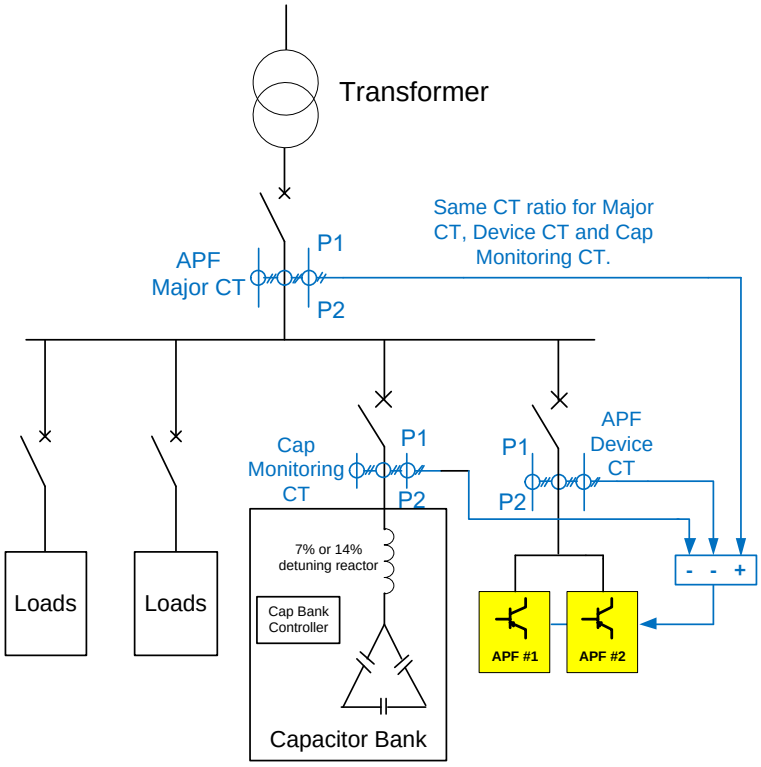


Figure 4-38 CT Connection for closed loop, with Device CT, along with cap bank, double wall-mounted APF units– SLD

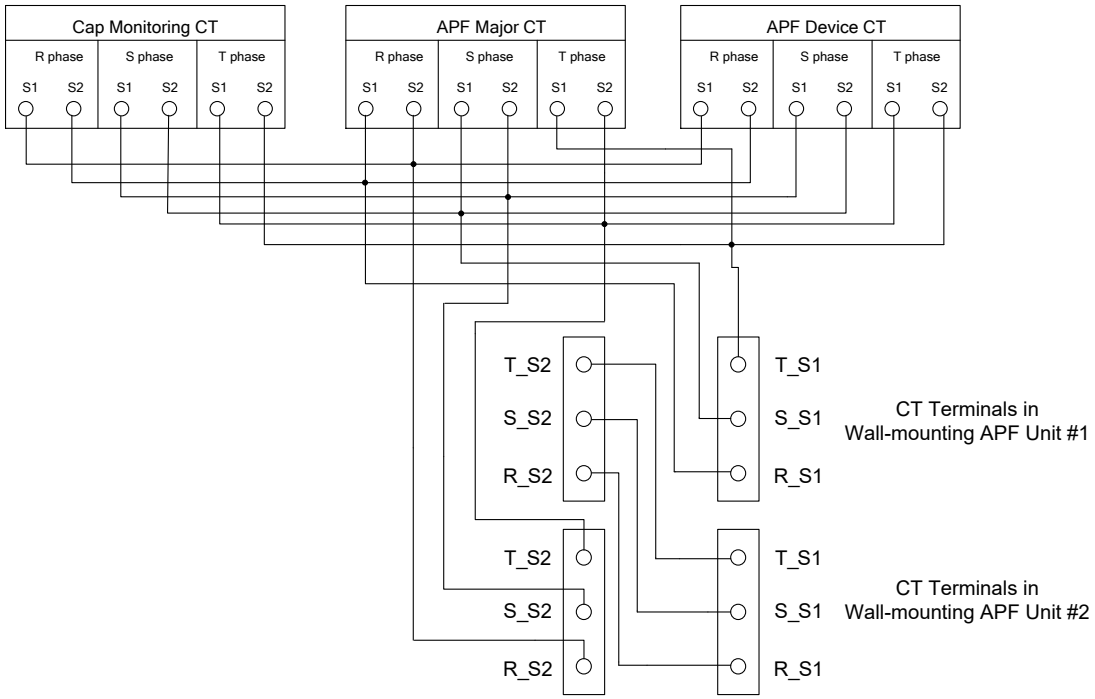


Figure 4-39 CT Connection for closed loop, with Device CT, along with cap bank, double wall-mounted APF units– details

If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

- Corresponding CT settings in Touch Screen HMI

Setting Location	Setting Value
General Setting→ CT Position	Load Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
General Setting→ System Percent	50% for same capacity, if different capacity Cabinet#1: Cabinet#1 capacity/whole capacity Cabinet#2: Cabinet#2 capacity/whole capacity
Adv Setting→ CT Number	3-CT
Adv Setting→ 1-CT Location	No need to set

5. APF+SVG Hybrid System CT Configuration

5.1 APF+SVG Hybrid System CT Selection

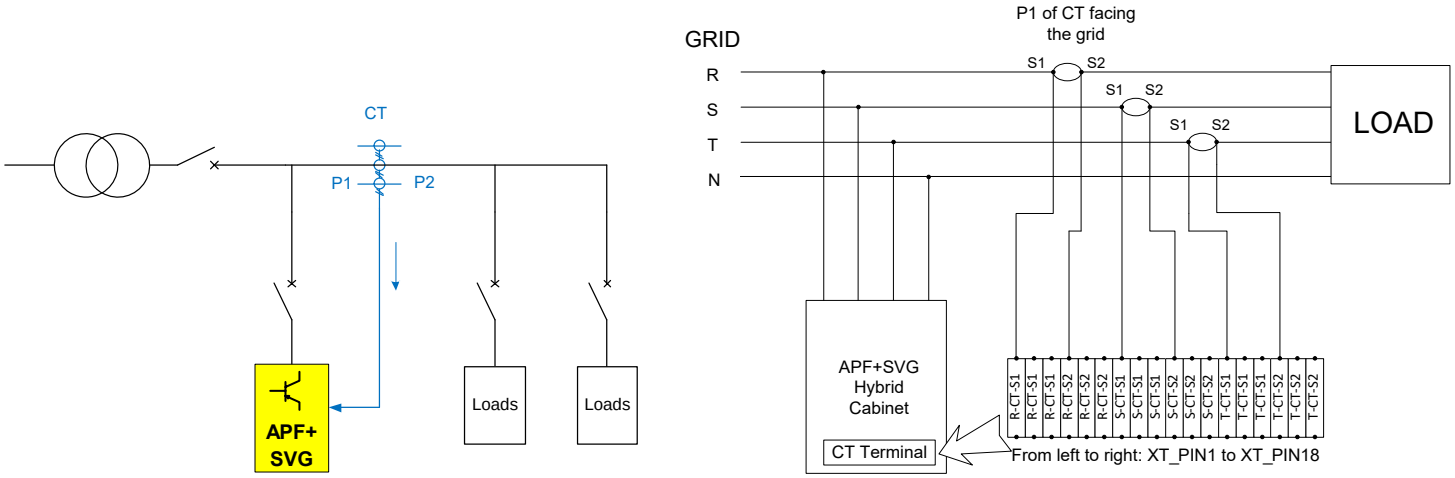
CT selection for APF + SVG hybrid system is the same as APF CT selection, and corresponding settings are the same as APF.

Note: Minimum ID module must be APF because HMI will read minimum ID module parameters and send harmonic parameters to APF, reactive parameters to SVG. If minimum ID module is SVG, then harmonics parameters will be missed.

5.2 CT Connection for APF+SVG Hybrid Cabinet System

5.2.1 Open loop, Without Cap Bank, Single APF+SVG Hybrid Cabinet External CT Connection

In this scenario, 3 pieces of CT shall be installed at load side (R/S/T phases), P1 of which should be facing the grid side, refer to Figure 5-1 for single line diagram (SLD) and detailed connection.



A) Single Line Diagram *B) Detailed CT Connection*

Figure 5-1 CT Connection for open loop, without cap bank, single hybrid cabinet scenario

If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

- Corresponding CT settings in Touch Screen HMI

Setting Location	Setting Value
General Setting→ CT Position	Load Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
Adv Setting→ CT Number	3-CT
Adv Setting→ 1-CT Location	No need to set

5.2.2 Open loop, Without Cap Bank, Double APF+SVG Hybrid Cabinets External CT Connection

In this scenario, 3 pieces of CT shall be installed at load side (R/S/T phases), P1 of which should be facing the grid side, all these CT shall be shared by two hybrid cabinets, refer to *Figure 5-2* for single line diagram (SLD) and *Figure 5-3* for detailed connection.

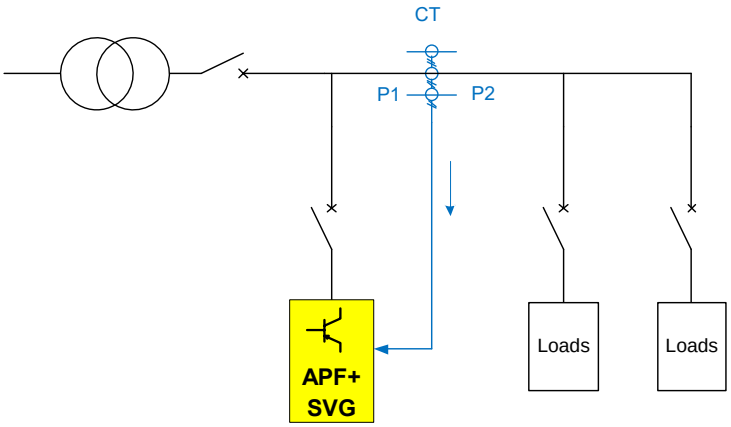


Figure 5-2 CT Connection for open loop, without cap bank, double hybrid cabinets scenario - SLD

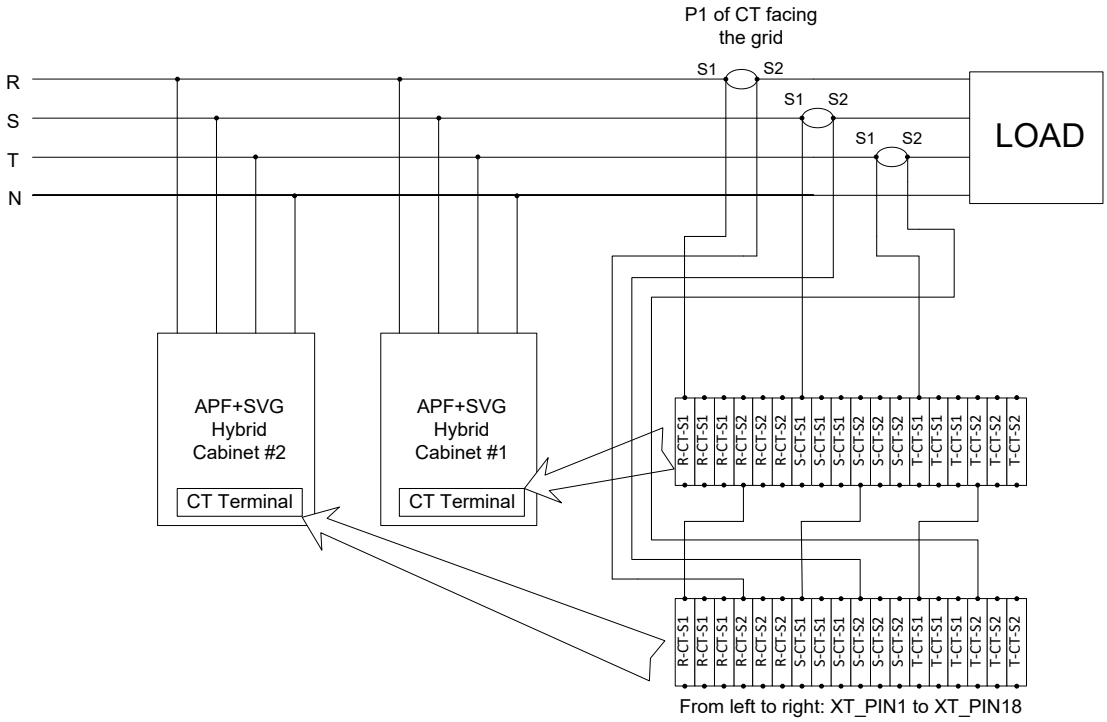


Figure 5-3 CT Connection for open loop, without cap bank, double hybrid cabinets scenario – detailed connection

If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

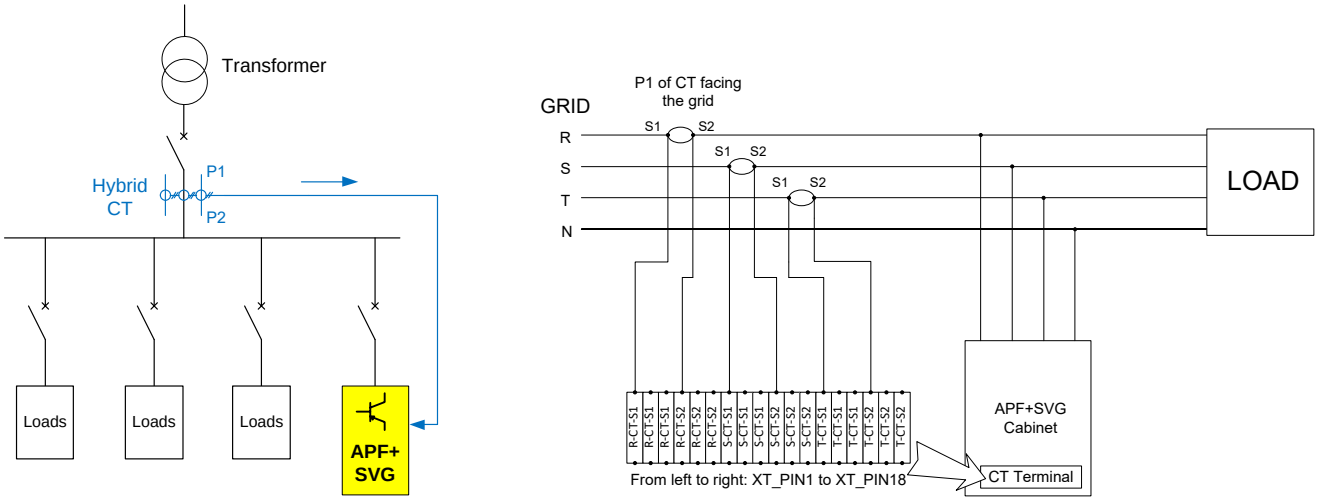
- Corresponding CT settings in Touch Screen HMI

Setting Location	Setting Value
General Setting→ CT Position	Load Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
General Setting→ System Percent	50% for same capacity, if different capacity Cabinet#1: Cabinet#1 capacity/whole capacity Cabinet#2: Cabinet#2 capacity/whole capacity
Adv Setting→ CT Number	3-CT
Adv Setting→ 1-CT Location	No need to set

5.2.3 Closed loop, Without Device CT, Without Cap Bank, Single APF+SVG Hybrid Cabinet External CT Connection

In this scenario, 3 pieces of CT shall be installed at grid side (R/S/T phases), all the CT's P1 should be facing grid side, with same CT ratio.

Refer to *Figure 5-4* for single line diagram (SLD) and detailed connection.



A) Single Line Diagram *B) Detailed CT Connection*

Figure 5-4 CT Connection for closed loop, without Device CT, without cap bank, single hybrid cabinet scenario

If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

- Corresponding CT settings in Touch Screen HMI

Setting Location	Setting Value
General Setting→ CT Position	Grid Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
Adv Setting→ CT Number	3-CT
Adv Setting→ 1-CT Location	No need to set

5.2.4 Closed loop, With Device CT, Without Cap Bank, Single APF+SVG Hybrid Cabinet External CT Connection

In this scenario, 3 pieces of CT shall be installed at grid side (R/S/T phases), and another 3 pieces of CT shall be installed at hybrid cabinet input side, all the CT's P1 should be facing grid side, with same CT ratio.

Refer to *Figure 4-8* for single line diagram (SLD) and *Figure 4-96* for detailed connection.

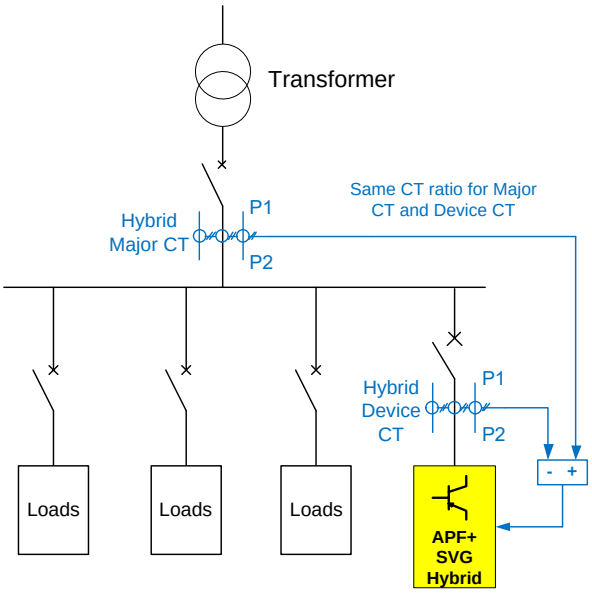


Figure 5-5 CT Connection for closed loop, with Device CT, without cap bank, single hybrid cabinet scenario – SLD

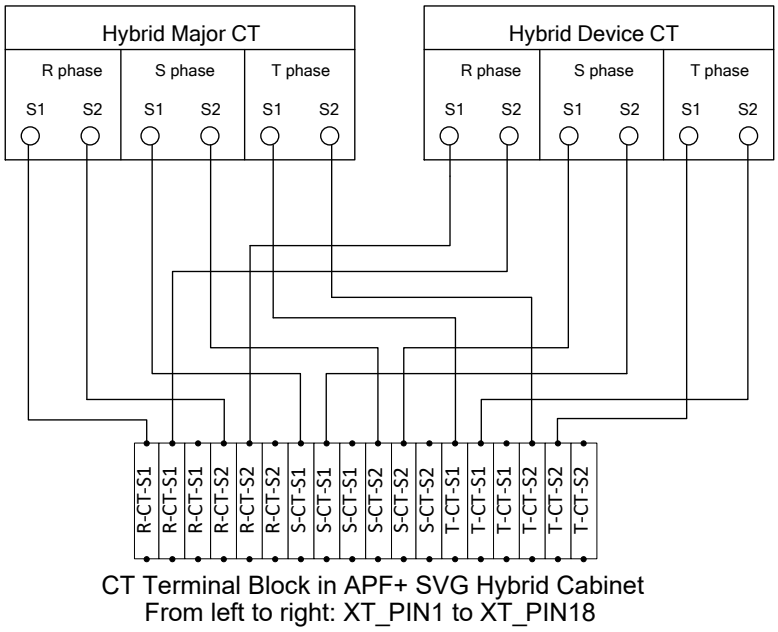


Figure 5-6 CT Connection for closed loop, with Device CT, without cap bank, single hybrid cabinet scenario – details

If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

- Corresponding CT settings in Touch Screen HMI

Setting Location	Setting Value
General Setting→ CT Position	Load Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
Adv Setting→ CT Number	3-CT
Adv Setting→ 1-CT Location	No need to set

5.2.5 Closed loop, Without Device CT, Without Cap Bank, Double APF+SVG Hybrid Cabinets CT Connection

In this scenario, 3 pieces of CT shall be installed at grid side (R/S/T phases), all the CT's P1 should be facing grid side, with same CT ratio.

Refer to *Figure 5-7* for single line diagram (SLD) and *Figure 5-8* for detailed connection.

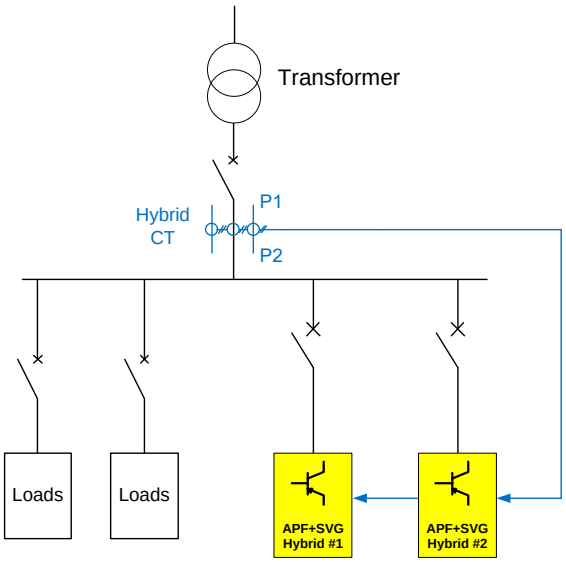


Figure 5-7 CT Connection for closed loop, without Device CT, without cap bank, double hybrid cabinets scenario – SLD

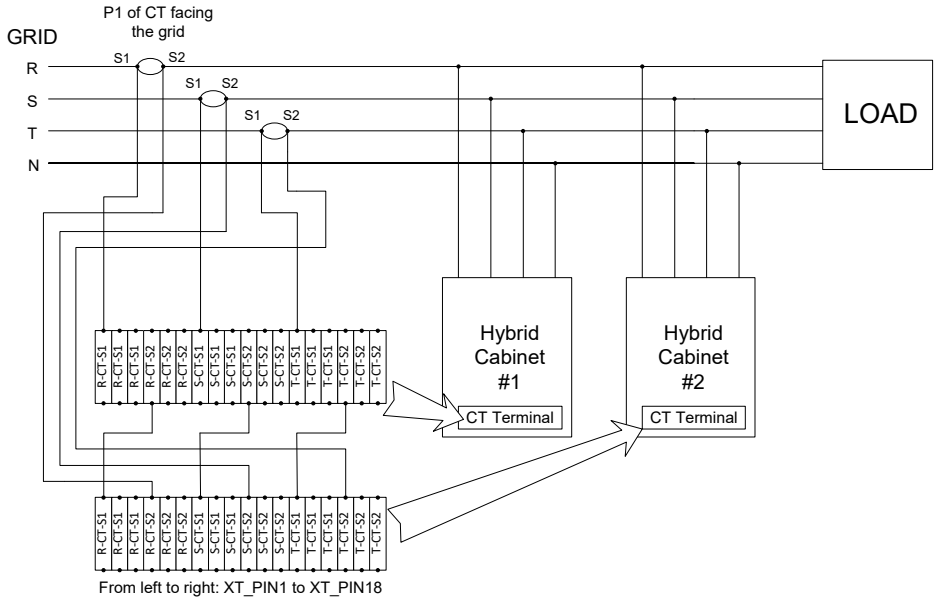


Figure 5-8 CT Connection for closed loop, without Device CT, without cap bank, double hybrid cabinets scenario – details

If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

- Corresponding CT settings in Touch Screen HMI

Setting Location	Setting Value
General Setting→ CT Position	Grid Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
General Setting→ System Percent	50% for same capacity, if different capacity

	Cabinet#1: Cabinet#1 capacity/whole capacity Cabinet#2: Cabinet#2 capacity/whole capacity
Adv Setting→ CT Number	3-CT
Adv Setting→ 1-CT Location	No need to set

5.2.6 Closed loop, With Device CT, Without Cap Bank, Double APF+SVG Hybrid Cabinets External CT Connection

In this scenario, in total, 9 pieces of CT are required, out of which, 3 pieces of CT shall be installed at grid side (R/S/T phases), another 3 pieces of CT shall be installed at Hybrid Cabinet#1 input side, and the other 3 pieces of CT shall be installed at Hybrid Cabinet #2 input side, all the CT's P1 should be facing grid side, with same CT ratio.

Refer to *Figure 5-9* for single line diagram (SLD) and *Figure 5-10* for detailed connection.

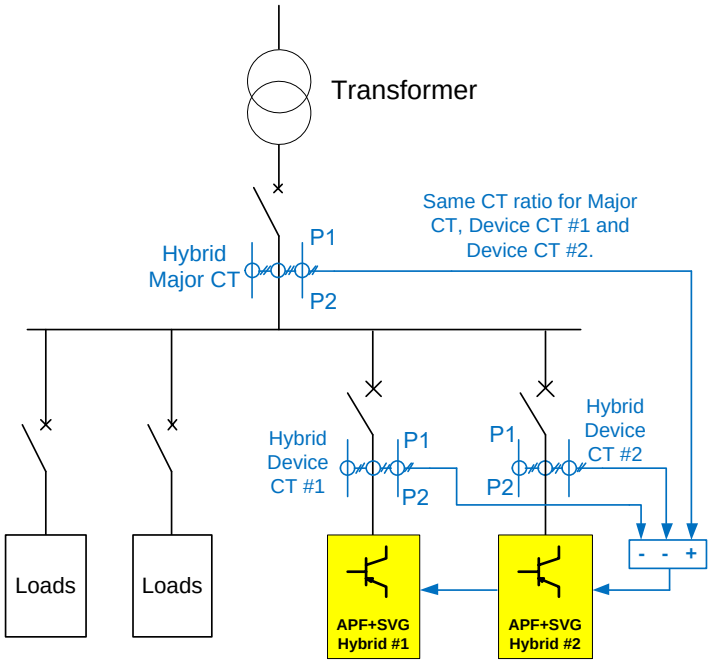


Figure 5-9 CT Connection for closed loop, with Device CT, without cap bank, double hybrid cabinets scenario – SLD

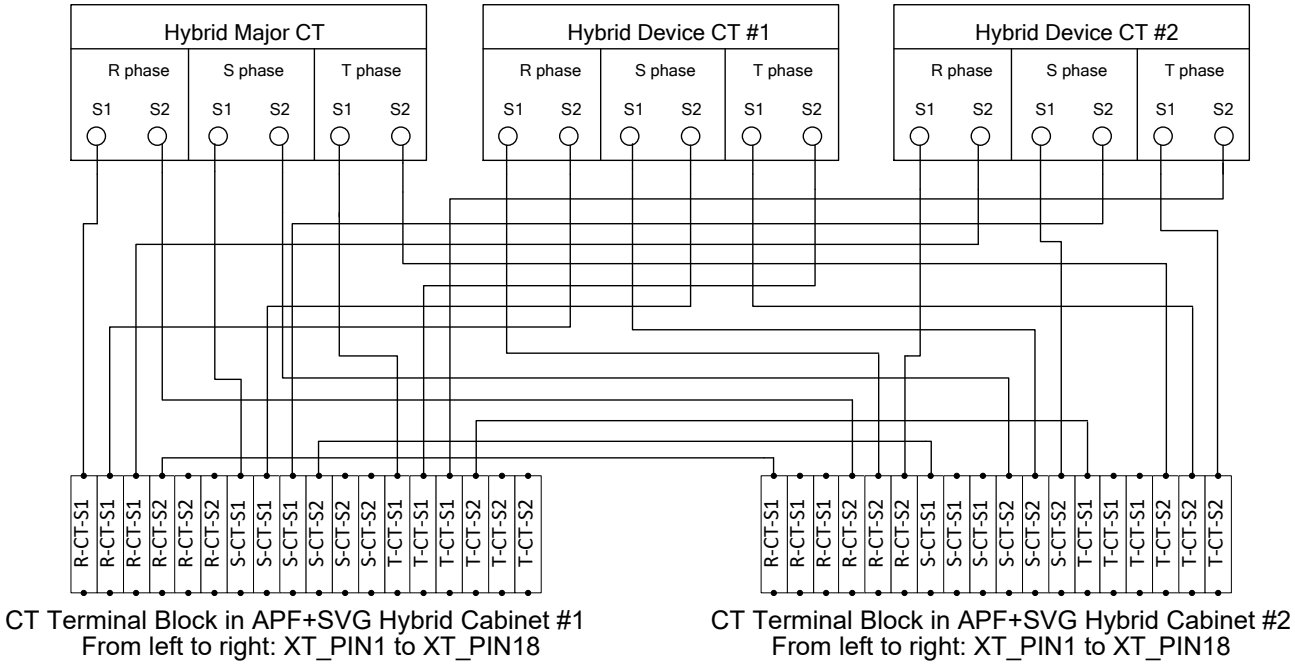


Figure 5-10 CT Connection for closed loop, with Device CT, without cap bank, double hybrid cabinets scenario – details

If CT connection is following this pattern, CT related parameters should be set according to following table for Touch Screen HMI.

- Corresponding CT settings in Touch Screen HMI

Setting Location	Setting Value
General Setting→ CT Position	Load Side
General Setting→ CT Direction	Positive
General Setting→ CT Ratio	Actual CT ratio
General Setting→ System Percent	50% for same capacity, if different capacity Cabinet#1: Cabinet#1 capacity/whole capacity Cabinet#2: Cabinet#2 capacity/whole capacity
Adv Setting→ CT Number	3-CT
Adv Setting→ 1-CT Location	No need to set