

Constant Voltage Transformers (CVTs)

From Power Quality Solutions Inc.

PQSI GENERAL CVT SPECIFICATIONS: All PQSI CVTs are of a ferro-resonant design and are supplied in a NEMA 1 enclosure with terminal block connections for both the input and output voltages. Typical steady-state input voltage ranges are: for 120Vac (90Vac to 132Vac), and for 480Vac (360Vac to 528Vac). Within the steady-state input voltage range noted, the output voltage is regulated plus/minus 3% up to the full kVA rating of the CVT. The CVT's output harmonic voltage distortion is 5% maximum at full load. Voltage surge suppression is typically 250:1 and complies with ANSI/IEEE C62.41 A & B, and PQSI provides additional MOV devices on both the CVT's primary and secondary windings, i.e. 575V MOV on 480Vac ratings and 150Vac MOV on 120Vac ratings.



PQSI CVTs provide circuit high-frequency switching noise isolation of 120dB common mode/ 60dB normal mode, and under short circuit load conditions the load current is limited to a maximum current of 250%. PQSI CVTs are unconditionally warranted for 1 year, and safety agency listings can be provided for an additional fee.

Typical PQSI CVT overall dimensions, weights, and losses versus selected VA rating are listed in the below table:

CVT VA RATING	~OVERALL DIMENSIONS	~WEIGHT (LBS)	~LOSSES (BTU/HR)
500	6.6"H x 6.5"W x 14"D	35	225
1000	6.6"H x 6.5"W x 16"D	50	350
1500	9.5"H x 10"W x 18"D	80	425
2000	9.5"H x 10"W x 20"D	100	485
3500	9.5"H x 10"W x 23"D	160	625
5000	14"H x 14.5"W x 24"D	250	850

PQSI GUIDELINES TO LOOK FOR WHEN PURCHASING A CVT

PQSI guarantees their products will meet their published specifications. PQSI CVTs are specified to recognized industrial standards and under well defined conditions may be capable of operating "outside" their specified limits. While as mentioned earlier, CVTs are highly reliable and are effective at stabilizing electric service supply variations, it would be prudent before purchasing a CVT, to review the following application issues to ensure the CVT will be compatible with your application:

- [a] **High Input & High Output Voltages Upon Operation of Input Protection Devices:** Establish the proper input fuse and/or circuit breaker rating required for the application. Identify what the maximum primary RMS current is under secondary short-circuit conditions for determining the rating of the fuse or circuit breaker. Beware that sizing fuses and circuit breakers for conventional transformers is not applicable when sizing fuses and/or circuit breakers for CVTs. This is because CVTs are high impedance units (typically 10 times higher than a control transformer) compared to the equivalent rated conventional transformer. Therefore, it is essential that the CVT customer discuss with PQSI these guidelines before finalizing their fuse sizing and/or circuit breaker rating requirements. *Please note: with the correct input fuse or circuit breaker the application should work fine until the protection opens at about 150% of the nominal input voltage. In some cases, after the circuit protection opens, the CVTs output voltage will rise with increasing input at about 20% of the increase, i.e. the output voltage may go up 1% for each 5% the input voltage rises. This situation*

may “overvoltage” the load you want to protect. That’s why this should be discussed with PQSI manufacturer.

- [b] **Operating at Low Input Voltage:** If the CVT is operated at significantly lower input voltage continuously, the output voltage will sag as the input voltage sags. Underloading the CVT unit will greatly improve the CVTs output voltage performance. If this kind of operation is possible in your application, please discuss with PQSI to what extent would the CVT have to be “underloaded” to prevent this situation from occurring.
- [c] **Non-sinusoidal Input Voltage:** If the correct alternating frequency is applied to the CVT it will operate. Also, PQSI CVTs can tolerate an input harmonic voltage distortion (V_{thd}) up to 25% or even a square wave input for short-term durations. If this situation may exist in your application, please discuss with PQSI how the selected CVT will perform with various levels of V_{thd} versus application duration. It would also be good to note if the proposed CVT application may have an input frequency variance, if this is the case, PQSI can advise on the impact of this condition on the CVT’s output voltage variance characteristics.
- [d] **Overloading:** Depending on the actual level of the PQSI CVT’s input voltage, the CVT may deliver up to 50% more power than specified. Beyond this level, the CVT will self protect by reducing the output voltage progressively until it reaches nearly zero. The CVT can be operated into a short circuit indefinitely. Whether the CVT can handle the “inrush current” of any single load or group of loads will depend on the sequencing of the loads, and the aggregate inrush current level. To establish the proper CVT rating for the intended application, please discuss with PQSI both the steady-state and dynamic inrush current profiles for your application.
- [e] **Power Factor Loads:** Linear inductive loads depress the CVT’s output voltage and can usually be corrected by adding load capacitors. Linear capacitive loads have the opposite effect on CVTs. If your loads are non-linear ask PQSI how it’s CVT will be effected.
- [f] **Switching Loads:** Ordinary switched mode power supplies (SMPS) are particularly suited to be used with most CVTs. But when CVTs have “self adjusting” arrangements, care must be taken because with some dimmer or phased control load circuits problems could arise. In these kind of applications, discuss with PQSI how it might specifically document its CVT product’s performance regarding the CVT’s compatibility with dimmer and phased controlled loads.
- [g] **Low Ambient Temperature Performance:** PQSI CVTs can tolerate ambient temperatures down to 0° C. Lower than 0° C the capacitor becomes the limiting factor. If the intended CVT application is at lower temperatures than 0 °C, discuss this with PQSI on what CVT “modifications” are possible for operating the CVT below 0° C.
- [h] **High Ambient Temperature Performance:** PQSI CVTs can tolerate ambient temperatures up to 50°C. Short term excursions up to 70°C may be possible. Again, the capacitor becomes the limiting factor. If the intended CVT application is at higher temperatures than 50°C, discuss this with PQSI on what CVT “modifications” are possible for operating the CVT higher than 50°C. *Please note: it is commonly understood in the CVT supplier industry that for every 5 degrees C above 50°C, expect the CVT’s life expectancy to be halved from the calculated 300,000 hours mean time before failure (MTBF).*
- [i] **High Humidity Performance:** PQSI CVTs can operate at 90% relative humidity without problems. If the CVT has been stored at 100% relative humidity, it probably will require drying out before starting up. If this situation might be possible in your application, please discuss with PQSI what their proposed procedures for “drying out CVTs” and the consequences of operating continuously above 90% relative humidity.

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