

GE Ultra Efficient Harmonic Mitigating Transformer

FAQ

Frequently Asked Questions

1. What is an ultra-energy efficient harmonic mitigating transformer?

It is a transformer that combines the energy-saving core from an ultra-efficient transformer with the zig zag wound coils from a harmonic mitigating transformer. In an ultra-efficient transformer, the energy savings occurs in the core due to superior steel type and precision assembly. In a harmonic mitigating transformer, the harmonic cancellation occurs in the coils that have a zig zag winding connection.

2. What is a zig zag winding?

A transformer with a zig zag winding connection connects in series, portions of windings of different phases. Stated differently, a zig zag transformer contains six coils on three cores. The first coil on each core is connected in the opposite direction to the second coil on the next core. The second coils are then all tied together to form the neutral, and the phases are connected to the primary coils.

3. What are harmonics?

A harmonic is an electrical frequency that is an integer multiple of the fundamental frequency, i.e. if the fundamental frequency is f , the harmonics have frequencies $3f$, $5f$, $7f$, etc.. For example, if the fundamental frequency is 60 Hz, the frequencies of the harmonics are: 180 Hz, 300Hz, 420Hz, etc. 180Hz is the 3rd harmonic. 300Hz is the 5th harmonic, etc.

Each load type has a characteristic set of harmonics. The presence of non-characteristic harmonics could be an indication of potential equipment damage.

Load Type	Characteristic harmonics
Single phase electronic loads such as PCs	3, 5, 7, 9, 11, 13, 15, 17
Three phase electronic loads such as small variable frequency drives (Six pulse)	5, 7, 11, 13, 17
Three phase electronic loads such as large variable frequency drives (Twelve pulse)	11, 13
Transformer saturation	3, 5, 7
Electric arc furnaces and welders	5, 7
Saturable core reactors	3, 5, 7

4. What are triplen harmonics?

Triplen harmonics are harmonics that are multiples of the number three. For example, triplen harmonics include the 3rd, 9th, 15th, etc. harmonic. Each of these harmonics is a multiple of three and therefore called a triplen harmonic. *Triplen harmonics will all be filtered by a zig zag winding connection.*

5. What does 0° phase shift and -30° phase shift mean?

The phase shiftment is the electrical angle between the voltage (or current) at the secondary side of the transformer with respect the primary side, at same phase. Any deeper explanation will begin to cause drowsiness, but here is what you need to know about phase shiftment.

GE offers two versions of harmonic mitigating and ultra-efficient harmonic mitigating transformers: 0° phase shift and -30° phase shift.



If you have a project that requires harmonic mitigating or ultra-efficient harmonic mitigating transformers, should you select a 0° phase shift or -30° phase shift transformer? What if there are multiple transformers on the project? Which one do I choose?

Scenario 1 – one HMT transformer in the building

If the project specifies only **one(1)** harmonic mitigating or ultra-efficient harmonic mitigating transformer, then you can *select either* the 0° phase shift model or the -30° phase shift model. It doesn't matter. Either transformer is acceptable and they will be equally effective at eliminating the triplen (3rd, 9th, 15th) harmonics. Individually, they work the same so it doesn't matter which one you choose.

Scenario 2 – More than HMT one transformer in the building

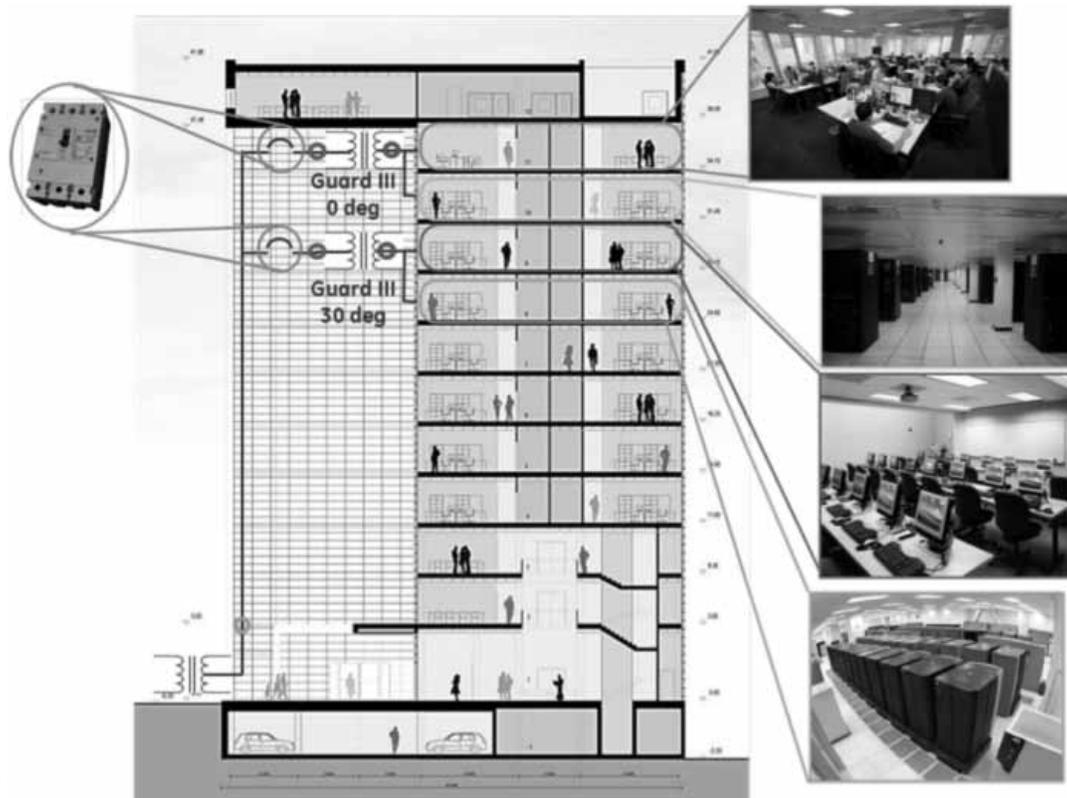
If you have a project that specifies **more than one** harmonic mitigating or ultra-efficient harmonic mitigating transformer, then you should **select a combination of both 0° phase shift and -30° phase shift** transformers. As stated above in Scenario 1, when used separately, both the 0° and -30° are equally effective at canceling the triplen harmonics. But when used together in the same building, they work together to cancel additional harmonics, like the 5th and 7th harmonic, in addition to the triplen harmonics. The diagram below shows a 0° phase shift Guard III transformer on one floor and a -30° phase shift Guard III transformer two floors below. Both work together to cancel the 5th and 7th harmonics.

When using both 0° and -30° transformers in the same building, a few installation guidelines will make them work more effectively. 1) Connect the transformers to loads that are as similar as possible; similar as far as type of load, load level and duty cycle. Obviously, be sure the loads are energized at the same time, otherwise no harmonic cancellation will occur. 2) Position the transformers as close as possible – electrically. Physical proximity is not as important as electrical proximity.

If you have further questions, call Bill Forsythe at (860) 747-7027

6. What is NEMA Premium efficiency?

In 2010, NEMA, working with transformer manufacturers, developed a new efficiency standard, higher than TP-1, for premium transformers. The goal was to create a new standard that was universally recognized and agreed upon by the transformer industry. Prior to NEMA Premium, manufacturers were not following the same efficiency standard. NEMA Premium is generally equivalent to DOD CSL-3. A transformer meeting the NEMA Premium specification will satisfy a DOD CSL-3 specification. The NEMA Premium label is now used on GE Ultra Efficient transformers to identify them as meeting the NEMA Premium efficiency standard.



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