Application Notes

PQS

Support for Suppliers:
PFC in the Automotive Industry

Power Quality Solutions

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Foreword

Manufacturing parts for the automotive industry is a very important business, as the driver's wellbeing depends on the functionality and reliability of the various parts. So the production equipment must guarantee a high degree of precision and quality.

To ensure a continuously high level of production, Ege Indüstri A.Ş. of Turkey decided to invest in a harmonic PFC system – an investment that has already paid off by providing a high and constant level of power quality.

The Author

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Power Factor Correction

Support for Suppliers: PFC in the Automotive Industry

Building model cars has been a popular hobby since the middle of the last century, when the first wooden kits appeared. There is now a large community of collectors of scale car models, which arrive in their homes in a huge number of single components – more than 300 pieces are not unusual!

Considering the variety of single parts needed to build a small model car, one can imagine how many parts are required to build a real one: body, brakes, axles, wheels, steering mechanism, gear box… ad infinitum!

Component suppliers for the automotive industry specialize in producing the components that will finally end up as a status symbol, a family car or simply a means of transportation.

1. The company

Ege Endüstri A.Ş. of Izmir, Turkey, specializes in **manufacturing commercial vehicle axles and axle components including fabricated axle housings and tag axles**.

The **company's goal** of "becoming the preferred business partner for our customers by exceeding their expectations in supplying the best quality products, understanding their requirements and maintaining a good relationship with them" was in jeopardy due to problems with **power quality and stability.**

Fig. 1: Ege Endüstri A.Ş. – supplier to the automotive industry

2. Company history

1974: Ege Endüstri A.Ş. was founded to serve the Turkish automotive manufacturing industry.

1986: Ege Endüstri floated on the Istanbul Stock Market

1987: Ege Fren, a joint venture with Arvin Meritor USA *(previously Rockwell)*, founded.

1990: Bayraktar Holding acquired the majority of the shares.

Ege Endüstri's products are used by most of the world's commercial vehicle manufacturers.

The company operates **two manufacturing plants**, both located in Izmir, the main plant in Pinarbasi and the second in the Aegean Free Zone. It manufactures axle components, axle housings, trailer axle beams, front axle beams, steering knuckles, front-axle linkage components, suspension components as well as axle assemblies.

When the transformer output at the Pinarbasi plant had reached its limits, technical experts from Siemens were called in to make a proposal for **increasing the transformer output** from 1,250 kVA to 3,150 kVA. During their meetings with the various facility managers, they heard about the **power supply problems** that Ege Endüstri was experiencing. Several breakdowns and failures each week had a serious negative impact on production capability. Cases of burnt-out PCB cards were reported, meaning a **complete knock-out** for the "brain" of the production equipment. As these cards need a specific voltage and current, the experts suspected the **presence of a high harmonic content** in the grid. Harmonics place an additional load on the grid due to unforeseen voltages and currents – an extremely undesirable phenomenon. The **basic recommendation** was to install a PFC system to supply the needed reactive power to the load, thus utilizing the transformer in a more economical way. In view of the evidence of harmonics in the grid, however, the **final decision** was to install a detuned PFC system. By using an anti-resonance harmonic filter, the harmonics were significantly reduced.

Fig. 2: The plant at Pinarbasi with a production area of 14,800 square meters

3. Evaluation of the initial situation

Ege Endüstri had installed two transformers of 1,250 kVA each at their Pinarbasi plant. **Inductive loads** of 12% and **capacitive loads** of 7% caused eight to ten system failures per month. The **main target** was to reduce the load ratio and to stabilize the power supply by reducing the harmonic content. Evrim Elektrik, a panel building company, was called in to design a **customized PFC system solution**.

Fig. 3: Ege Endüstri – products for the automotive industry

4. Existing conditions

Kind of loads: Compressors, water pumps, lighting, air-conditioning, cooling, presses, CNC machines, welding machines, cranes, water motors.

Inductive load	12%
Capacitive load	7%
Operating time	24 hours per day
Transformer rating	2 x 1,250 kVA

Fig. 4: Production equipment

5. PFC system design and targets

Transformer rating	1 existing transformer 1,250 kVA 1 new transformer 3,150 kVA
Detuned PFC system	1,875 kvar at 400 V for 3,150 kVA transformer
Capacitor voltage	440 V
Capacitor types	MKK PhaseCap
Steps	1 x 25 kvar + 1 x 50 kvar + 2 x 100 kvar + 8 x 200 kvar
Detuning factor	5.67 %
Inductive load	Reduction to 3%
Capacitive load	Reduction to 3%

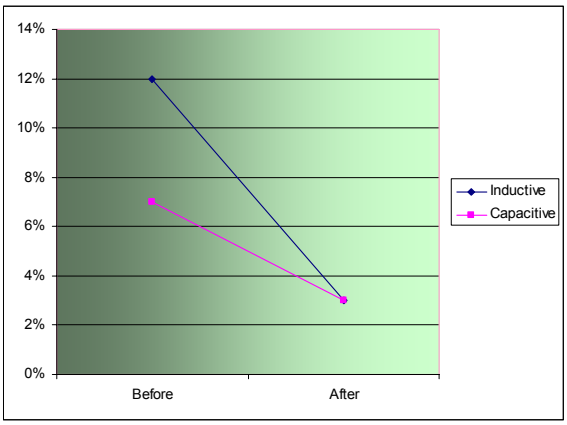

Fig. 5: Comparison

Fig. 6: PQS components: PFC capacitor, PF controller, harmonic filter

6. Conclusions

Mr. Nida Gürtan Civaner, who is in charge of all electrical and electronic systems at Ege Endüstri, defined the targets of the new PFC system as follows: to reduce the harmonic content in order to prevent production down-times due to failures of PCB cards and to reduce the ratio of capacitive and inductive power. Both targets were reached – failures due to harmonics have now been eliminated and the ratio of capacitive and inductive loads was reduced to 3%. After putting the new PFC system into operation, Mr. Civaner said:

"Before the new PFC system was installed, we used to suffer from PCB card failures at least every three days – an unbearable situation! It really cost us a lot of time and money… those cards are very expensive. The new PFC solution has eliminated the failures due to harmonics and we can keep our capacitance at a stable level!"

7. Standards

The recommendations and proposals stated in this Application Note are based (amongst others) on several international standards for PFC capacitors, LV switchgear design and electrical systems:

- IEC60831: LV-PFC Capacitor Standard
- IEC61921: Power Capacitors LV PFC banks
- DIN EN61921: Leistungskondensatoren Kondensatorbatterien zur Korrektur des Niederspannungsleistungsfaktors
- EN 50160: Voltage Characteristics of Electricity Supplied by Public Distribution Systems
- Engineering Recommendation G5/4: Planning levels for harmonic voltage distortion and the connection of non-linear equipment to transmission systems and distribution networks in the United Kingdom
- IEEE Standard 519-1992: IEEE Recommended practices and requirements for harmonic control in electrical power systems
- IEC60439-1/2/3: Low-voltage switchgear and control gear assemblies

The specifications in the standards and manufacturers' data sheets should always be observed.

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