

## CASE STUDY

### ENERGY SAVING IN ESCALATORS

#### ABSTRACT

This case study explores the installation of energy saving apparatus in escalators at the Tel Aviv central bus station. Benefits include reduction of operational costs by 23% - 26% and a return on investment of around two years.

#### CLIENT PROFILE

Tel-Aviv's central bus station is the largest central bus station in the world, with a built area of 230,000 m<sup>2</sup> and a total area of 44,000 m<sup>2</sup>. The station opened to the public in 1993 and features a public retail shopping mall over seven floors, serviced by 29 escalators, 13 elevators and featuring more than 1,000 shops and restaurants.



#### BUSINESS NEED

Ever increasing electricity prices and business demands for increased profitability, led the Tel Aviv central station's managers to seek energy saving solutions.

The station has 19 escalators which operate 19 hours per day. These escalators are designed to

#### OVERVIEW

##### PRODUCT USED

SinuMEC – Sinusoidal Motor Efficiency Controller

##### CLIENT PROFILE

The Tel-Aviv central bus station

##### BUSINESS NEED

Reducing energy costs and enhancing equipment lifetime.

##### SOLUTION AND BENEFITS

Installation of Power Electronics Systems' Sinusoidal Motor Efficiency Controller designed to reduce motor voltage according to escalator load improved motor efficiency and lifetime.

The SinuMEC saved 23%-26% of energy with an ROI of around 2 years, in addition to improving motor lifetime.

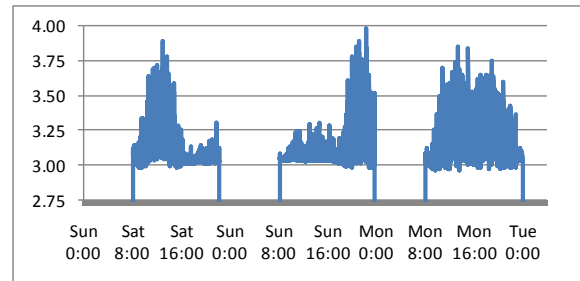
support their maximum load, which means up to two persons on each stair. As in many similar locations, most of the time the escalators run with no load or very low load, a fact which offers significant potential for energy savings.

#### SOLUTION

The Tel Aviv central station implemented Power Electronics Systems' innovative SinuMEC (Sinusoidal Motor Efficiency Controller) to induce energy savings. The SinuMEC, utilizes known phenomena whereby reducing the supplied voltage to partially loaded motors, their efficiency increases. The uniqueness of the SinuMEC lies in its patented technology which provides pure sine wave.

While the escalator control voltage was kept unchanged, the power voltages were supplied through the SinuMEC which constantly measured the power demand and changed the provided voltage accordingly. In addition to the two voltage levels supplied by the SinuMEC, the escalator control included a star/delta connection (operated during upstairs operation mode only) which together provided up to four voltage levels. The outcome was that the most efficient voltage level was provided to the escalator, allowing optimal utilization of the escalator motor and softer starting.

The following chart shows typical escalator load in kW during the weekend and week day, which means the average kW is approx. 3.3kW:



## RESULTS

In order to allow a uniform comparison basis, the following results are for an unloaded escalator. In normal load operation, the escalator works in delta connection for both directions. As such, the saving calculations were based on the average between star and delta operation.

The results are listed in the following tables:

### Downstairs Escalator

SinuMEC Mode	Bypass	Save	Saving
<b>kW</b>	2.54	2.11	<b>17%</b>
<b>Amp</b>	13.5	7.8	<b>42%</b>
<b>PF</b>	0.28	0.39	<b>40%</b>
<b>kVAr</b>	8.85	4.93	<b>44%</b>
<b>Motor V</b>	393	307	

### Upstairs Escalator

Connection Mode	Delta Bypass	Star Bypass	Star Save	Average Saving
<b>kW</b>	2.97	2.60	2.37	<b>15%</b>
<b>Amp</b>	13.9	5.6	4.4	<b>55%</b>
<b>PF</b>	0.31	0.68	0.78	<b>58%</b>
<b>kVAr</b>	9.04	2.82	1.88	<b>42%</b>
<b>Motor V</b>	387	228	178	

## BENEFITS

The direct benefits from the SinuMEC operation were as follows:

- Reduced direct kWh reading by 15% to 17%
- Reduced network losses by 70% to 80% or 5% to 6% from kW (assuming 7% losses)
- Reduced capacitor losses by 43% or 2% from kW (assuming self losses and harmonics increase due to the use of capacitors of 5%)
- Reduced motor waste heat, reduces air conditioning costs by 15% to 17% or 1% (assuming motor efficiency in low load of 80% and chilling COP of 3.0)
- Increased motor life expectancy
- Reduced startup current and motor stress

The station is opened 19 hours a day, 6 day a week, which means 5450 hours a year. The average kW during kWh price is €0.09 / \$0.14. The total energy per year per escalator is 17,985kWh. With total expected saving of 23% to 26%, it will save €372/\$580 to €420/\$655 per year with ROI of around two years, in addition to increased motor life expectancy.

Similar benefits were measured in other SinuMEC installations in low or variable load motors, such as conveyors, plastic molding machines, compressors and mixers.