



Las Vegas, Nevada

**TECHNOLOGY AND MARKET TRIALS PROGRAM**

*Final Report*

*Motorboss Motor Controller Field Test*

*Levi Strauss and McCarran Airport Test Sites*

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## Executive Summary

The Motorboss motor controller is a device designed to work with an electric motor to optimize the motor voltage at partial loads to reduce magnetic losses in the motor core. This reduces the electrical demand and energy consumption of the electric motor. The motor controller is most beneficial in reducing losses for motors running for long periods at low loads.

The objective of the testing was to determine the level of motor efficiency improvement resulting from installation of Motorboss motor controllers on three conveyor motors at a Levi Strauss facility in Henderson and one escalator motor at McCarran Airport in Las Vegas. These installations are representative of a large number of motors used in conveyor and escalator applications. Testing consisted of measuring electrical demand and energy consumption of the motors with and without the Motorboss motor controller turned on, and comparing the results. The resulting data was analyzed and the results are documented in this report.

Results showed that peak electrical demand reductions of 0.117-0.173 kW (11.5-14.6%) were achieved on the three Levi Strauss conveyor motors due to Motorboss operation. A peak demand reduction of 0.79 kW (31.2%) was achieved on the McCarran Airport 15 HP escalator motor.

Annual energy savings of 521-769 kWh/year (11.5-14.6%) were projected for the three Levi Strauss conveyor motors. An annual energy saving of 6,515 kWh/year (34.2%) was projected for the McCarran Airport 15 HP escalator motor.

Annual cost savings from utility billing reductions were projected to range from \$43 for the 1.5 HP Levi Strauss conveyor motor to \$64/year for the 5 HP motor, based on the current Nevada Power Company electric rate and 17 hour/day, five day/week use. Although energy savings on a percent basis were significant for these motors, actual cost savings were relatively small. For an installed cost of \$400 for each of the Motorboss units, the payback periods ranged from 6.3 to 9.3 years.

Cost savings from utility billing reductions were projected to be about \$496/year for the McCarran Airport 15 HP escalator motor, based on the current Nevada Power Company electric rate and 24 hour/day, seven day/week use. Assuming an installed cost of \$1500 for the Motorboss, the payback period would be 3.0 years.

The results of installing a Motorboss motor controller on conveyor and escalator motors tended to confirm that lightly loaded motors in the 1.5 HP to 15 HP range are appropriate applications for motor controllers of this type. Motor loadings were less than 50% for the conveyor motors and less than 20% for the escalator motor. The payback period was shorter for the escalator motor, which was more lightly loaded and was operated a greater percentage of the time than the conveyor motors.

A motor controller reduces the motor's operating electrical current and associated conductor losses. This in turn reduces motor operating temperatures which may extend motor life. A motor controller also provides a soft start capability which reduces mechanical stresses on the motor and associated machinery. These benefits may influence a user's decision to install a motor controller, but do not impact electric utility operations and were not addressed in this report. If included, these additional benefits would tend to reduce the payback period.

## **1. Introduction**

Nevada Power Company (NPC) authorized field testing of Motorboss motor controllers as part of its Energy Efficiency and Conservation group's Technology and Market Trials Program. The tests were performed to measure and verify the manufacturer's motor controller performance claims and assess the energy savings and electrical demand reductions achievable in customer "field-use" situations at the Levi Strauss facility in Henderson, Nevada and at the McCarran International Airport in Las Vegas, Nevada.

### **Technology Description**

While electrical impedance, mechanical, and magnetic losses are all present during the operation of an electric motor, it is the motor's core losses that are the focus of the Motorboss motor controller products. Core losses are the sum of energies expended to energize a motor's stator and rotor core. These losses can be grouped into two core-related loss categories: hysteresis and eddy current. Hysteresis losses result from energy expended in initially magnetizing the motor's core material; Eddy current losses result from energy expended in the form of heat when unavoidable currents flow within the conductive core material, motor housing, and any other conductive parts of the motor.

Because the magnitude of the core losses is proportional the square of the source voltage applied to the motor stator, the Motorboss motor controller attempts to minimize the voltage applied to the motor when operation and load demands require less than full line voltage (i.e. partial motor loading). When the motor load is low, the motor voltage is reduced to reduce losses. As the load increases, the Motorboss continuously adjusts the motor voltage appropriately to meet the required load. The Motorboss controller utilizes an electronically controlled thyristor system to achieve this control. The Motorboss controller is most beneficial in reducing losses for motors running for long periods at low load.

### **Test Objectives**

The tests were performed to measure and verify the manufacturer's motor controller performance claims and assess the energy savings and electrical demand reductions achievable in customer "field-use" situations at the Levi Strauss facility (three conveyors) in Henderson, Nevada and at the McCarran International Airport (one escalator) in Las Vegas, Nevada.

Testing consisted of measuring electrical energy consumption of the motor with and without operating the Motorboss motor controller under similar operating conditions and comparing the results. The resulting data was analyzed and the results documented in this report.

A benefit-cost calculation was made to assess the overall impact of utilizing the Motorboss motor controller as compared to operating the facilities' motors alone.

## 2. Site Description and Test Methodology

### Site Facilities

The testing was conducted at two locations: The Levi Strauss facility at 501 Sky Harbor Blvd, Henderson, NV 89015 and at McCarran International Airport, Las Vegas, NV 89119. Business hours at the Levi Straus facility are typically Monday through Friday, 6:00 am to 11:00 pm. McCarran International Airport is open 24 hours per day, seven days per week.



Figure 1. Map to Levi's Test Site

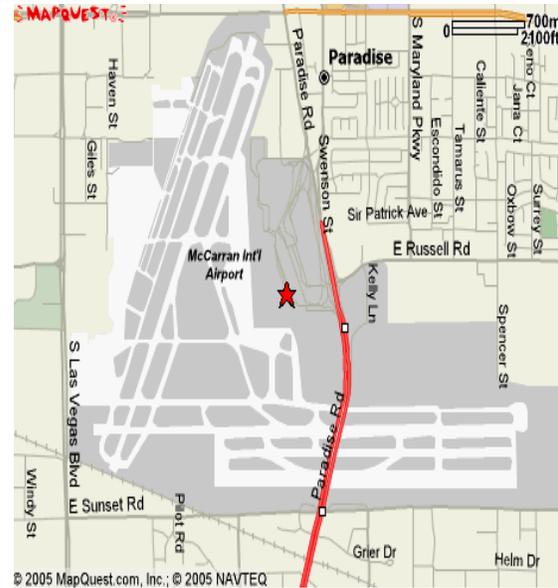


Figure 2. Map to McCarran Test Site

The level of motor electrical efficiency improvement resulting from installation of the Motorboss motor controller was tested on four separate electric motors, each a different size and having different functions and loading characteristics.

#### a) Levi Strauss Facility

- 1.5 HP Conveyor Motor
- 3 HP Conveyor Motor
- 5 HP Conveyor Motor

#### b) McCarran International Airport

- 15 HP Escalator Motor (This escalator transports passengers downward to the lower floor.)

The three conveyor system motors at the Levi Strauss facility typically run continuously during plant operations. According to the plant technical supervisor, the 1.5 HP and 3 HP motors run on conveyor systems that transport empty product containers. The 5 HP motor runs on a conveyor system that transports fully/partially loaded product containers.

The escalator motor at McCarran International Airport is typically run continuously 24 hours/day, seven days/week. The loading of this motor ranges from light to heavy and is intermittent and variable, depending on passenger density and travel inside the airport terminal.



Figure 3. Levi Strauss 3 HP Conveyor



Figure 4. McCarran Airport Escalator

The motors' specifications are given in the following table.

	Levi Strauss Facility	Levi Strauss Facility	Levi Strauss Facility	McCarran Airport
<b>Motor Description</b>	Conveyor	Conveyor	Conveyor	Escalator
<b>Manufacturer</b>	Baldor	Baldor	Baldor	Imperial
<b>Model/Serial #'s</b>	VM3554T 35A03W206 F695	VM3611T 35L114Y334 F395	VM3615T 36A03W415 E1194	543252 0-027731-034 -
<b>Rating(HP)</b>	1.5	3	5	15
<b>Rating(Volts)</b>	208/230/480	208/230/480	208/230/460	460
<b>Rating(Amps)</b>	5.3-5/2.5	8.5-8.2/4.1	15-13.2/6.6	22.8
<b>Phases</b>	3	3	3	3
<b>RPM</b>	1725	1725	1725	870
<b>Power Factor</b>	0.72	0.82	0.80	-
<b>Service Factor</b>	1.15	1.15	1.15	Continuous Duty
<b>Full Load Efficiency</b>	78.5%	84.0%	85.5%	87.6%
<b>Motorboss Model #</b>	Integra MBI2.2	Integra MBI2.2	Integra MBI11	Integra MBI11

## Test Procedures

In each test case, the Motorboss motor controller was installed on the branch circuit between the motor's existing controls/starter and the motor unit. As shown in Figure 5 below, the data logging instrumentation was installed between the distribution panel circuit breaker and the existing motor controls/starter. Installation of the data logging instrumentation at this location in the branch circuit provides the means to capture the electrical parameters associated with the combination of motor and motor controls/starter with/without the Motorboss controller. Electrical savings measured at this point represent the savings that would be recorded by the utility's electric meter.

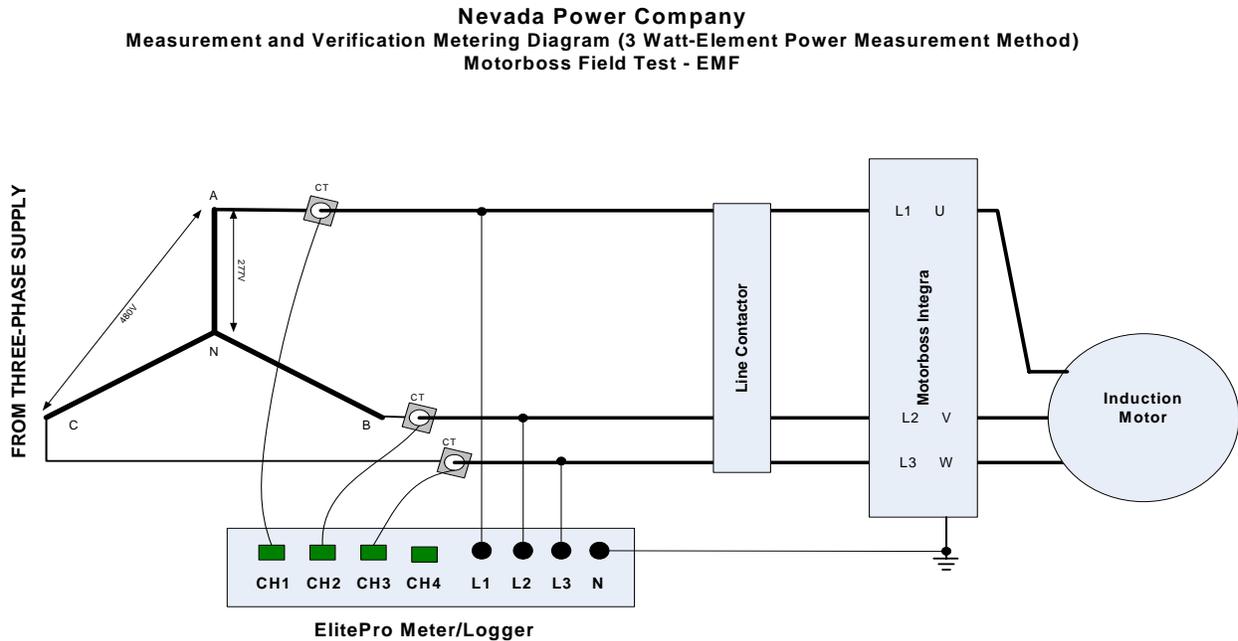


Figure 5. Electrical Connection Location of the Motorboss Controller and Elite Pro Datalogger.

The sequence and timelines for field tests and metering measurements were as follows:

a) 1.5 HP, 3 HP, and 5 HP Electric Motors (Levi Strauss Facility)

- Baseline Testing

*Test Duration and Data Collection Rate:* 24 hours at 2-minute intervals.

*Parameters Measured/Calculated:* Voltage, current, demand power (kW), complex power (kVA), and power factor.

*Conditions:* Motor is operating. The Motorboss motor controller is disconnected and is not present in electrical system.

*Objective:* Determine the baseline operating characteristics of the target motor.

- Performance Testing

*Test Duration and Data Collection Rate:* 24 hours at 2-minute intervals.

*Parameters Measured/Calculated:* Voltage, current, demand power (kW), complex power (kVA), and power factor.

*Conditions:* Motor is operating. The Motorboss motor controller is installed, enabled and operating in the motor branch circuit.

*Objective:* Determine the operating characteristics of the motor circuit with the Motorboss motor controller installed, enabled, and operating in the circuit.

b) 15 HP Electric Motor (McCarran Airport)

- Baseline Testing

*Test Duration and Data Collection Rate(1):* 45 minutes at 3-second intervals.

*Test Duration and Data Collection Rate(2):* 2 days at 2-minute intervals.

*Parameters Measured/Calculated:* Voltage, current, demand power (kW), and power factor.

*Conditions:* Motor is operating. The Motorboss motor controller is disconnected and is not present in electrical system.

*Objective:* Determine the baseline operating characteristics of the target motor.

*Additional:* In order to capture and identify repeatable loading conditions, time-stamped photographs were taken as needed throughout the testing period. Being able to isolate and identify repeated loading conditions enable a more detailed analysis of the collected data at specific load ranges.

- Performance Testing

*Test Duration and Data Collection Rate(1):* 45 minutes at 3-second intervals.

*Test Duration and Data Collection Rate(2):* 2 days at 2-minute intervals.

*Parameters Measured/Calculated:* Voltage, current, demand power (kW), and power factor.

*Conditions:* Motor is operating. The Motorboss motor controller is installed, enabled and operating in the motor branch circuit.

*Objective:* Determine the operating characteristics of the motor circuit with the Motorboss motor controller installed, enabled, and operating in the circuit.

*Additional:* In order to capture and identify repeatable loading conditions, time-stamped photographs were taken as needed throughout the testing period. Being able to isolate and identify repeated loading conditions enable a more detailed analysis of the collected data at specific load ranges.

NOTE: Because the McCarran Airport escalator can experience varying loading and unloading, this application required addition of a high-resolution test to accurately determine electrical performance of the Motorboss under rapidly varying conditions. The Levi Strauss conveyors are operated such that loading changes are more gradual, and can be captured with the 2-minute interval data collection setting.

### Test Instrumentation

Voltage, current, and power measurements were made using a Dent Instruments Elite PRO Recording Poly Phase Power Meter. This meter is a three-phase true-rms recording power meter, 12-bit A/D, with a sampling frequency of 7.68 kHz. Clip-on voltage leads were used to monitor

voltage in each phase of the three phase circuit. The current was monitored in each phase using split core current transformers from Dent Instruments. Current transformers rated at 5 amps were used for the 1.5 HP and 3 HP conveyer motors at the Levi Strauss site. Current transformers rated at 50 amps were used for the 5 HP conveyer motor at the Levi Strauss site and the 15 HP escalator motor at the McCarran Airport site. The instrumentation installation configurations are shown for the Levi Strauss 3 HP conveyer motor and McCarran Airport escalator motor in Figures 6 and 7 respectively.

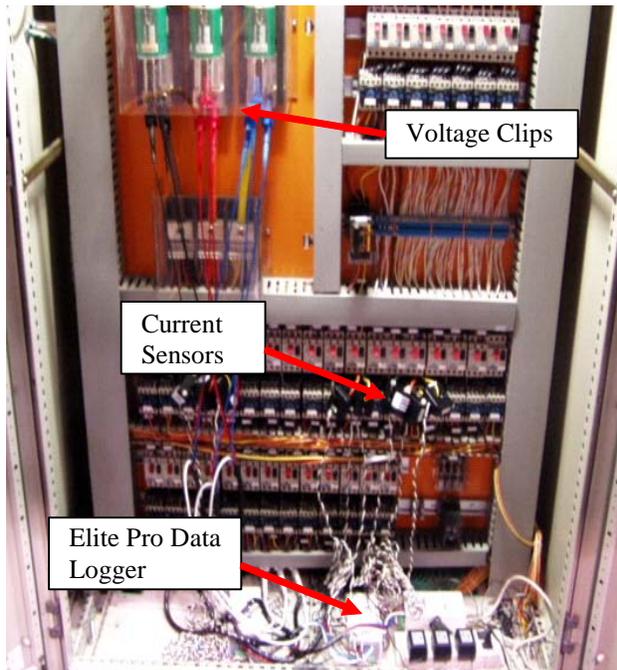


Figure 6. Instrumentation at Levi Strauss 3 HP Conveyor Motor Electrical Panel

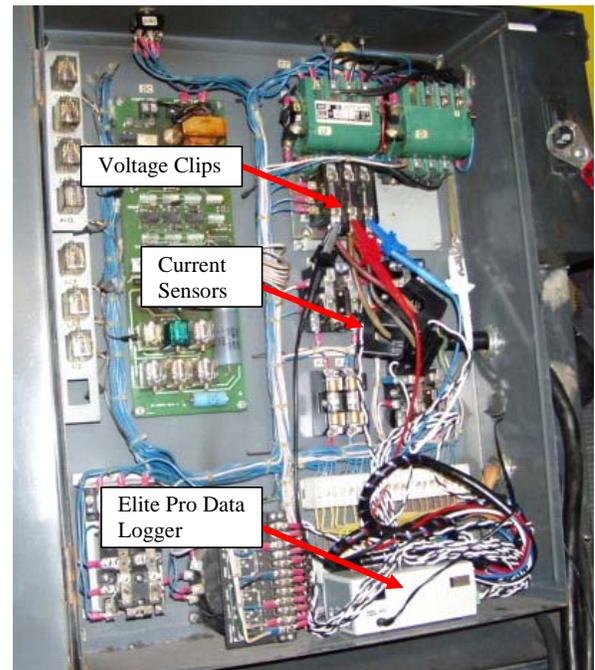


Figure 7. Instrumentation at Airport Escalator Motor Electrical Panel.

The installation of the instrumentation at the electrical panels was done by Paragon Consulting Services and site electricians.

### **Test Conditions**

The tests of the three conveyer motors at the Levi Strauss facility were conducted on February 10 - 11, 2005. During the first day of testing the motors were monitored during normal operation, with the Motorboss connected, from around 10:00 am until 11:00 pm on February 10 when the plant closed for the night. When the facility opened at 6:00 am on February 11, the three conveyer motors were monitored with the Motorboss disconnected until the end of the February 11 shift at 11:00 pm.

The test of the escalator motor at the airport was conducted in two phases. First the high resolution test data was done. This test consisted of monitoring the motor for a period of about 50 minutes with the Motorboss enabled, then disconnecting the Motorboss and monitoring for about 40 minutes. This test duration was limited to about 90 minutes total due to the memory capacity of the logger at the 3-second interval setting.

Then a 46 hour test at the 2-minute resolution setting was conducted at the escalator from 2:00 pm on February 14 to noon February 16. The Motorboss was disconnected during the first part of the test, and enabled at about 1:45 pm on February 15 for the duration of the test.

Mr. Ron Leighton, Regional Sales Manager for the Motorboss distributor, Electric Magnetic Force, was present at the tests and reviewed all Paragon data collection activities.

### 3. Discussion of Analysis and Results

The data collected from the field test was summarized and analyzed to determine the level of benefits obtained from the operation of the Motorboss motor controller with three conveyor motors and one escalator test motor. The primary benefits of interest to Nevada Power Company were the impacts on electrical demand, kW, and electrical energy savings, kWh. Other potential benefits to a user of the Motorboss, such as reduced motor operating temperature/increased motor life and soft start capability, were not analyzed in this analysis. These potential benefits may influence a user’s decision to install a motor controller, but do not impact electric utility operations.

#### Impact on Demand Reduction, kW

The reduction of motor losses and corresponding improvement efficiency should result in reduced electrical demand for the same level of motor output. Figure 8 shows the electrical demand of the 1.5 HP conveyer motor at the Levi Strauss site with the Motorboss operating, “On”, and not operating, “Off”.

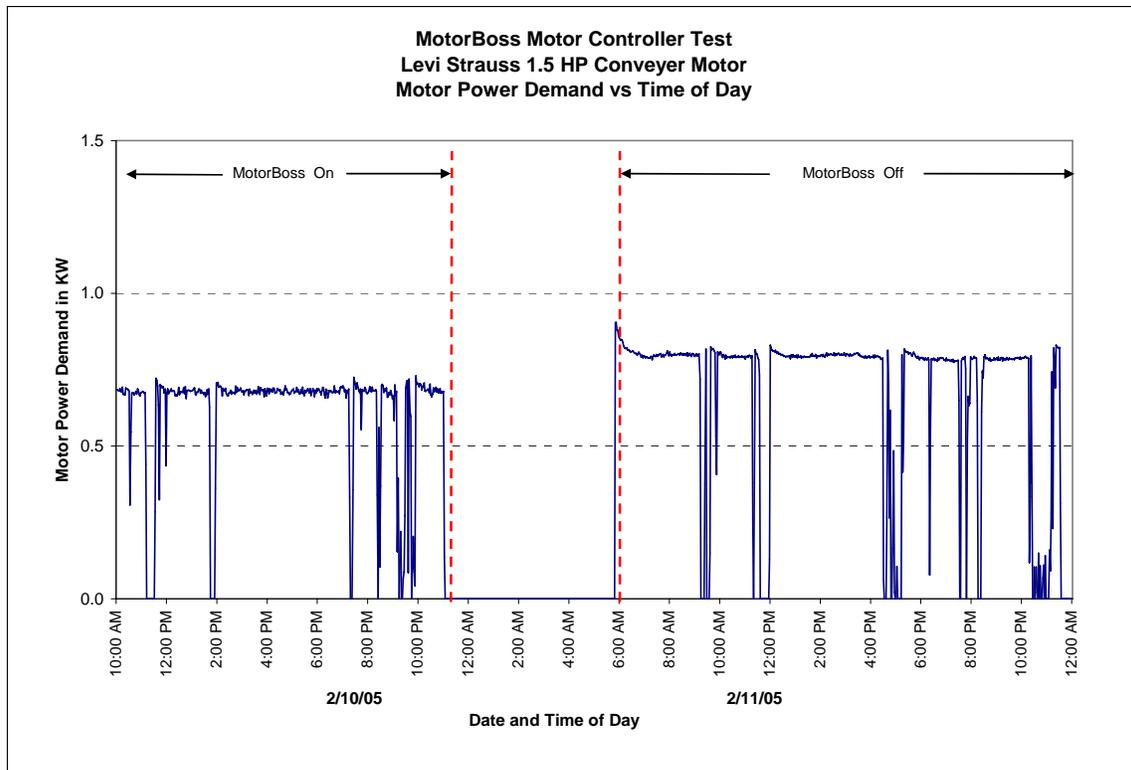


Figure 8. Motor Power vs. Time, 1.5 HP Conveyor: Motorboss “On” and Motorboss “Off” Periods.

In Figure 8, it can be seen that there were several periods in which the conveyor was briefly shut down as part of normal operational activity. These shut downs were ignored for the purposes of this analysis, and the comparison of the electrical demand included only the times the motor was operating. It was further assumed that the motor loading was similar from one day to the other during the time periods when the power was at a uniform level. Overall loading of the conveyor motor was around 50%.

The average kW demand over the five hour period 2:00-7:00 pm, February 10 was compared to the average kW over the two hour period 7:00-9:00 am and the three hour period 1:00-4:00 pm on February 11. These were periods of uniform loading and were assumed to represent similar operating conditions for the Motorboss “On” and Motorboss “Off” periods.

The average demand for the Motorboss “On” period was 0.6795 kW and for the Motorboss “Off” period was 0.7968 kW, a reduction of 0.117 kW or 14.3% when the Motorboss was operating.

Figure 9 shows the electrical demand of the 3 HP conveyer motor at the Levi Strauss site with the Motorboss operating, “On”, and not operating, “Off”.

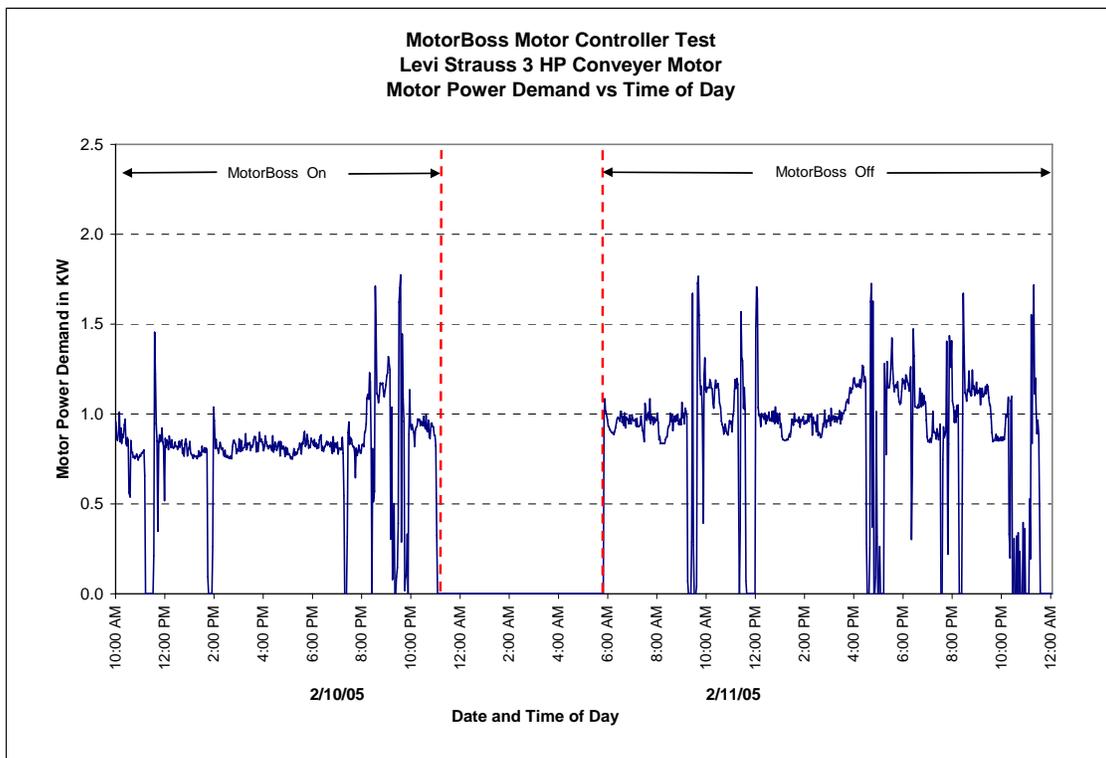


Figure 9. Motor Power vs. Time, 3 HP Conveyer: Motorboss “On” and Motorboss “Off” Periods.

Following the methodology used in analyzing the 1.5 HP conveyer results, the average kW demand over the four hour period 2:00-6:00 pm, February 10 was compared to the average kW over the three and one-half hour period 12:06-3:36 pm on February 11. These were periods of reasonably uniform loading and were assumed to represent similar operating conditions for the

Motorboss “On” and Motorboss “Off” periods. In this test there were several periods of increased power demand by the motors. However, it was not possible to determine whether the loads were equivalent or not, so these periods were not compared. Overall loading of the conveyor motor was around 40-45%.

The average demand for the Motorboss “On” period was 0.815 kW and for the Motorboss “Off” period was 0.955 kW, a reduction of 0.140 kW or 14.6% when the Motorboss was operating.

Figure 10 shows the electrical demand of the 5 HP conveyor motor at the Levi Strauss site with the Motorboss operating, “On”, and not operating, “Off”.

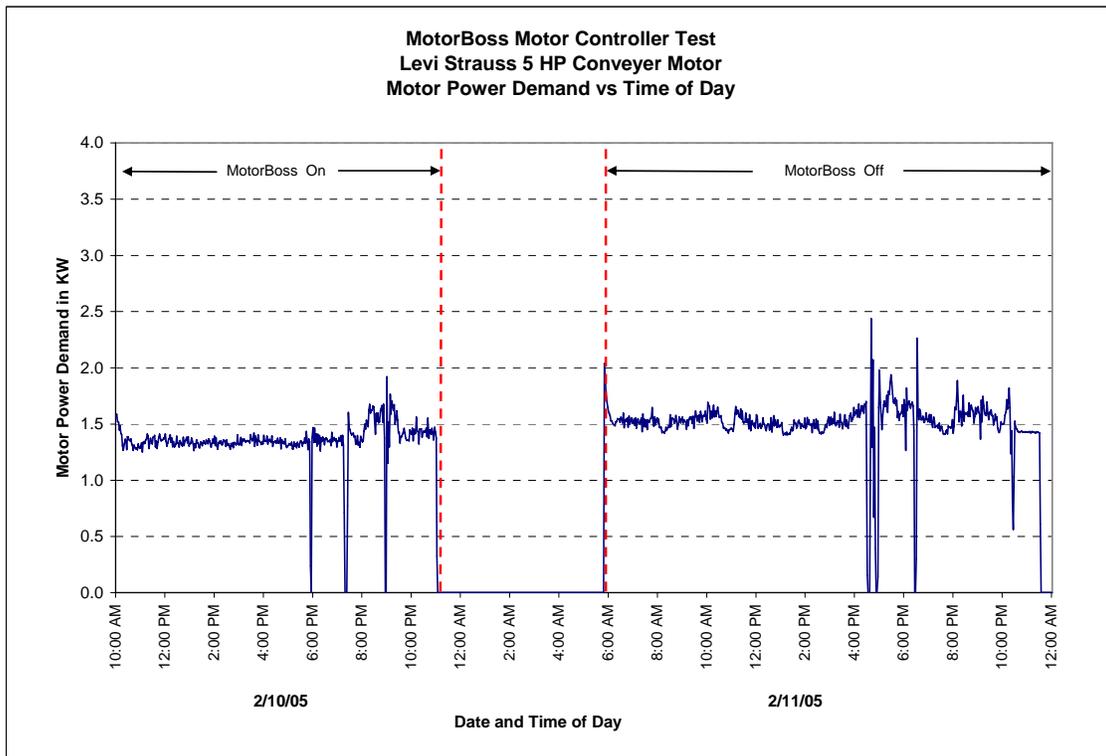


Figure 10. Motor Power vs. Time, 5 HP Conveyor: Motorboss “On” and Motorboss “Off” Periods.

Following the methodology used in analyzing the 1.5 HP and 3 HP conveyor results, the average kW demand over the five hour period 12:00-5:00 pm, February 10 was compared to the average kW over the eight hour period 7:00 am -3:00 pm on February 11. These were periods of reasonably uniform loading and were assumed to represent similar operating conditions for the Motorboss “On” and Motorboss “Off” periods. Overall loading of the conveyor motor was around 40%.

The average demand for the Motorboss “On” period was 1.338 kW and for the Motorboss “Off” period was 1.511 kW, a reduction of 0.173 kW or 11.5% when the Motorboss was operating.

Figure 11 shows the electrical demand of the 15 HP escalator motor at the McCarran Airport site with the Motorboss not operating, “Off”, and operating, “On”.

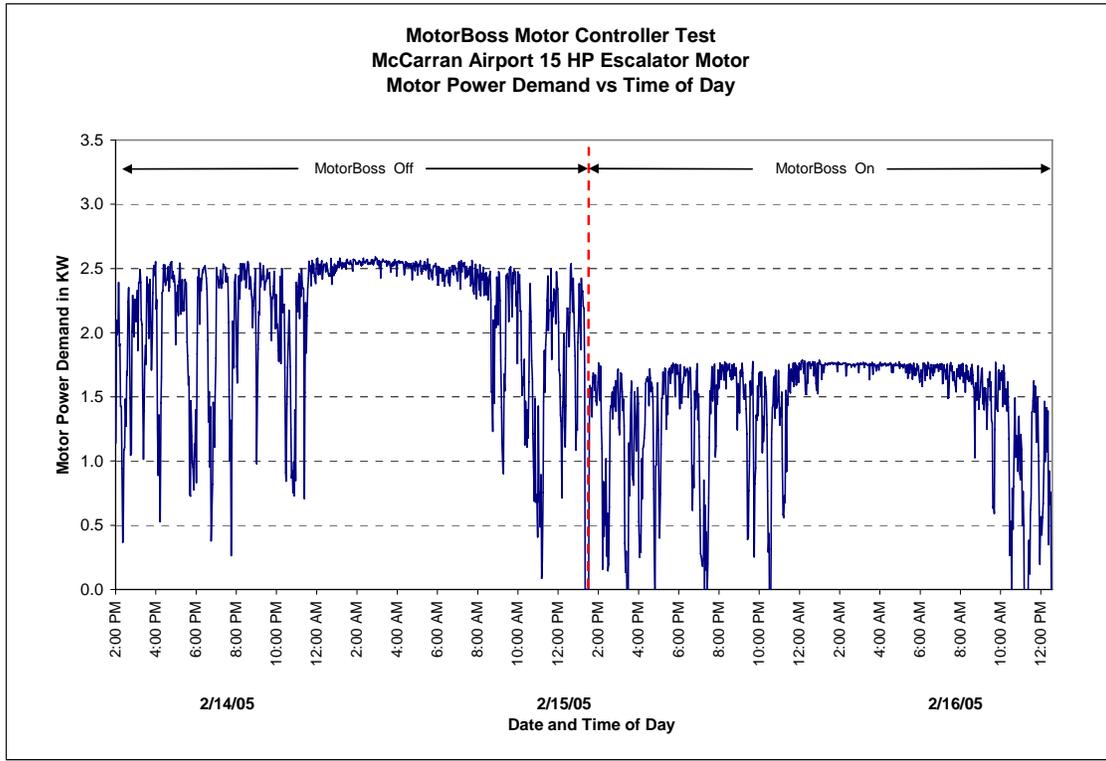


Figure 11. Motor Power vs. Time, 15 HP Escalator: Motorboss “Off” and Motorboss “On” Periods.

For an “up” escalator, an increase in traffic on the escalator would increase the load on the motor. This escalator is a “down” escalator and an increase of people using the escalator would tend to reduce the load on the motor. This is evident in Figure 11 which shows that there are various reductions in load during the day when the escalator is used. The peak demand occurs during the 1:00 am to 5:00 am period when there is little use of the escalator.

It was assumed that the motor loading was similar from one day to the other during the 1:00 am to 5:00 am time periods when the power was at a uniform level.

The averaged kW demand over the peak four hour period 1:00-5:00 am, February 15 was compared to the averaged kW over the peak four hour period 1:00 am -5:00 pm on February 16. These were periods of reasonably uniform loading and were assumed to represent similar operating conditions for the Motorboss “Off” and Motorboss “On” periods.

The peak demand for the Motorboss “Off” period was 2.54 kW, and for the Motorboss “On” period was 1.75 kW, a reduction of 0.79 kW or 31.2% when the Motorboss was operating during times of its peak electrical demand.

The average electrical kW demand over the full operating period is used to determine the electrical energy, kWh, use over the period. For this case the average demand for the Motorboss “Off”

period (2:00 pm, February 14 – 12:00 pm, February 15) was 2.17 kW and for the Motorboss “On” period (2:00 pm, February 15 - 12:00 pm, February 16) was 1.43 kW, a reduction of 0.74 kW or 34.2%.

The motor was lightly loaded, about 20%, when there was little use of the escalator, and even more lightly loaded when being used. A lightly loaded motor is generally considered to be a preferred application for a motor controller of this type.

A test was also conducted in which high resolution, 3-second interval, data was taken for a 110 minute period, 60 minutes with the Motorboss “On” and 50 minutes with the Motorboss “Off”. During this period the traffic on the escalator has highly variable, producing a very non-uniform loading. Even with time stamped photos it was not possible to make a meaningful comparison of the equivalent-load kW demand between the periods when the Motorboss is off and on. As a result, no conclusions were drawn from this data.

### **Impact on Energy Consumption, kWh**

The kW demand reduction resulting from the operation of the Motorboss was used to determine the energy consumption reduction of the motor. The average kW demand reduction multiplied by the number of hours in a period determines the energy consumption in kWh for that period. For the Levi Strauss conveyor motors, the reduction in peak kW determined from the test period was assumed to be representative of average kW reduction for the entire test period. This provides energy use reductions of 0.117, 0.140, and 0.173 kWh per hour for the 1.5 HP, 3 HP, and 5 HP motors respectively. In the case of 17 hour/day, five day/week operation (as was the case for the Levi Strauss motors), the annual energy savings would be 521 kWh, 621 kWh, and 769 kWh for the three motors.

This assumes that the demand reduction determined from the tests is representative of all other periods of operation. This also assumes that the number of hours of operation per week (17 hours/day and five days/week) is representative of the entire year.

Data taken by the Motorboss manufacturer representatives in July 2004 at the Levi Strauss facility indicated higher conveyor motor loads and somewhat higher demand reduction benefits. Levi Strauss reportedly operates its facility additional hours at times during the year on an as needed basis. Taking these factors into account would tend to increase the annual projected benefits by a corresponding amount. However, these factors could not be accurately quantified or independently verified, and only the February 2005 data collected by Paragon Consulting Services was used in this report.

For the McCarran Airport escalator motor, the reduction in peak kW determined from the test period (0.79 kW) was found to be slightly different from average kW reduction for the test period (0.74 kW). The average kW reduction (0.74 kW) was used to calculate the average kWh energy use reduction for the test period. This provides an average energy use reduction value of 0.74 kWh per hour for the escalator motor. In the case of 24 hour/day, seven day/week operation, the projected annual energy savings would be 6,515 kWh for the motor.

**Cost Effectiveness Overview**

An analysis was conducted to determine the cost savings resulting from installation of the Motorboss on the motors tested.

For the Levi Strauss motors, reductions in kWh and demand were valued based on its current Nevada Power Company Rate: LGS-3, primary distribution service. This rate is presented in the table below. Results show that the total savings would be \$43/year, \$52/year, and \$64/year for the 1.5 HP, 3 HP, and 5 HP motors respectively. Discussions with Electric Magnetic Force, the Motorboss distributor involved in these installations, indicated that the installed cost of the Motorboss controllers is \$400 each, which would indicate a payback of 9.3, 7.7, and 6.3 years respectively for the three motors. To the extent that Levi Strauss schedules overtime or weekend operations, these increased operating hours would increase savings and also reduce the payback period below the presented values.

For the McCarran Airport escalator motor, reductions in kWh and demand were valued based on its current Nevada Power Company Rate: LGS-3, secondary distribution service. This is presented in the table below. Results show that the total savings would be \$496/year for the 15 HP escalator motor. Based on information from Electric Magnetic Force, the installed cost of the Motorboss for the escalator motor is \$1500, which results in a payback of 3.0 years with the \$496/ year benefit.

<b>Applicable Nevada Power Company Electric Rates, Effective 06/01/04</b>			
	LGS-3, Primary Distr. Voltage	LGS-3, Secondary Distr. Voltage	
<b>ENERGY CHARGES</b>			Per kWh
<b>Summer</b>			<b>June 1-September 30</b>
Peak	\$0.09208	\$0.09897	1:00 pm-7:00 pm
Mid-Peak	\$0.07820	\$0.08377	10:00 am-1:00 pm & 7:00 pm-10:00 pm
Off-Peak	\$0.06161	\$0.06164	10:00 pm-10:00 am
<b>Winter</b>			<b>October 1-May 31</b>
All Periods	\$0.06162	\$0.06247	All Periods
<b>DEMAND CHARGES</b>			Per kW, based on maximum monthly 15-minute average kW reading
<b>Summer</b>			<b>June 1-September 30</b>
Peak	\$9.05	\$8.36	1:00 pm-7:00 pm
Mid-Peak	\$0.41	\$0.43	10:00 am-1:00 pm & 7:00 pm-10:00 pm
Off-Peak	\$0.00	\$0.00	10:00 pm-10:00 am
<b>Winter</b>			<b>October 1-May 31</b>
All Periods	\$0.50	\$0.50	All Periods
<b>FACILITIES CHARGE</b>			Per kW, based on maximum demand for billing period and previous 12 months
All Periods	\$2.50	\$2.94	All Periods Throughout Year
<b>CUSTOMER CHARGE</b>			Per meter, fixed monthly fee.
Per Meter	\$268	\$184	All Periods Throughout Year

If other potential Motorboss benefits, such as reduced motor temperature/increased motor life and the value of soft start capability were taken into account it would tend to reduce the payback periods for these Motorboss applications. These potential benefits may influence a user’s decision to install a motor controller, but do not impact electric utility operations. Evaluation of these potential benefits was not within the scope of this analysis.

**Tabulation of Results**

The test results discussed in the previous section are summarized in the following table.

	<b>Levi Strauss Facility</b>	<b>Levi Strauss Facility</b>	<b>Levi Strauss Facility</b>	<b>McCarran Airport</b>
<b>Motor Description</b>	Conveyor	Conveyor	Conveyor	Escalator, Down
<b>Rating(HP)</b>	1.5	3	5	15
<b>Motorboss Model #</b>	Integra MBI2.2	Integra MBI2.2	Integra MBI11	Integra MBI11
<b>Operating Schedule</b>	17 hr/d, 5 d/wk	17 hr/d, 5 d/wk	17 hr/d, 5 d/wk	24 hr/d, 7 d/wk
<b>Demand Reduction</b>				
Peak Demand Reduction in kW	0.117 kW	0.140 kW	0.173 kW	0.79 kW
Peak Demand Reduction in %	14.3%	14.6%	11.5%	31.2%
<b>Energy Use Reduction</b>				
Annual Energy Use Reduction in kWh	521 kWh	621 kWh	769 kWh	6,515 kWh
Annual Energy Use Reduction in %	14.3%	14.6%	11.5%	34.2%
<b>Cost Savings</b>				
Utility Electric Rate	LGS-3, Primary	LGS-3, Primary	LGS-3, Primary	LGS-3, Secondary
Annual Peak Demand Charge Savings	\$ 8	\$10	\$12	\$ 58
Annual Energy Savings	\$35	\$42	\$52	\$438
Total Annual Cost Savings	\$43	\$52	\$64	\$496
Payback Period	9.3 years	7.7 years	6.3 years	3.0 years

Motorboss manufacturer data taken in July 2004 for the McCarran Airport escalator was generally similar to the results presented in this report.

Manufacturer data recorded in July 2004 for the Levi Strauss 1.5 HP and 3 HP motors indicated somewhat higher conveyer motor loads and higher benefits (by approximately 5-10 percentage points). The Motorboss manufacturer’s representative indicated that the Levi Strauss conveyer loading is typically higher in July than in February and could account for the difference. This could not be independently verified and only the February 2005 data collected by Paragon was used in this report.

## 6. Conclusions

- Peak kW demand reductions of 0.117-0.173 kW (11.5-14.6%) were achieved at the three Levi Strauss conveyor motors due to Motorboss operation.
- A peak demand reduction of 0.79 kW (31.2%) was achieved at the McCarran Airport 15 HP escalator motor due to Motorboss operation.
- Annual energy savings of 521-769 kWh/year (11.5-14.6%) were projected for the three Levi Strauss conveyor motors due to Motorboss operation.
- An annual energy saving of 6,515 kWh/year (34.2%) was projected for the McCarran Airport 15 HP escalator motor due to Motorboss operation.
- Cost savings from utility billing reductions were projected to range from \$43 for the 1.5 HP Levi Strauss conveyor motor to \$64/year for the 5 HP motor, based on the current Nevada Power Company electric rate. Assuming an installed cost of \$400 for each of the Motorboss units, the payback periods would range from 6.3 to 9.3 years. If Levi Strauss increases facility operation beyond 17 hours/day, five days/week, the payback periods may be reduced.
- Even though energy savings on a percentage basis may be significant for smaller motors, the energy cost saving is relatively small.
- Cost savings from utility billing reductions were projected to be about \$496/year for the McCarran Airport 15 HP escalator motor, based on the current Nevada Power Company electric rate and continued 24 hour/day, seven day/week operation. Assuming an installed cost of \$1500 for the Motorboss, the payback period would be 3.0 years.
- A lightly loaded motor is generally considered to be a preferred application for a motor controller of this type. Typical motor loadings were less than 50% for the conveyor motors and less than 20% for the escalator motor. The payback period was shorter for the escalator motor, which was more lightly loaded and was operated a greater percentage of the time than the conveyor motors.
- A motor controller reduces the motor's operating electrical current and associated conductor losses. This in turn reduces motor operating temperatures which may extend motor life. A motor controller also provides a soft start capability which reduces mechanical stresses on the motor and associated machinery. These benefits may influence a user's decision to install a motor controller, but do not impact electric utility operations and were not addressed in this report. If included, these additional benefits would tend to reduce the payback period.

## **Appendix A**

### **Manufacturer Specifications For Field Test Motors Equipped with Motorboss Controllers**

- 1. Baldor Motor, 1.5 HP, Conveyor, Attached**
- 2. Baldor Motor, 3 HP, Conveyor, Attached**
- 3. Baldor Motor, 5 HP, Conveyor, Attached**
- 4. Imperial Motor, 15 HP, Escalator, Tabulation Not Available**



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## Specifications: VM3554T

Catalog Number:	VM3554T
Specification Number:	35A03W206
Horsepower:	1 1/2
Voltage:	208-230/460
Hertz:	60
Phase:	3
Full Load Amps:	5.3-5/2.5
Usable at 208 Volts:	5.3
RPM:	1725
Frame Size:	145TC
Service Factor:	1.15
Rating:	40C AMB-CONT
Locked Rotor Code:	K
NEMA Design Code:	B
Insulation Class:	B
Full Load Efficiency:	78.5
Power Factor:	72
Enclosure:	TEFC
Baldor Type:	3520M
DE Bearing:	6205
ODE Bearing:	6203
Electrical Specification Number:	35WGW206
Mechanical Specification Number:	35A003
Base:	N
Mounting:	F1

\* For certified information, contact your local [Baldor office](#).



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## Specifications: VM3611T

Catalog Number:	VM3611T
Specification Number:	35L114Y334
Horsepower:	3
Voltage:	208-230/460
Hertz:	60
Phase:	3
Full Load Amps:	8.5-8.2/4.1
Usable at 208 Volts:	8.5
RPM:	1725
Frame Size:	182TC
Service Factor:	1.15
Rating:	40C AMB-CONT
Locked Rotor Code:	K
NEMA Design Code:	B
Insulation Class:	F
Full Load Efficiency:	84
Power Factor:	82
Enclosure:	TEFC
Baldor Type:	3535M
DE Bearing:	6206
ODE Bearing:	6203
Electrical Specification Number:	35WGY334
Mechanical Specification Number:	35L114
Base:	N
Mounting:	F1

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## Specifications: VM3615T

Catalog Number:	VM3615T
Specification Number:	36A03W415
Horsepower:	5
Voltage:	208-230/460
Hertz:	60
Phase:	3
Full Load Amps:	15-13.2/6.6
Usable at 208 Volts:	15
RPM:	1725
Frame Size:	184TC
Service Factor:	1.15
Rating:	40C AMB-CONT
Locked Rotor Code:	J
NEMA Design Code:	B
Insulation Class:	F
Full Load Efficiency:	85.5
Power Factor:	80
Enclosure:	TEFC
Baldor Type:	3634M
DE Bearing:	6206
ODE Bearing:	6205
Electrical Specification Number:	36WGW415
Mechanical Specification Number:	36A003
Base:	N
Mounting:	F1

\* For certified information, contact your local [Baldor office](#).