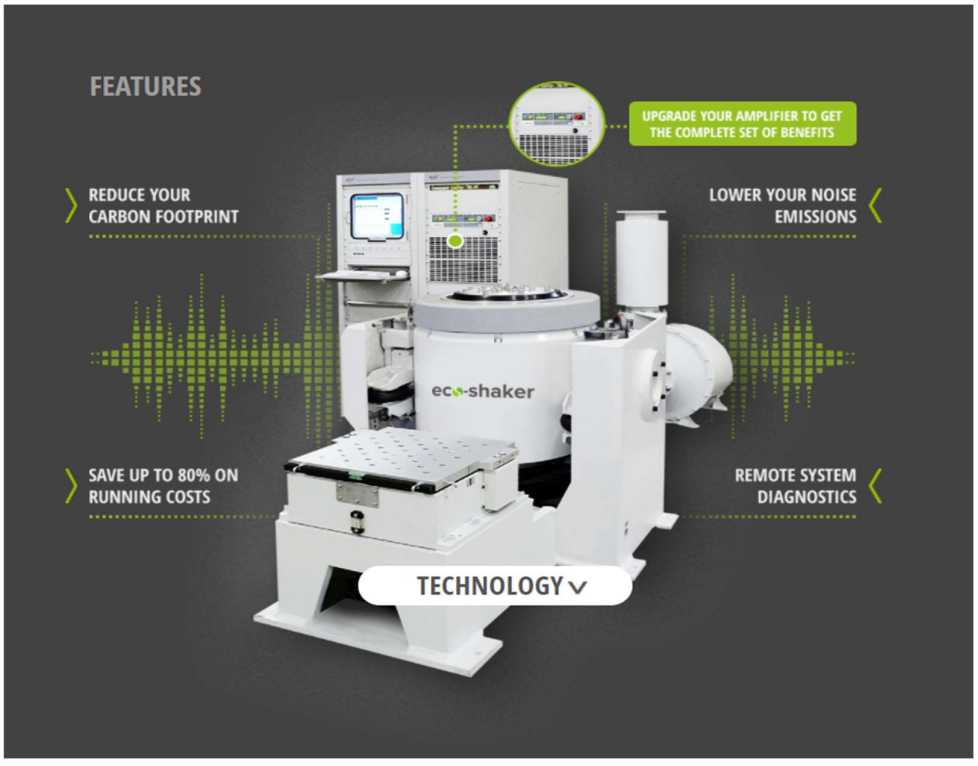

THE WORLD'S FIRST FULLY AUTOMATIC
ECO-VIBRATION TEST SYSTEM
FEATURES


FEATURES
UPGRADE YOUR AMPLIFIER TO GET THE COMPLETE SET OF BENEFITS
REDUCE YOUR CARBON FOOTPRINT
LOWER YOUR NOISE EMISSIONS
SAVE UP TO 80% ON RUNNING COSTS
REMOTE SYSTEM DIAGNOSTICS
eco-shaker
TECHNOLOGY

TECHNOLOGY

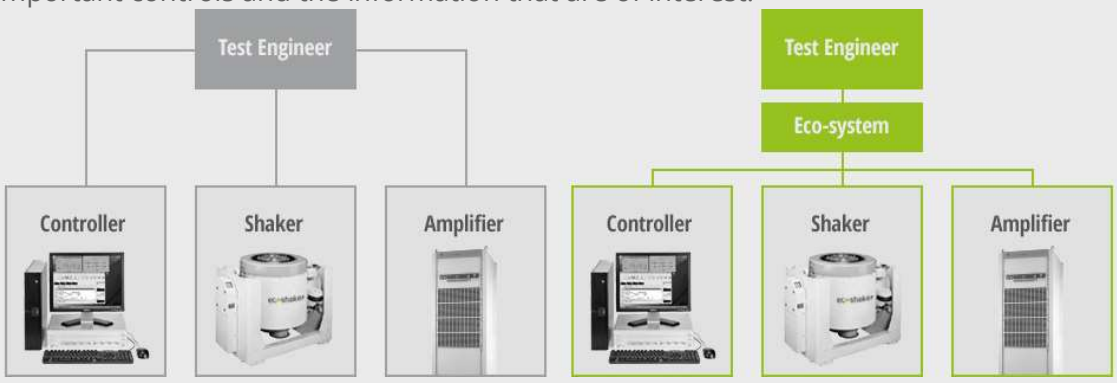
CONCEPT OF IMV'S UNIQUE ECO-SYSTEMS

- Up to 80% cost and energy saving
- Quiet operation
- High shock velocity
- Advanced service support
- Water-cooled shakers

Click here to read the ECO-Shaker paper

Click here to read 'The Future of Vibration Testing'

IMV has taken the approach to design the ECO-systems by putting the user at the centre of the system and following a whole system design approach. The user is presented with the important controls and the information that are of interest.



Behind the User Interface, the ECO-software runs the system and constantly checks the system health by monitoring all of the key operating parameters.

When using IMV's ECO-system, the user programmes the required vibration profile and once ready to start the test, the controller automatically starts the ECO-system and brings it to the ready state for testing. No need for the user to operate two systems.

On starting the ECO-system, the field is set to nominal power, to prepare for the upcoming test, but while waiting for the vibration test to start (with no armature power yet), the speed of the blower is already being controlled to save energy, since maximum cooling is not required at this stage.

As the test runs, the ECO-system constantly monitors the running parameters of the ECO-shaker and automatically adjusts the field power and blower speed to optimum levels required for the actual test. If the vibration test requires a low force rating, then the field power will be automatically reduced and with low field power and low armature power (low force test), the speed of the cooling fan will be reduced to save more energy.

If the force required for the vibration test increases, then the ECO-system automatically increases the field power and with increasing field power and armature power (higher force test) the speed of the cooling fan is automatically increased to achieve the optimum cooling air flow.

Running in the background, the ECO-system monitors up to 200 operating parameters to ensure the system is constantly operated safely and always using the minimum energy possible for the test. All sensors are health monitored and if a sensor is found to be out of range, the ECO-shaker is set to nominal operating conditions to allow the test to continue uninterrupted and an alert set for a check-up at the next service visit.

The Test Engineer has only interacted with the vibration controller and therefore it is possible to concentrate on the important information of the test, the test profile and response signals.

The ECO-system runs ***fully automatically*** in the background, saving energy and money.

IMV's ECO-technology is secured by international patents and IMV is the only manufacturer able to supply a fully automatic ECO-shaker.

HOW DOES THE IMV SYSTEM ADJUST THE FIELD POWER?

The IMV ECO-system controls the field current between 0% and 100%, using a power converter with a control switching frequency of over 20kHz. The result is that the field power is fully variable between a minimum value (0%) and the nominal value (100%) and due to the high switching frequency of the power converter, no ripple resulting from adjusting the field current can appear on the armature. The high switching frequency also allows the field current to change quickly from one operating point to another.

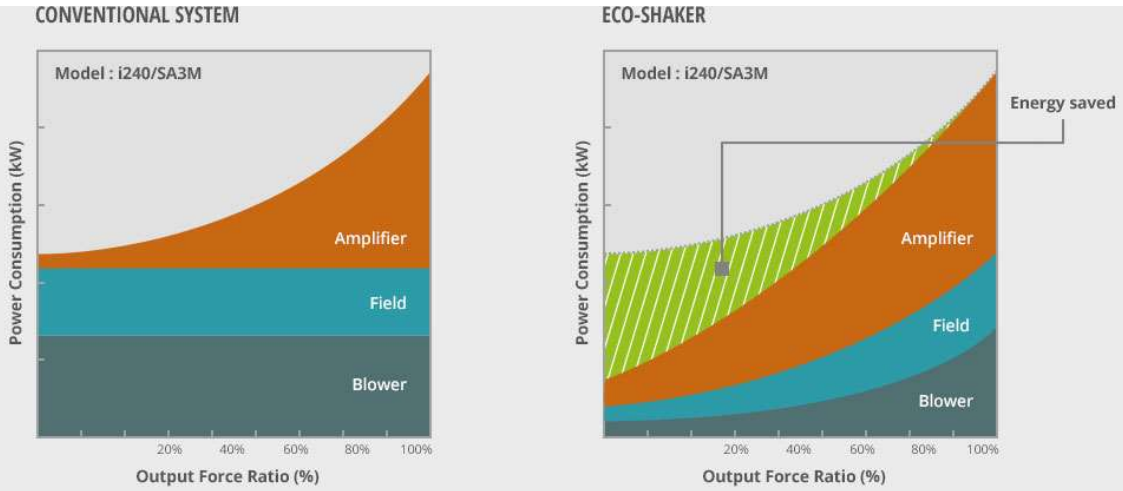
HOW DOES THE IMV SYSTEM ADJUST THE COOLING BLOWER SPEED?

The IMV ECO-system controls the blower speed between 5% and 100%, using a power converter with a control switching frequency of over 20kHz. The result is that the blower speed is fully variable between a minimum value (5%) and the nominal value (100%). The high switching frequency gives excellent control over the blower speed and also allows the blower speed to change quickly from one operating point to another.

HOW DOES IMV'S ECO SYSTEM SAVE ENERGY AND MONEY?

Conventional shaker systems set the field power and blower speed to the nominal settings as soon as the system is started. Only the armature power is varied according to the force required for the test.

IMV's ECO-shaker system constantly monitors the force required to operate the vibration test and by using the high frequency power converters discussed above, the ECO-system automatically adjusts the field power and cooling blower speed to run at the point of minimum energy consumption.



Energy saving can be significant. Some examples of running IMV's ECO-shakers are shown below. This is a real cost saving and keeping money in the bank account. These calculations are based on actual shaker performance parameters.

24kN	Average force ratio	25%		50%	
	Power saved in ECO mode (kW)	7.0		5.3	
	Yearly average working ratio	25%	70%	25%	70%
	Saving charges (€/year)	2,299	6,439	1,741	4,875
	20 year savings (€)	45,980	128,780	34,820	97,500
	CO_2 reduction (tonne/year)	8.1	22.5	6.1	17.1
54kN	Average force ratio	25%		50%	
	Power saved in ECO mode (kW)	28.1		22.8	
	Yearly average working ratio	25%	70%	25%	70%
	Saving charges (€/year)	10,140	28,392	8,239	23,069
	20 year savings (€)	202,800	567,840	164,780	461,380
	CO_2 reduction (tonne/year)	32.3	90.3	26.2	73.4

Note 1: Unit price of electricity: 0.15 €/kWh. CO_2 emission factor: 0.0000525 tonnes/kWh. Total hours during year: 8736 Hours.
Note 2: CO_2 emission factor published by DEFRA (UK Government) – Conversion factors 2011

20 year savings (€)
€567,840

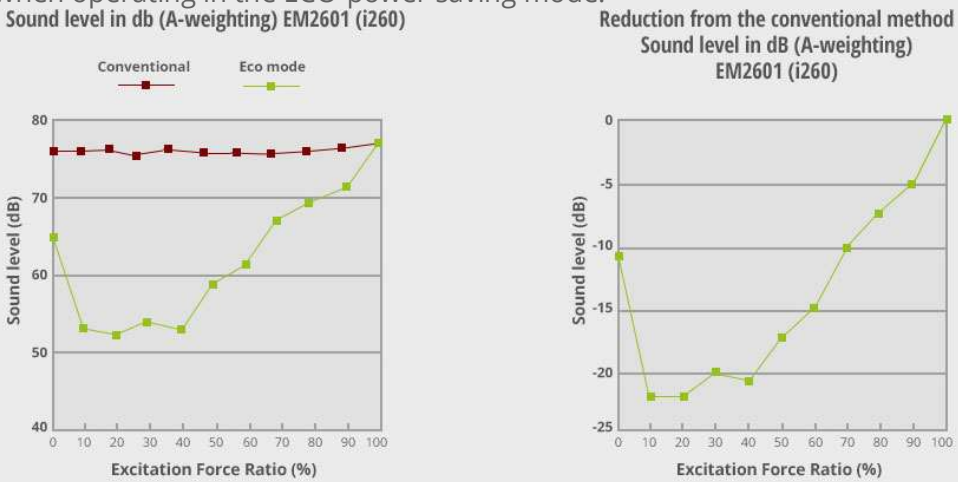
When saving energy, IMV's ECO-system is also saving CO_2, helping to reduce your Company's carbon foot print. the tables above show this CO_2 reduction.

The ability to maximise the energy saving and continuously operate the shaker in a completely safe region throughout all of the possible operating modes is based on years of research by IMV Corporation on detailed analysis of shaker system design and performance.

WHY IS IMV'S ECO SYSTEM SO QUIET?

In minimising the energy used by IMV's ECO-shaker to run any particular test, then the cooling requirement is also minimised. Not only does this save energy, but it also means that for most tests, the ECO-system is quiet. Air-cooled shaker systems are sometimes criticised for the level of blower noise, but IMV's ECO-system solves this problem. For low force tests, the cooling blower automatically runs at a reduced speed and the total system noise level is much

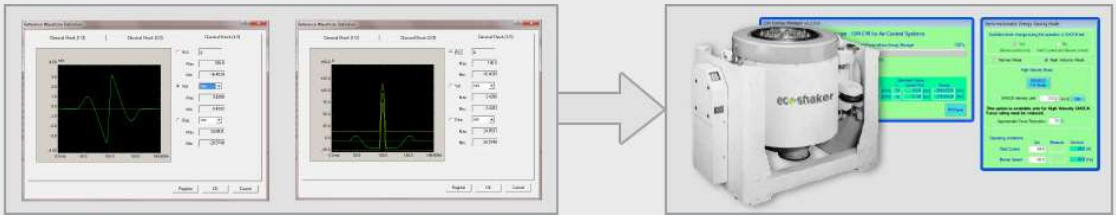
reduced. When the shaker is running at full force, the noise from the shaker table exceeds that of the blower and the blower noise is not an issue. Many of IMV's customers are buying the ECO-system for the noise reduction alone and the energy saving is an additional benefit!!
The figures below show the measured sound levels of IMV's i260 shaker (rated force 54kN) when operating in the ECO-power saving mode.



ADDITIONAL ADVANCED FEATURES – HIGH SHOCK VELOCITY

Click here to read 'Optimising Vibration Test Systems for Battery Testing using ECO Technology'
Where a test requires a high shock velocity, traditional shaker systems use a matching transformer to achieve the necessary higher armature voltage. This increases the system cost and means that modern armature positioning systems (dc control) will no longer work.
Since IMV's ECO-system has complete control over the field level, the field value can be adjusted to increase the maximum shock velocity capability of the system. This field weakening technique is well-known in electromechanical machines, but the automatic application in shaker systems is unique to IMV's ECO-shaker.
By entering the specified shock profile in to IMV's K2 controller, the field level in the shaker is automatically adjusted to ensure that the required velocity is achieved. Nothing for the user to do.

Profile entry into K2 ***Field level automatically set***



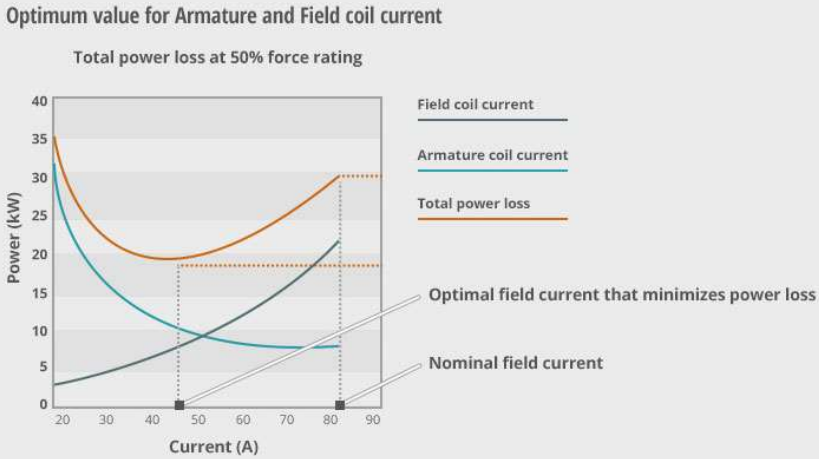
The figure below shows an example of the increased velocity capability of IMV's J260 shaker system.

	Standard System – J260	ECO-System – EM2605
Shock Force (kN)	108	154*
Velocity (m/s)	2.4	3.5*
Displacement (mm)	100	100
Sine/Random Force	54	54
Power required (kVA)	86	86

** These values are the maximum possible and must be traded one against the other depending on test specification*

CAN THE ECO TECHNOLOGY BE USED FOR WATER-COOLED SHAKERS?

As described above, the force produced by a shaker is proportional to the product of the field current and armature current. As the field current reduces, the armature current must increase to maintain the same force level. This means that there is an optimum operating point of minimum energy consumption in the system for any required force rating which can be achieved by correct balancing of the field current and armature current.This technique is equally applicable to water-cooled shakers and IMV offers its range of ECO –systems for both air-cooled and water-cooled shakers.



ADVANCED SERVICE SUPPORT – MAINTENANCE MANAGER

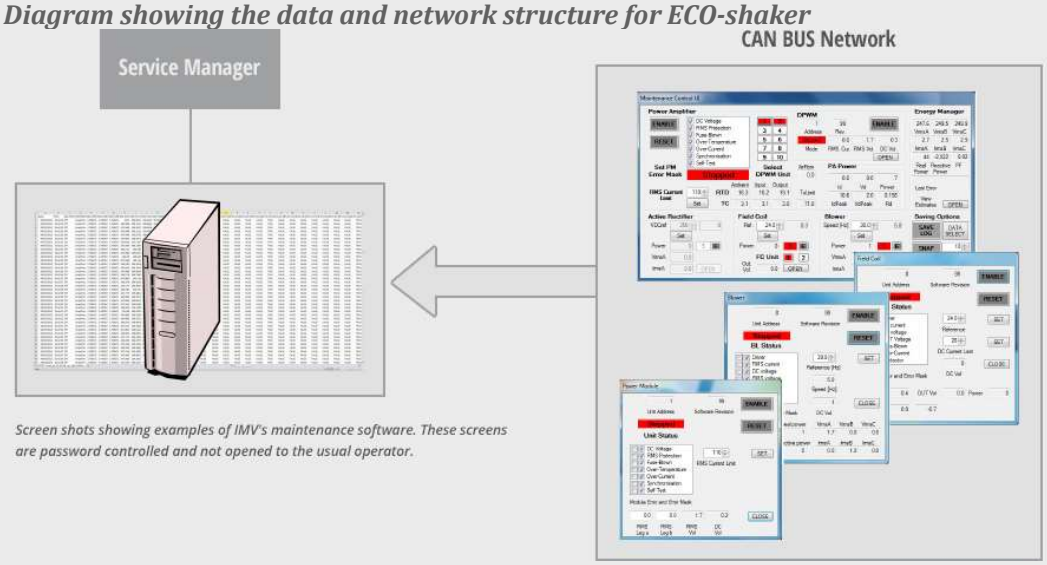
IMV's ECO-system monitors up to 200 parameters, including for example power module operating conditions, system temperatures, interlock status, controller status, 3-phase supply conditions and so on. By recording these parameters and saving them to a log file enables advanced diagnostics to be made on the system. Further, each time a system interlock occurs, a snapshot is taken of the system operating parameters both before and after the interlock occurred. All of this information means that IMV can remotely diagnose a system problem such that:

- The problem can be resolved remotely and the system is back up and running without the need for service engineer to visit

- If a Service visit is required, the engineer will bring the correct spare part and have the system running again in only one trip.

Everything is done to keep the ECO-system running for the maximum amount of time and maximise your return on investment.

Diagram showing the data and network structure for ECO-shaker



Screen shots showing examples of IMV's maintenance software. These screens are password controlled and not opened to the usual operator.

I PREFER MY EXISTING CONTROLLER, DO I NEED TO USE IMV'S K2 CONTROLLER?

IMV's advanced K2 controller has been proven in the most extreme control environments, from single axis, single-point control through to simultaneous multi-axis, multi-point control. The operation of the ECO-system using K2 is seamless and automatic. But the benefits of the ECO-system can be fully realised with any controller; same energy saving, same low noise operation, same advanced service support, same increase in system performance.

TRADITIONAL SYSTEMS

Shaker systems have always been designed as individual components; amplifier, shaker, cooling fan, controller.

When operating a conventional vibration test, the user programmes the required vibration profile and once the profile is entered, starts the amplifier, then runs the test from the controller. The shaker system and the controller are operated separately.

As the shaker system starts, the field power is set to the nominal (maximum) rating and the blower runs at the nominal speed (50Hz or 60Hz). Even without a test started, the shaker system is consuming significant power. As the vibration test starts, the armature power is increased to achieve the required force rating.

The force produced by a shaker is proportional to the product of the field current and armature current. As the field current reduces, the armature current must increase to maintain the same force level. This means that there is an optimum operating point of minimum energy consumption in the system for any required force rating which can be achieved by correct balancing of the field current and armature current. Minimising energy in a system is desirable both from the point of view of cost saving and also long-term reliability, less system energy means less system stress!

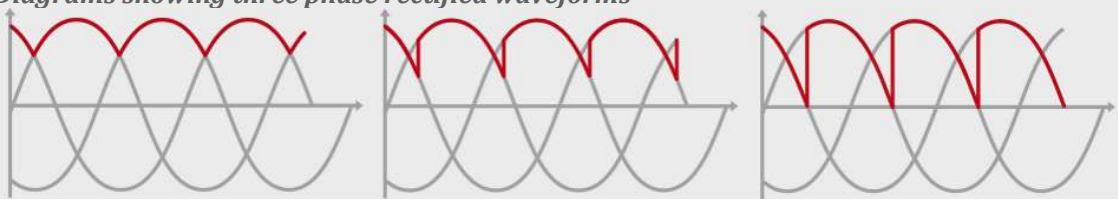
BUT OTHER SHAKER SYSTEMS HAVE AN ADJUSTABLE FIELD?

Shaker systems that have the ability to vary the field power have long been used in vibration testing, with a typical option to set the field current to a level of 70% of the nominal value. This field level must be pre-set before the test and therefore requires the operator to have prior knowledge about the required force rating (lower field current means lower available force). Further, what happens if the required force changes during the test?

The difficulty in knowing the required force throughout a test means that the field often can't be pre-set. Of course a pre-set level means that further energy savings could be missed if the actual test had a lower force requirement and therefore the possibility to set the field even lower.

These traditional methods to reduce the field current typically rely on a 3-phase controlled rectifier. As the field current is reduced, a 300Hz ripple appears on the field waveform and this will be reflected on to the armature. This limits this technique to a maximum reduction in the field current to around 70% of the nominal value and therefore limits any potential power saving.

Diagrams showing three phase rectified waveforms



AMPLIFIER UPGRADE

REPLACEMENT AMPLIFIERS

All of the benefits of IMV's ECO system can also be achieved by replacing the old system amplifier with an IMV ECO-amplifier, same energy saving, same low noise operation, same advanced service support, same increase in system performance.

As the vibration industry matures, there are many installed shaker systems around the world. Shakers are typically manufactured from custom parts and can be continuously maintained. Armature coils and field coils can be re-wound, suspension and guidance parts can be replaced and if well cared for, a shaker can continue to run for many years.

Conversely, amplifiers used for vibration systems are built from standard electronic parts and these parts are made obsolete by the electronics industry, typically after 10 to 15 years. It therefore becomes increasingly difficult to maintain and support an amplifier.

To preserve the investment in the well-running shaker and keep the system running, replacing the amplifier has been increasing in popularity. With IMV's ECO-amplifier technology, this replacement amplifier programme can bring exactly the same benefits of energy saving, low noise operation, improved service support, high shock velocity capability, and so on as experienced with IMV's ECO-systems.

ONE REPLACEMENT AMPLIFIER, SEVERAL SHAKERS

IMV's replacement ECO-amplifier can also be used with several shakers. Since the field and blower are completely controlled by the ECO amplifier, then a single ECO-amplifier can be adapted to a variety of shakers.

- Support for an upgrade programme; replace the oldest amplifier and run with the oldest shaker. At a later date, replace the old shaker with an new system and move the replacement ECO-amplifier to the next oldest shaker
- Two existing but different shakers for different applications. Install an ECO-amplifier and switch between two (or more) shakers, the field and blower are adjusted to suit the requirements of each shaker.