White Paper

Advances in Load Bank Control

ASCO Power Technologies®

Advances in Load Bank Control

In recent years, load bank control and instrumentation systems have evolved significantly. With the introduction of these advanced systems, instrumentation has become an integral part of the load bank providing precise data monitoring. Standard features now include multiple networked load bank control, load correction, transient speed instrumentation, real-time graphs, full data acquisition and reporting.

As power systems and load bank applications continue to develop, the use of modern load control has become essential. Major load bank manufacturers can provide the equipment and control to meet most sophisticated test requirements.

MANUAL SWITCH CONTROL

When load banks were first developed manual toggle switches were the primary control method due to their simple operation. However as power testing has advanced to be interfaced with modern generator sets, UPS systems, and power distribution applications; manual switches might limit certain stringent test criteria.

THE RISE of the MICROPROCESSOR ELECTRONIC CONTROL

Market leading microprocessor-based control systems are now available to improve load testing and provide a number of features developed to be in line with modern power systems. Many load banks have an embedded programming that provides the ability to utilize various control types to meet demands. Listed below are numerous features that have been specifically developed to improve load testing.

Remote Control

The option to control load banks remotely opens a number of load testing opportunities. Remote control allows the operator to be near the power source (supply-on-test) when load is changed. This is vital in ensuring proper and efficient load bank operation. Furthermore, remote control also reduces the amount of operators required, which results in decreasing costs and boosting efficiency. Load banks can often be controlled from up to 3,280 feet (1000 meters) away and still provide instant control, especially important in large facility load tests.

No Pre-Calculations

Many gen-set maintenance programs require load testing to percentages of name plate ratings. Digital load bank controls allow the operator to specify power source details with pre-detected voltage and frequency, from this all the percentage loads are calculated for the operator saving time and reducing error.

Instrumentation and Real Time Data

Clear and concise digital instrumentation is critical in load bank operation. Correct power, frequency and voltage displays ensure the power source is tested correctly. The operator needs to have the confidence the data displayed is accurate and can be easily downloaded for QC and specification compliance.

Synchronous Load Changes

Synchronous load changes ensure correct load is selected before it is applied. This provides a real-life simulation of a generators reaction to load changes. Older load banks without synchronous load changes allow the generator governor a small recovery time while the load is changed and doesn't provide accurate representation of real-life conditions.

Supply Ratings

To ensure operator safety and testing efficiency many load bank control systems allow supply ratings to be entered and modified. This can protect the power source from accidental power overload, incorrect Voltage and allows the operator to work in percentage of load without any pre-calculations (essential in complying with NFPA regulations and ISO8528 best practices). Entering supply details also reduces operator calculation time and the chance of potential errors. Reports can then be created to include the generator testing details.

Graphical Display

Customizable graphs within load bank control systems show selected voltages, power and frequency (Figure 1). The real time display provides the operator with a graph that shows the ups and downs, and voltage recovery times when load is changed. The operator can then pick out key events from the load test for comparisons and as a means of diagnosing potential issues with a power system.

Figure 1. Graphical displays are particularly useful in transient response load tests.

Automatic Testing

Load control provides a means of testing power automatically. Automatic testing has the advantage of allowing the exact same test parameters to be used repeatedly. Typically, generator manufacturers use automatic testing in test cells for quality control of a new gen-sets engines and verification of power. Operators can create customized heat run and transient test parameters prior to testing and reuse the same test criteria for every single power system and compare and contrast results.

Data Capture

Data capture provides a means of proving load test results for verification of new machinery and as part of maintenance program. If a generator or other power source fails during a load test, the exact moment it failed can be traced back to a specific time, date, voltage, frequency, and power. This will allow the operator to understand the reasons behind the failure and rectify with an adequate solution.

When data is captured there is a full back-up of how and when a power supply has been tested. The data can be catalogued and referred back to in the future to help build a picture of the health of a power system over its life. It also provides a useful understanding of how future systems may degrade and how to prevent it.

Photo courtesy of ASCO Power Technologies

Voltage Correction

Today, most test and commissioning engineers will often be working with different supply voltages and frequencies. One day they may need to apply 500kW at 400V, 50Hz and the next they may want the same load bank to apply 500kW at 480V, 60Hz. This requires the load control system to be able to correct for different supply voltages. One solution is to provide a manual voltage selection switch. However most, modern load bank control systems automatically adjust to differing supply voltage and frequency – making the load bank operation easier and ensuring the generator is loaded correctly. The other advantage to modern control systems is that the user no longer needs to perform manual calculations.

Load Correction

Market leading load controls use both closed loop load control along with stored load history to compensate for voltage changes and to ensure the correct load step is applied. When load is applied the control system will calculate loading using the instrumentation values instead of the rated values. This will compensate for any voltage droop or frequency variation by adjusting the load accordingly.

If the voltage droops on load application, it will be necessary for the control system to instruct the load bank to apply more capacity to achieve the requested load. As a safety feature, the load correction algorithm will not apply more than 10% extra load than that requested.

Testing to Pre-Determined Standards

Depending on the location and application of the load test, local rules and regulations will apply to ensure testing is done correctly. Many load bank control systems will allow testing to customized standards and best practices such as ISO8528 (G1, G2 and G3) and NFPA.

Networking

Modern load banks are capable of networking multiple units together. Networking load banks provides enhanced flexibility for load testing. In a network, the total utilizable capacity is increased. For example, by connecting eight 100kW load banks together in effect you now have 800kW unit. This is especially useful for applications on roofs or basements; the 100kW units will fit through doors and elevators where as a single 800kW unit may not.

Load banks are available in various types; resistive, inductive, capacitive, and combined. Network together an inductive and resistive load bank for lagging power factor testing or alternatively network capacitive and resistive units for a leading power factor test.

Networking smaller units together also provides fine load resolution on high capacity testing; many higher capacity load banks will have large load steps such as a 25kW or 50kW on a 1MW load bank. However by networking, the load resolution is taken from the smallest load bank, where finer load steps would be available.

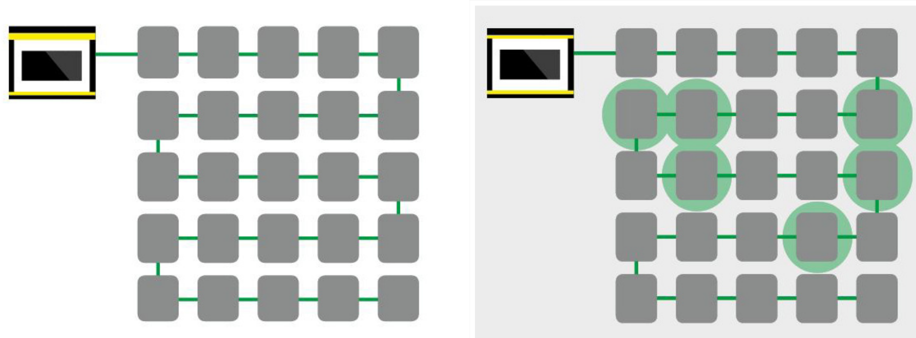

Figure 2. Left: A single remote control can connect many load banks together. Right: Load can be applied proportionally to all or specific load banks in a network.

Another benefit of networking is a single operator can control many load banks. Once set up, a remote control is able to control the load banks where previously the operator would require help to manually change each non-networked load bank when required. Furthermore, a networked load bank can provide redundancy if a problems occurs, saving the need for an operator to watch the load tests for long periods of time.

Recent developments in control now allow individual control of a specific load bank in a network. Previously load was applied proportionally to the load banks in the network, but now it can be specified to each load bank individually. The driving factor in this development has been the rise in use of load banks for data centres HVAC testing. Temperature “hot spots” with in the data center can be created by modifying the specific capacity of a load bank in the network. (Figure 2)

Variable Power Factor Testing

The majority of AC alternators today have a 100% data plate kVA rating at 0.8p.f. lagging, but in certain cases, (marine applications), 0.7p.f. is the norm.

Resistive and Reactive, (inductive or capacitive), load banks fitted with a modern microprocessor based control system, are capable of varying power factor testing, (lagging/leading respectively). Applying any combination, (from 0 to 1p.f.) of resistive and reactive load is possible within the capability of the load bank and or supply-under-test.

The majority of testing is carried out at either unity, (1.0) or 0.8 power factor, but in certain cases 0.7p.f. is the requirement as mentioned above. Finally, some test specifications call for short time 0.4p.f. testing, and having the varying power factor capability is essential for these types of testing.

ModBus Integration, Building Management Systems (BMS), SCADA

Many industrial facilities and factories utilize BMS control systems to allow communication via ModBus from a central control room to machines and systems. Generating sets, chillers, compressors, and HVAC systems are all able to be controlled via ModBus and modern load banks are no exception. Load banks can be seamlessly integrated into existing control systems. All standard control features are still available so operators can schedule automatic load tests, transient response tests, and create reports. This integration provides customized, automated, and repeatable testing all from a centralized location.

Site Load Correction

Gen-sets may run for long periods at less than 40% of the rated capacity. By running at reduced load, the engines do not reach optimal operating temperature to burn off excess carbon in the system, a process called ‘wet stacking’. Load banks can apply load to the gen-set to make it reach those higher operating temperatures. Site load correction directly facilitates the communication between a generator and the load bank and is able to apply load according to percentage load of a gen-set. Thresholds of when and how much load is applied can be configured by the operator.

CONTROL TYPES

Local Control

Control Type	Description	Features
Toggle Switches	Basic manual switch for applying and rejecting load locally.	Simple Load Control
Decade Switches	Basic switches similar to toggle switches but provides synchronous load changes.	Synchronous load changes.
Digital Toggle Switches	Toggle switches with the features of electrical control including synchronous load step changes and digital instrumentation.	Synchronous load changes, digital instrumentation.

Remote Control

Control Type	Description	Features
Hand-Held Remote Control (Figure 4)	Load control and instrumentation that can be viewed on a hand-held control.	No pre-calculations, synchronous load changes, digital instrumentation, graphical display, networking, voltage correction, variable power factor testing.
PC Software	Feature rich control for testing that requires detailed instrumentation and reporting.	No pre-calculations, synchronous load changes, digital instrumentation, graphical display, networking, voltage correction, data capture, automatic testing, testing to predetermined standards.
BMS Integration	Integrate the load banks into an existing BMS system through PLC.	No pre-calculations, synchronous load changes, digital instrumentation, graphical display, networking, voltage correction, data capture, automatic testing, testing to predetermined standards, customized test parameters.

Figure 4. An Intelligent Hand-Held Terminal (IHT) remote load bank control.

SUMMARY

Load bank control is continually evolving to provide users with a multitude of platforms, from simple manual toggle control to sophisticated software. Load banks now have options to satisfy most testing applications. The rise of new testing applications and environments means that load bank controls will continue to evolve exponentially.

ASCO Power Technologies | Avtron
6255 Halle Drive
Cleveland, OH 44125
Tel: 216.573.7600
LBsales@ascopower.com

ASCO Power Technologies | NJ Froment & Co. Ltd
Easton-on-the-Hill
Stamford, PE9 3NP
United Kingdom
Tel: +44 1780 480033
froment.sales@ascopower.com

loadbanks.ascopower.com

whitepapers.ascopower.com
customercare@ascopower.com

ASCO. Innovative Solutions.