Speedflo™ is a multi-channel feedback control system for high speed adjustment of a reactive gas during magnetron sputter processes.
Feedback control of reactive gas enables improved deposition rates, coating properties and process reliability, which is not possible to achieve with constant flow.

It is a well known and troublesome phenomenon that reactive sputtering processes are highly unstable. A magnetron target can very quickly switch from a metallic state into a fully poisoned condition. This change will make the process unworkable and results in large variations in the sputtering rate.

One solution would be to use the target in fully poisoned mode (i.e. reaction product all over the target). However the compounds on the target sputter at a much lower rate than a pure metal, hence it is usually not desirable. A better solution is to use a feedback control system that can very quickly adjust the reactive gas flow in response to the plasma conditions, in order to hold the process in high rate metallic or transition mode.

Reactive sputtering feedback control will lead to enhanced sputter rates, improved uniformity through the simultaneous control of multiple gas inputs, and better process monitoring.

Speedflo is an advanced form of this type of control system, offering all of the advantages detailed above as well as a range of other benefits that help you to perfect your reactive processes.
There are many benefits to using the Speedflo technology all of which contribute to a more complete solution from Genoa.

Control algorithm
Speedflo utilizes a proprietary advanced PDF+ control algorithm that is capable of extremely fast and accurate feedback control. In addition to the PDF+ algorithm the Speedflo controller features a digital variable structure control law that is able to maintain fast-acting and stable control, even when the MFC becomes fully open or closed. This enables feedback control that is high performance, robust and reliable.

Multiple control channels
The Speedflo controller has up to eight fully featured and independent control channels. This allows for simultaneous feedback control of eight MFCs, with options to combine various sensors and duplicate control channels. This powerful capability is especially useful for large target areas, where precise deposition uniformity must be achieved.

Auto-calibration and controller tuning
The time-consuming process of sensor calibration and controller tuning has been eliminated with Genoa’s latest Speedflo development. An automatic calibration and tuning procedure – unique to Speedflo – automatically detects the sensor levels corresponding to poisoned and fully metal states. The optimum controller parameters for the current sensor and process are then automatically calculated to ensure fast, accurate and robust feedback control.

Advanced user interface
A highly developed software interface includes many powerful functions to allow different methods of configuring the process control and combating difficult control situations. All of the software functions can be seamlessly incorporated into an existing PLC system.
Plasma Emission Monitoring (P.E.M)
The visual light from the plasma contains information of all the species present via the optical emission spectrum. To monitor the intensity of any element in the plasma, a narrow band-pass filter can be used to allow through only the wavelength of light of the material or gas of interest.

P.E.M CCD
The plasma light can be captured by a CCD-type spectrometer which provides a universal picture of the process. For control purposes, the wavelengths of interest are electronically filtered and input to the controller. This type of tool delivers more information, however the integration time of the spectrometer slows down the feedback speed compared to the conventional band-pass P.E.M method.

Remote P.E.M (Penning P.E.M)
Gencoa’s Penning P.E.M sensor enables remote monitoring of gas emission levels, and is ideal if substrate interference is problematic with conventional P.E.M sensors. A small plasma is generated remotely in the Penning gaugehead. A conventional P.E.M sensor can then be used to measure light intensity at a wavelength of interest. This represents the excess gas from the process.

Lambda
The Lambda sensor is an oxygen probe which provides a direct signal of the oxygen concentrations present in the vacuum. The Gencoa Lambda sensor provides a robust signal with good response speeds. Like P.E.M, it can provide information from multiple monitoring zones down the target length.

Target voltage
A convenient sensor from the process is the target voltage output from the magnetron power supply. This can be used for some material combinations as a stand-alone signal or in addition to a secondary signal such as P.E.M. Successful materials for this type of sensor are silicon and aluminum oxides and nitrides.

HIPIMS
Gencoa has developed sensor technology that enables the control of reactive HIPIMS processes for reproducible depositions and stable system performance.
Many of Gencoa’s key staff can boast a wealth of experience in the process and control environment. This is a key factor in our ability to develop products which are perfectly suited to the actual demands of the process.

Remote and on-site assistance
Gencoa can help customers optimize their processes remotely or on-site, and offer a complete reactive gas set-up and process control package – magnetrons, gas bars, controller and process know-how.

Speedflo Simulator
Gencoa's in-depth understanding of process control has resulted in the creation of a dynamic simulation of the Speedflo system. This tool replicates the Speedflo user interface, and simulates the effect of Speedflo features such as controller gains and calibration parameters as well as system characteristics such as gas delivery pipe length.

The simulator is a highly effective tool which can aid the system user’s understanding of feedback control, as well as the operation of the Speedflo system.

Speedflo auto-tune
Achieving high performance control of your system is a quick and easy process using Speedflo. A proprietary, state-of-the-art automatic controller tuning procedure provides optimum controller parameters for your process at the click of a button. The auto-tuning procedure is fast and effective – and works within any system or sensor configuration.

After performing an integrated system calibration and identification procedure, the auto-tuner instantly generates the optimum controller parameters for your process by using advanced inverse dynamics algorithms to analyze the collected data.

The whole procedure takes a couple of minutes and, thanks to Gencoa’s unique combination of process and control expertise, is perfectly suited to the demands of real processes.
3-Zone Process Control with 3 P.E.M Sensors
Typical configuration for a medium (0.75m – 2m) target length

5-Zone Process Control with 3 P.E.M Sensors
Typical configuration for a large (>1.5m) target length

Typical control methods
Trimming gas bars on outside (typical rotatable configuration)

Trimming gas bars in centre (typical planar configuration)

Slaved
Master (sensor feedback controlled)
Constant Flow
Magnet bars
Genco manufacture a wide range of magnetic arrays and associated active anodes that can be used to enhance many rotatable based reactive and non-reactive sputtering process. The different magnetic designs improve the target use and uniformity, but also provide significant tools to optimize the plasma environment to improve productivity or layer properties. The energy product of each individual magnet is measured to assess suitability and the field uniformity of the complete magnetic assembly is mapped for quality control purposes.

Gas bars
Gas distribution is a critical area for any reactive process as it will determine the speed of reactive gas control and coating uniformity. Genco dual chamber gas bars ensure a highly uniform delivery of gas with a fast gas response speed. This is combined with the ability to separate the different gas zones for uniformity tuning over large areas.

Active anodes
For plasma stability and to eliminate long term drift with reactive processes performed with rotatable magnetrons, Genco have developed an anode design that combines magnetic and electrical guiding of the plasma electrons. These active anodes serve to open up different power modes and greatly help to control the uniformity and plasma density over the substrate surface.

Rotatable magnetrons
Genco offer two types of rotatable magnetron depending upon the space available within the process machine and the process requirements. The Genco GRS75 magnetron accommodates targets ranging from 75 to 100mm OD. The SCI based end-block range accommodate targets of 152mm and greater. Both types are particularly suitable for reactive processes due to the self-cleaning of reaction product from the target surface.

Planar magnetrons
Genco offer rectangular magnetrons in the widest range available on the market for both internal and external mounting, with an unrivalled range of magnetic and mechanical options available to offer the optimum solution for your specific processing needs. Built-in gas distribution within the anodes provides uniform and fast gas responses for reactive deposition.

Ion sources
Linear ion sources provide a robust and flexible means of pre-cleaning polymer and glass substrates prior to thin film deposition. Genco Linear ion sources are powered by the IM3000 power supply and gas control module, which houses a Speedflo controller.