Parallel Position with O2 Trim
Combustion Control Systems (CCS)

Introduction
Combustion control is a critical function for all utility, industrial and institutional customers for the following reasons:

- Safety of operating personnel is paramount
- Reliability of utility operations is essential
- Energy usage is a major cost of operation
- Value of boiler equipment must be protected.

To safely, reliably and efficiently operate package boilers, the engineers at MicroMod have developed and supplied automatic combustion control systems for many years. This Application Data Sheet discusses control strategy as applied to automatic combustion control systems for parallel position, single burner, dual fuel boilers.

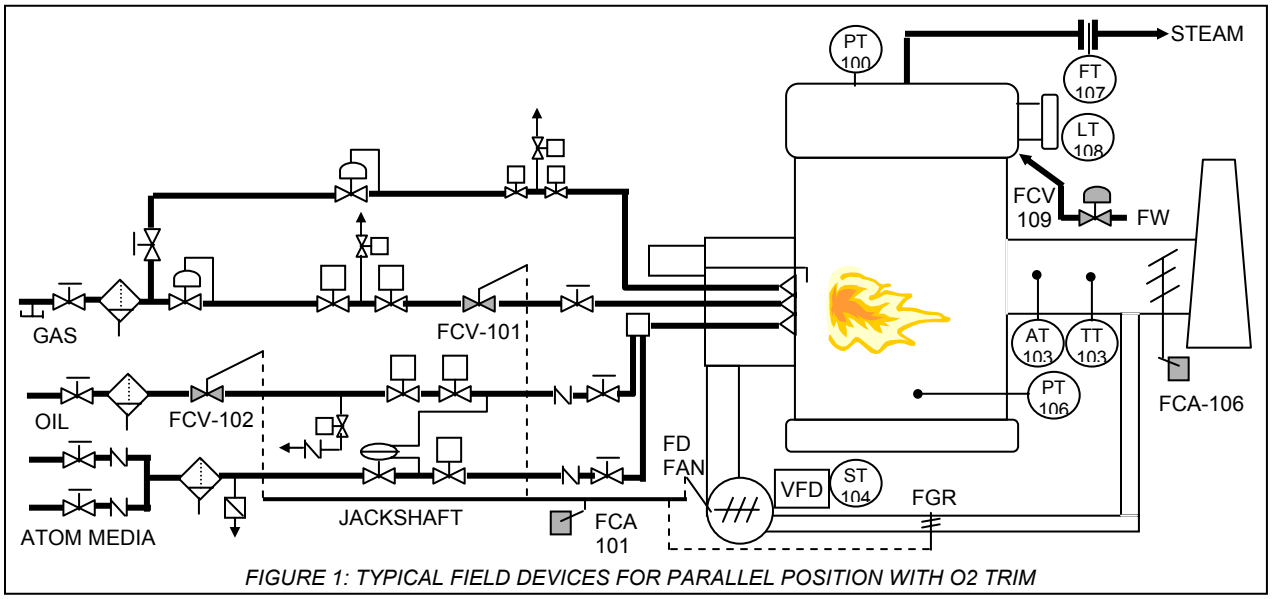

FIGURE 1: TYPICAL FIELD DEVICES FOR PARALLEL POSITION WITH O2 TRIM

APPLICATION DESCRIPTION
The automatic combustion control field hardware for a typical single burner, dual fuel package boiler is shown in Figure 1. The control system shown is a parallel position system. In a traditional parallel position system, there are two actuators: one for the fuel and one for the air. They are adjusted simultaneously by the same controller output, based on demand. Measurement of excess oxygen is provided for automatic fuel/air ratio trim. Flue gas recirculation is shown for low NOx burners. This is a safer and more efficient method for boiler control than jackshaft control alone.

When upgrading from a jackshaft system the traditional method is to break the jackshaft and install a second actuator for the air. However a more energy-efficient and less labor intensive method of installing parallel positioning control is to leave the jackshaft intact, and install a Variable Frequency Drive (VFD) on the motor of the FD (Forced Draft) fan. The fuel and air are still adjusted in parallel but the fan speed can be modulated to provide more or less air at the same damper position. This strategy is the one represented in Figure 1.

CONTROL STRATEGY
The control diagram for this combustion control strategy is shown in figure 2. The boiler is controlled as follows:

Boiler Master
The boiler master controller receives the steam pressure signal from the steam pressure transmitter and compares it to the operator-entered setpoint. The controller modulates its output in order to eliminate any difference between the signal and the setpoint. The output of the controller represents the boiler demand for steam, and modulates the fuel and air by means of the jackshaft. This technique is identical to jackshaft control only. The operator may adjust the setpoint in automatic or place the controller in manual to fire the boiler manually. The controller rejects to Manual on bad signal quality. A high/low pressure alarm is shown. A logic interface to the BMS (Burner Management System) is provided where a contact closure will position the fuel / air actuator to a pre-programmed purge, or light off position.

Excess O2 Trim
The means of trimming, or fine-tuning, the excess O2 is provided by adding a variable frequency drive to the FD fan. The jackshaft arrangement is set up by normal combustion testing of the boiler with the VFD at a constant 80% or less. This allows a control range for the O2 controller to vary the amount of airflow at the same damper position by changing the fan speed.

The excess O2 leaving the boiler is measured by an O2 analyzer and compared to setpoint by the O2 master. Load-programmed setpoints for oil and gas are provided by function generators, for the fuel selected. The O2 controller output will modify the demand for airflow by multiplying the position signal from the boiler master with a correction factor, before positioning the VFD, to eliminate any error in the auto mode. This modification is limited to +/-5% for safety. The operator may bias the setpoints in auto to compensate for variations such as fuel BTU content or ambient air temperature/pressur, or provide a manual correction in manual mode. The control rejects to Manual on bad signal quality. When the air flow is not in Automatic mode, the controller goes into track and does not make any correction. A logic interface to the BMS is provided where a contact closure will position the VFD to a pre-programmed purge, or light off position.

O2 Safety Limits
Operational safety is greatly improved during automatic control by VFD position testing. This technique utilizes a feedback signal from the VFD, which is compared to the controller output signal to the VFD. If these signals have a difference which exceeds a pre-set dead-band, the controller is set to manual and an alarm is provided to the BMS system by contact closure. This contact may be used as a running interlock by the BMS safety system. The signal has a time delay to account for drive stroke time.

FGR Control (If required)
The FGR damper on a low NOx burner is controlled by the jackshaft in the normal manner.

On Line Boiler Efficiency
The addition of flue gas temperature allows the on line calculation of boiler efficiency by the Heat Loss method.

Other Loops

Note that Furnace Pressure control and Drum Level control are shown for completeness. See individual Application Data Sheets for details on these loops.

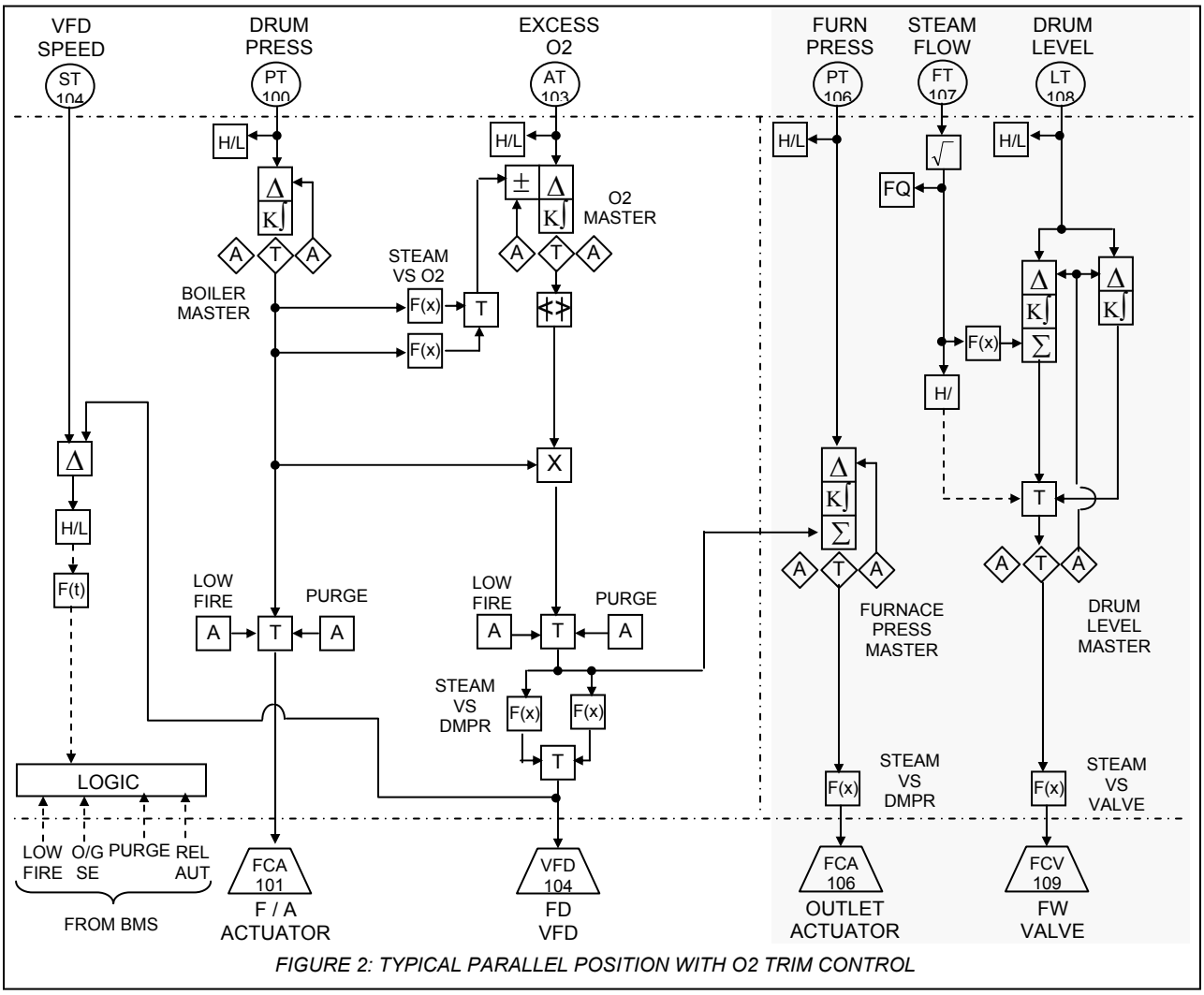

FIGURE 2: TYPICAL PARALLEL POSITION WITH O2 TRIM CONTROL