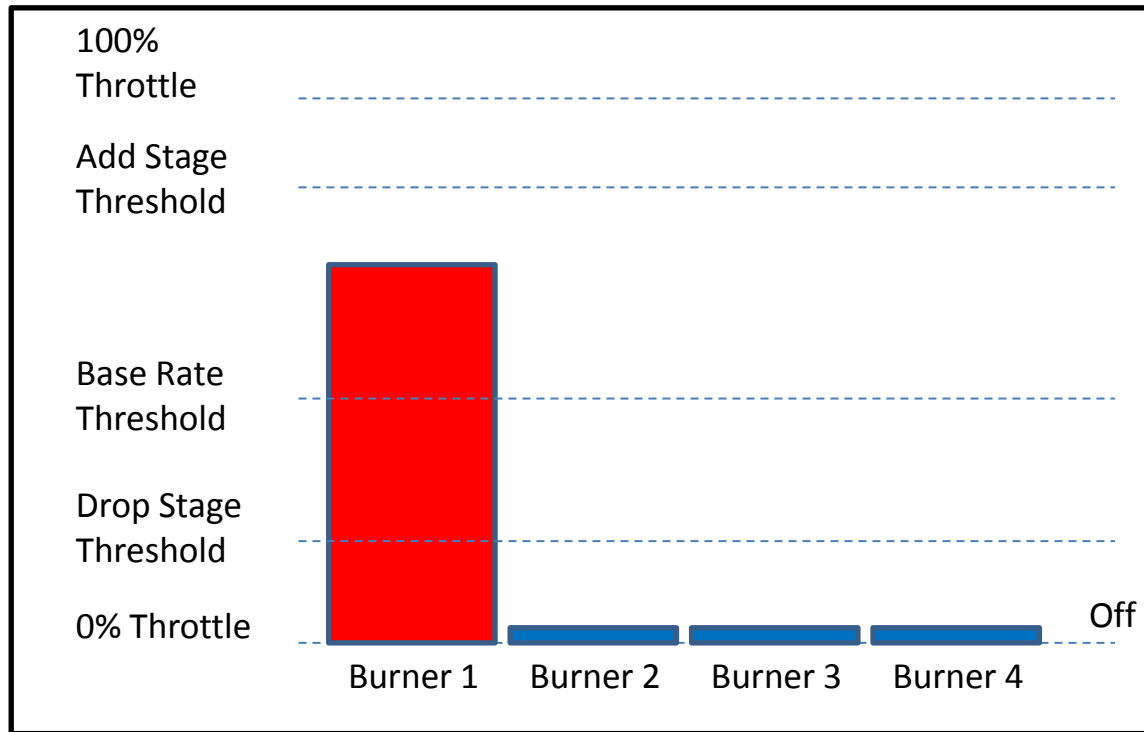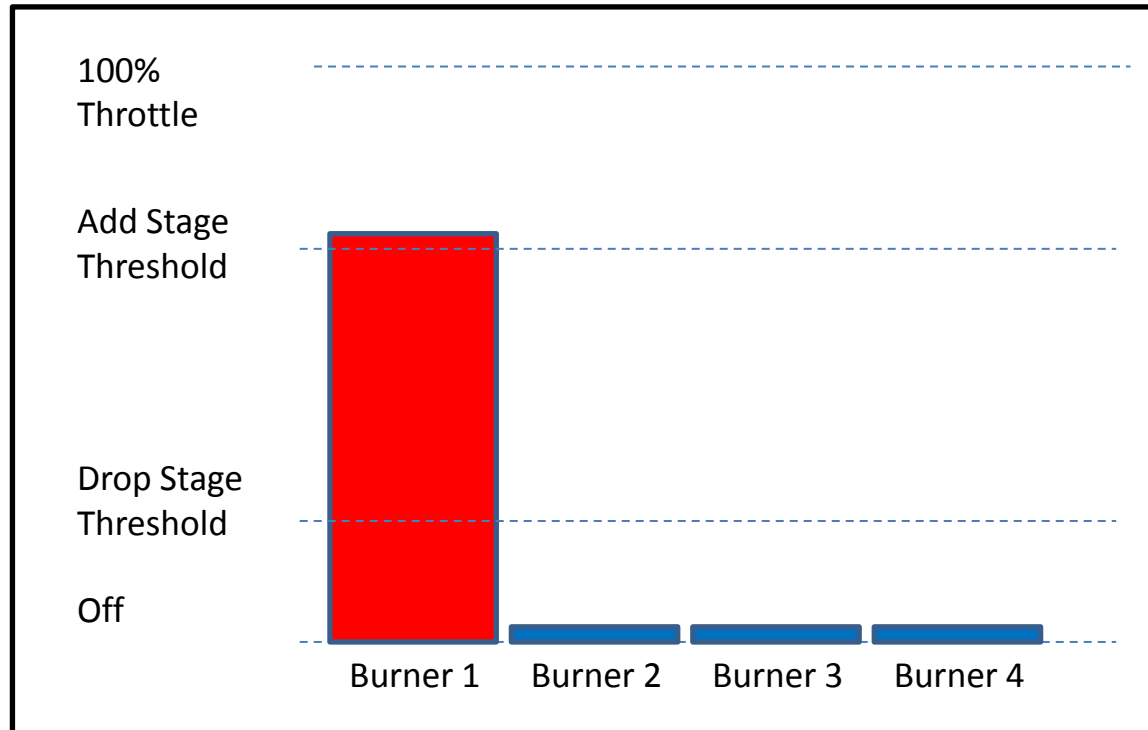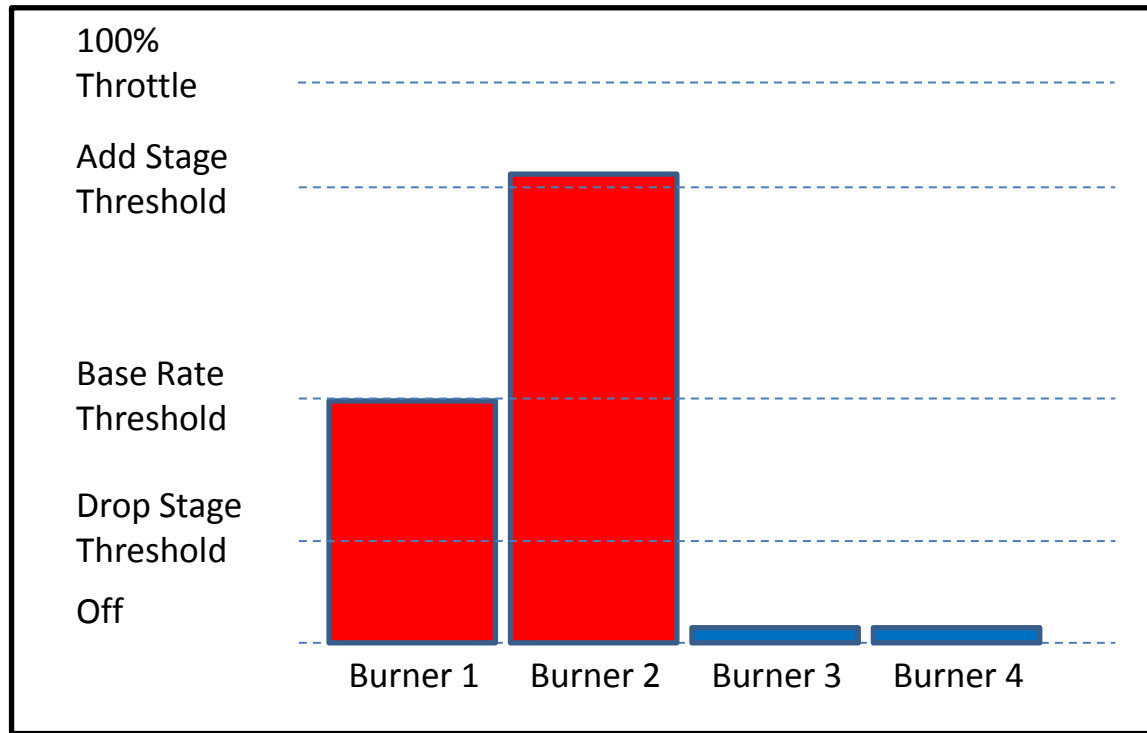## Sequence

When demand (call for heat) is generated via the built-in temperature controller, Burner 1 (or the first available burner) comes on-line. The inter-stage delay timer begins once Burner 1 reaches the RUN state. Burner 1 can modulate between the Add Stage Threshold and 0ff (0% throttle) without the next stage being requested. The first burner on/last burner off is allowed to modulate below the Drop Stage Threshold as long as demand persists. This operation is unique to the first burner only. The last burner firing shuts down when the temp controller no longer generates a demand.
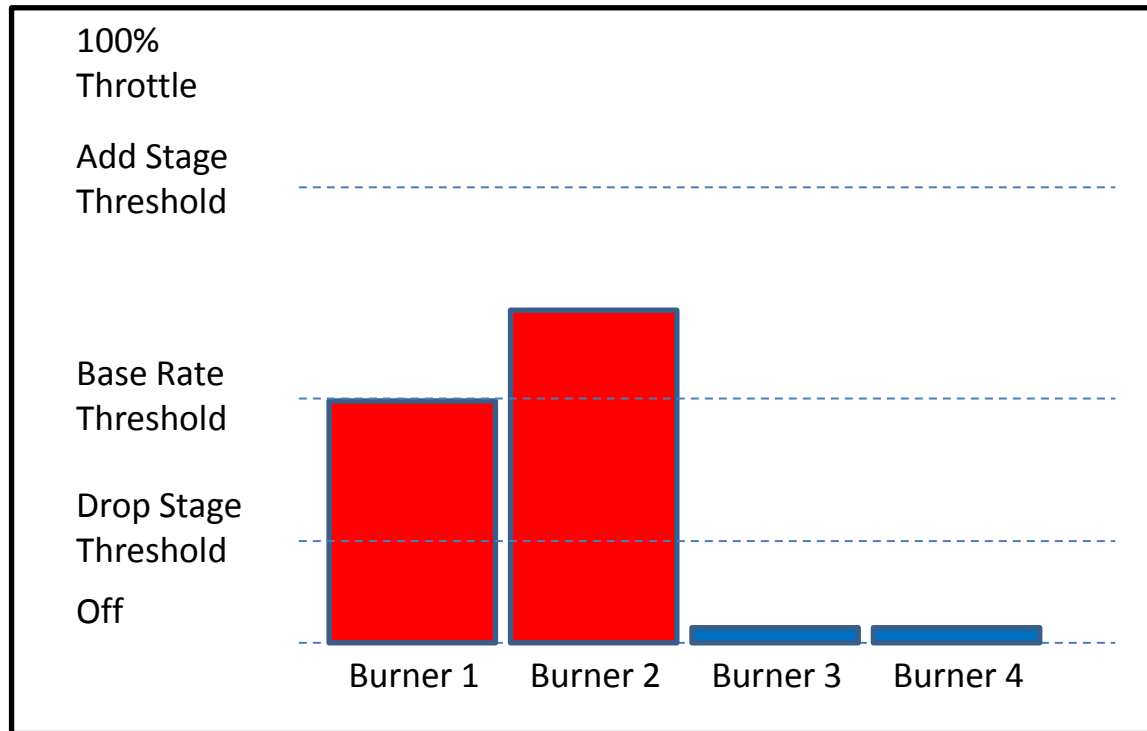
Sequence- Generating Demand for Burner 2

If the system throttle exceeds the Add Stage Threshold, if the minimum temp error threshold is exceeded, and if the inter-stage delay timer has elapsed a demand is generated for Burner 2 (the next available burner).
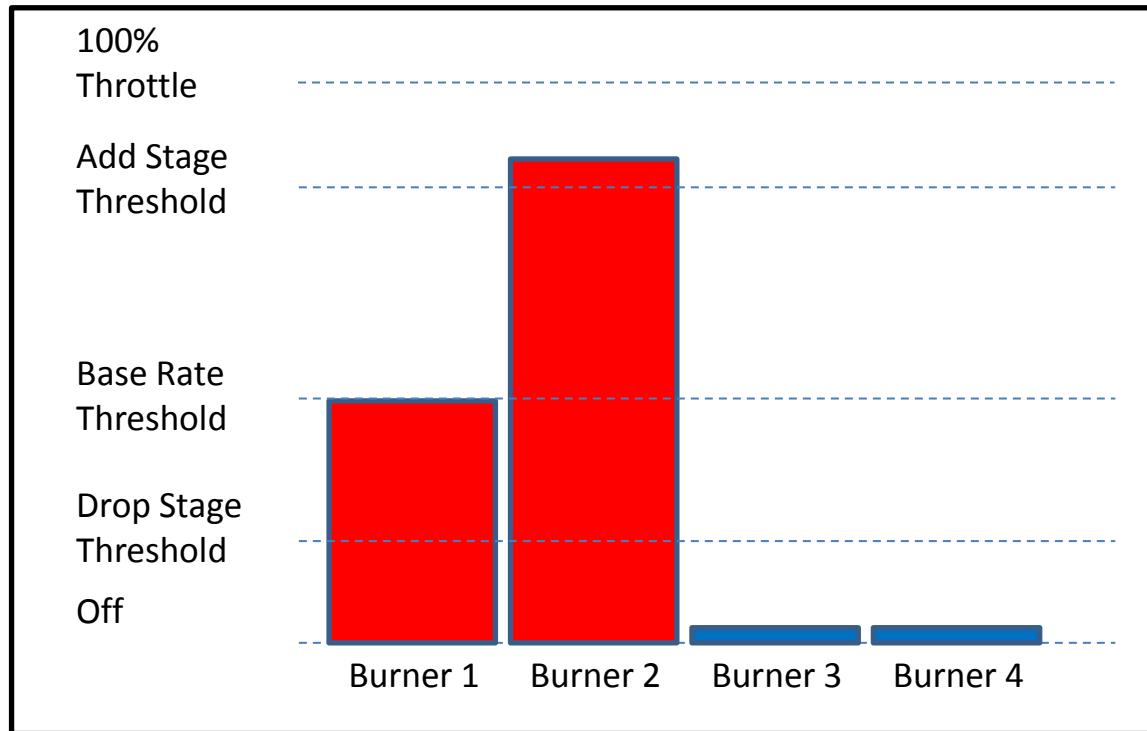
Sequence-Generating Demand for Burner 2

Once demand has been generated for Burner 2 and the temp error timer has elapsed Burner 2 will begin its cycle. When Burner 2 has entered the RUN state, Burner 1 is commanded to the Base Rate Threshold and Burner 2 is commanded to the current throttle value. Also at this time, the inter-stage delay timer begins counting down.
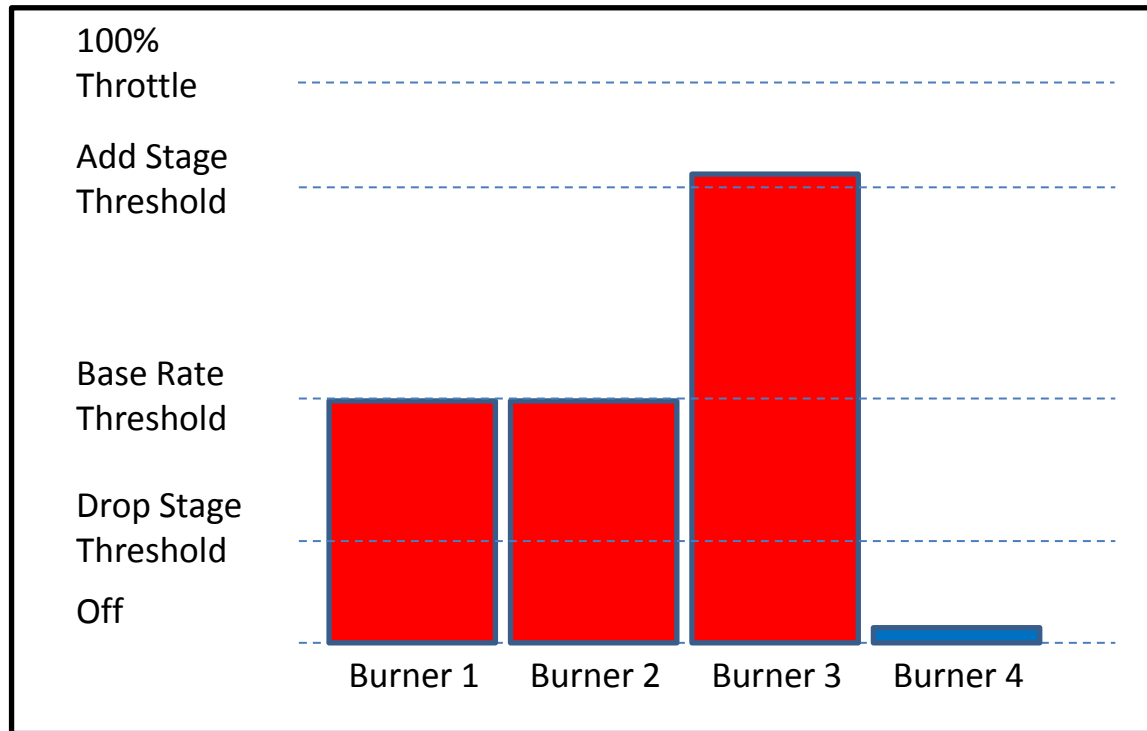
Sequence-adding stages

If the system throttle drops below the Add Stage Threshold but remains above the Drop Stage Threshold, then Burner 2 modulates freely and Burner 1 remains at the Base Rate Threshold. Burner 3 and Burner 4 remain off.
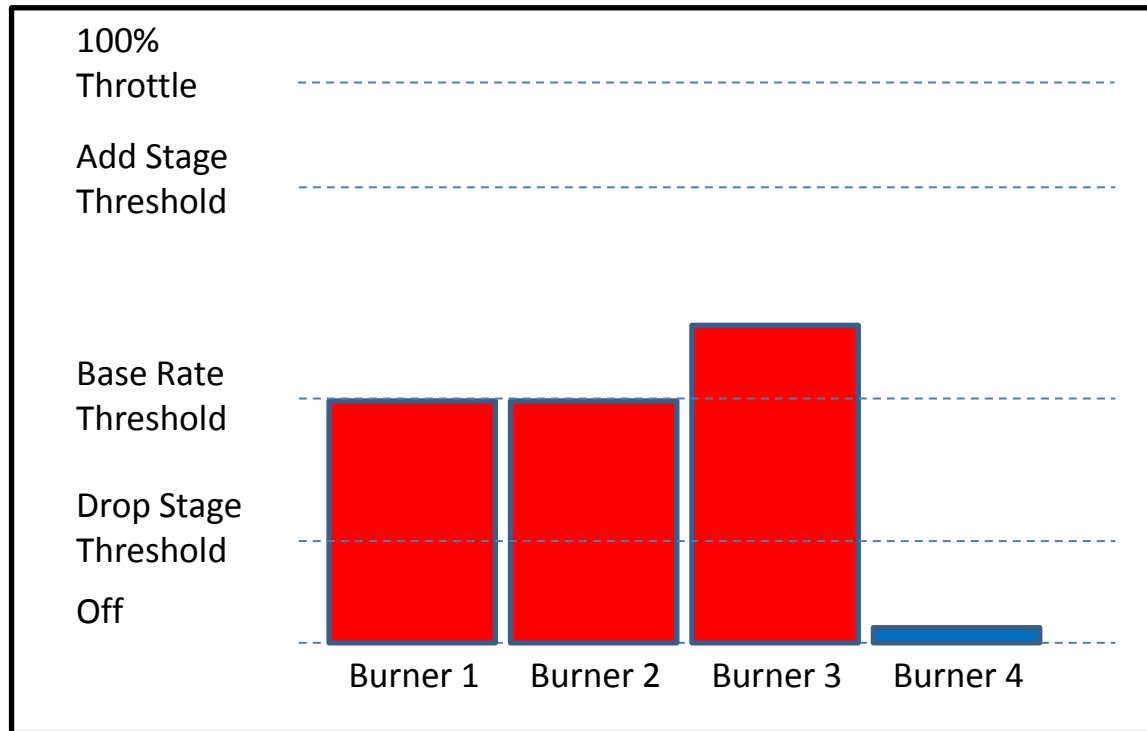
Sequence-adding stages

If the system throttle remains above the Add Stage Threshold, the inter-stage delay has expired, and the minimum temp error is exceeded, a demand is generated for Burner 3.
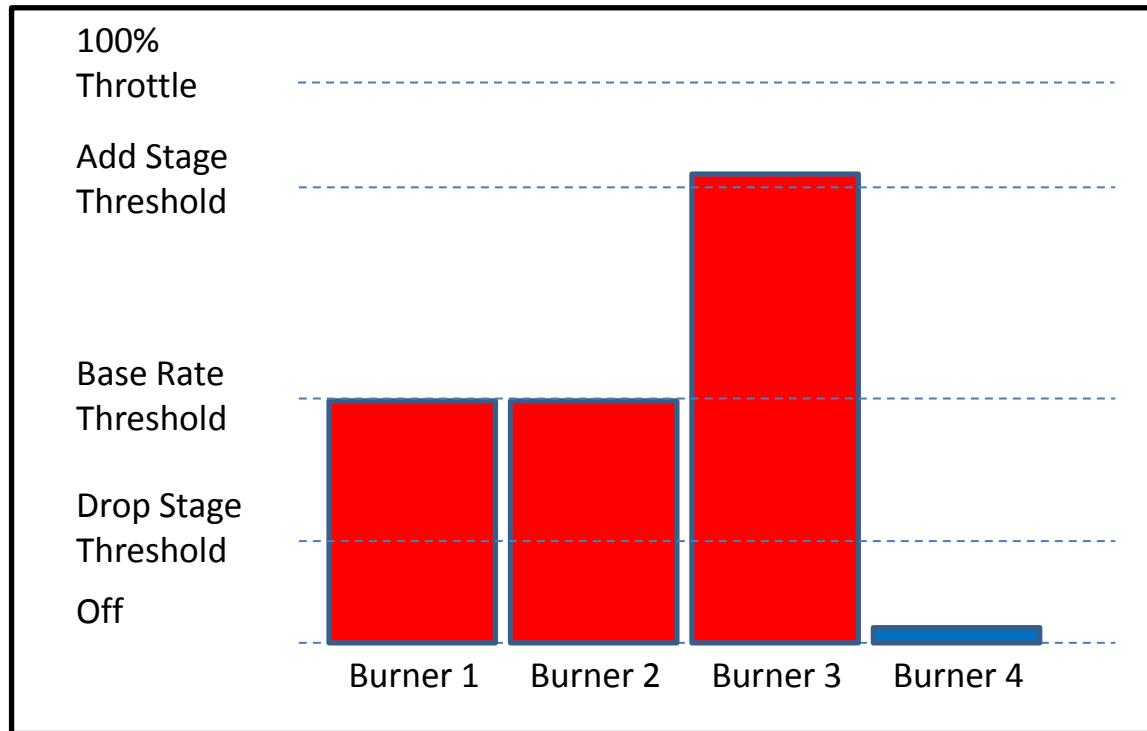
Sequence-adding stages

Once the minimum temp error timer has expired Burner 3 is allowed to start its sequence. Once Burner 3 enters the RUN state, the inter-stage delay timer begins. Burner 1 and Burner 2 are forced to the Base Rate Threshold.
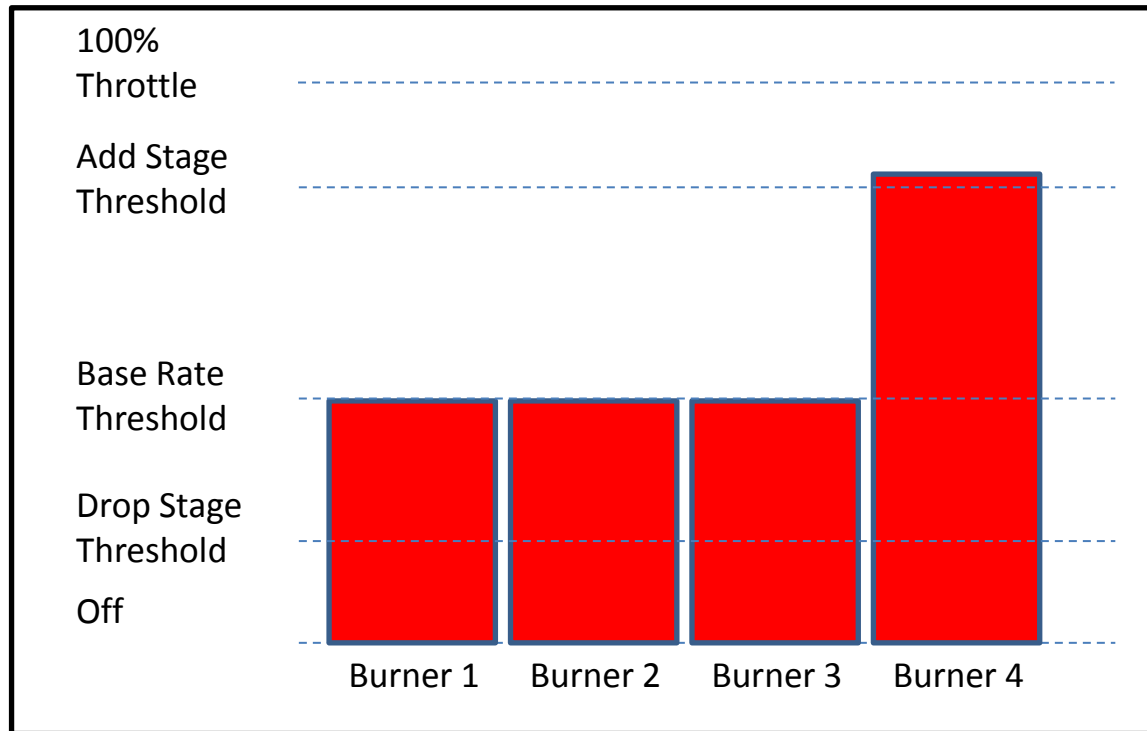
Sequence-adding stages

If the system throttle drops below the Add Stage Threshold but remains above the Drop Stage Threshold, then Burner 3 modulates freely and Burner 1 and Burner 2 remain at the Base Rate Threshold. Burner 4 remains off.
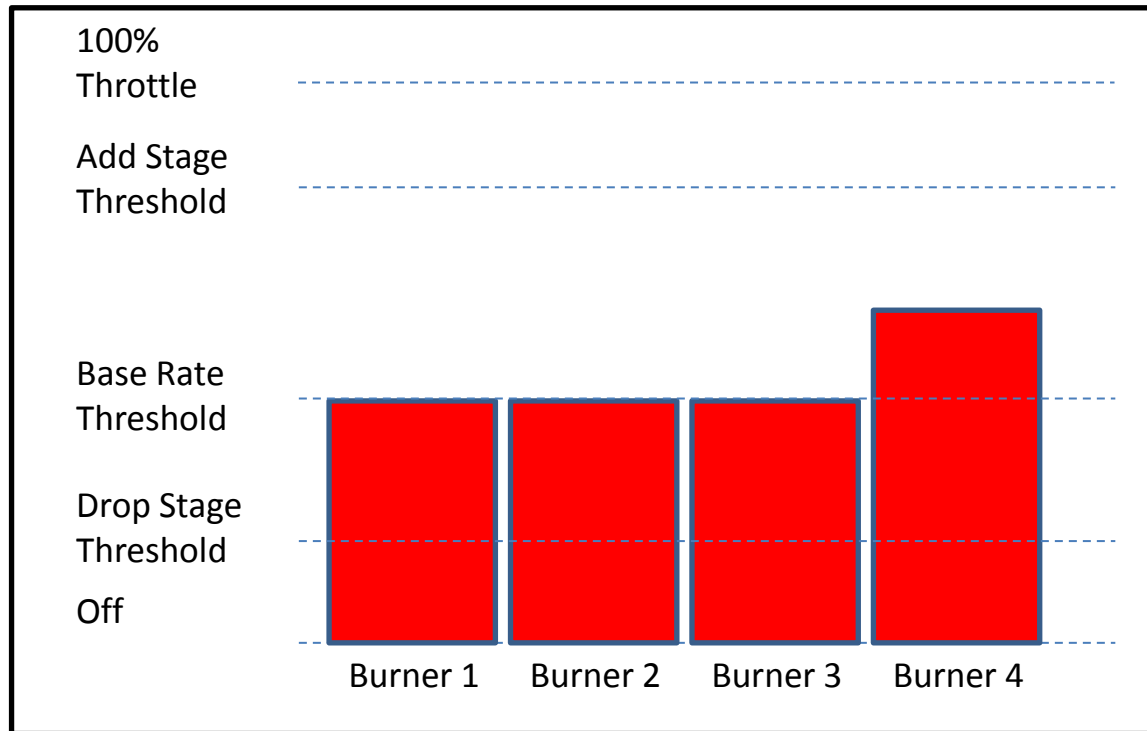
Sequence-adding stages

If the system throttle remains above or exceeds the Add Stage Threshold, the inter-stage delay has expired, and the minimum temp error is exceeded, a demand is generated for Burner 4.
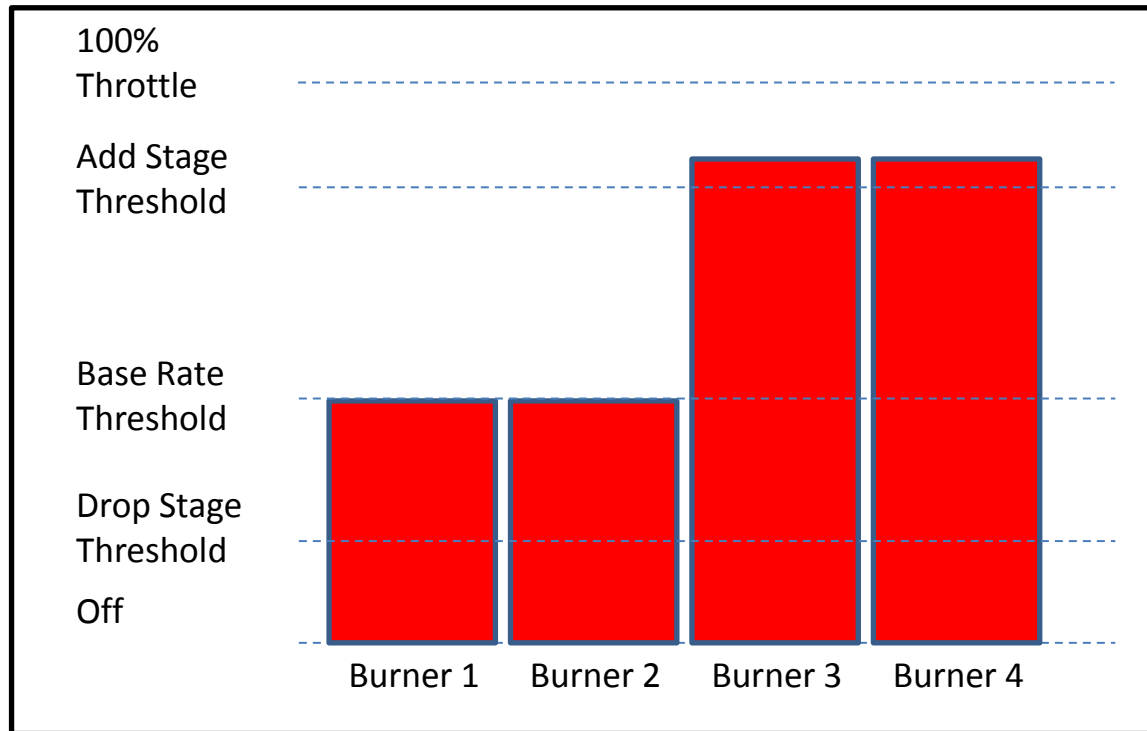
Sequence-adding stages

Once the minimum temp error timer has expired Burner 4 is allowed to start its sequence. Once Burner 4 enters the RUN state, the inter-stage delay timer begins. Burner 1, Burner 2, and Burner 3 are forced to the Base Rate Threshold.
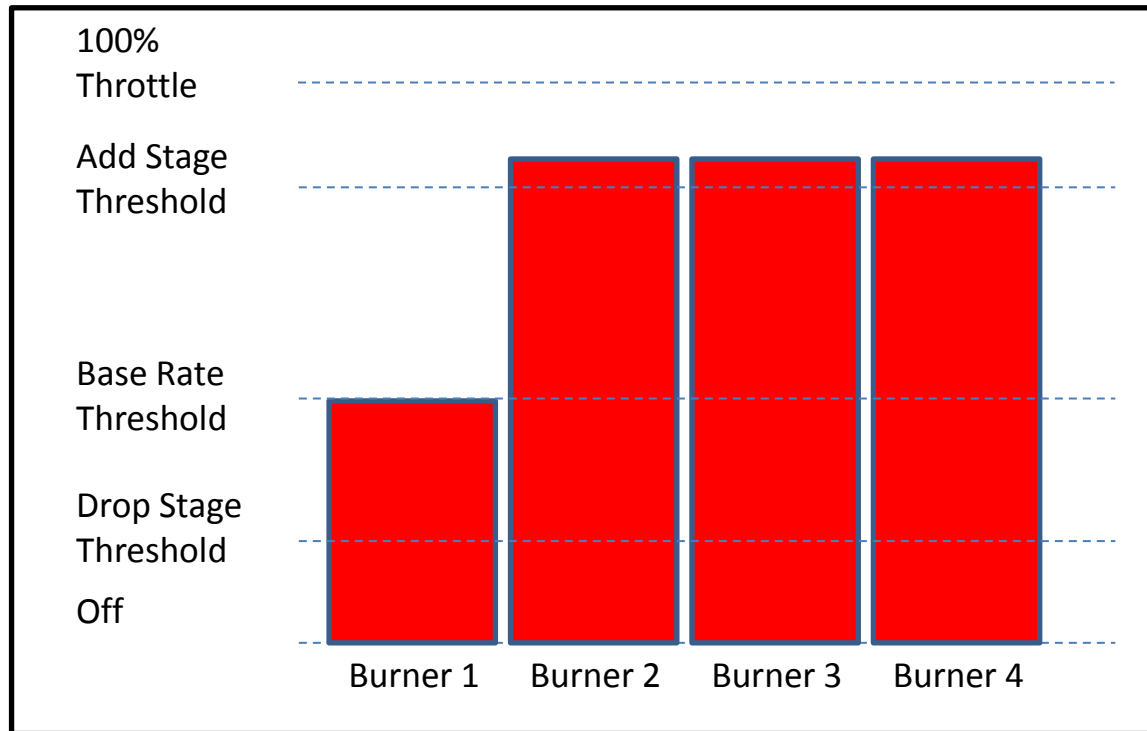
Sequence-adding throttle

If the system throttle drops below the Add Stage Threshold but remains above the Drop Stage Threshold, then Burner 4 modulates freely and Burner 1,Burner 2, and Burner 3 remain at the Base Rate Threshold. All burners are currently firing.

Sequence-adding stages

If the system throttle remains above or exceeds the Add Stage Threshold and the inter-stage delay has expired, Burner 3 is released from the Base Rate Threshold and allowed to modulate freely with Burner 4.

Sequence-adding stages

If the system throttle remains above or exceeds the Add Stage Threshold and the inter-stage delay has expired, Burner 2 is released from the Base Rate Threshold and allowed to modulate freely with Burner 3 and Burner 4.
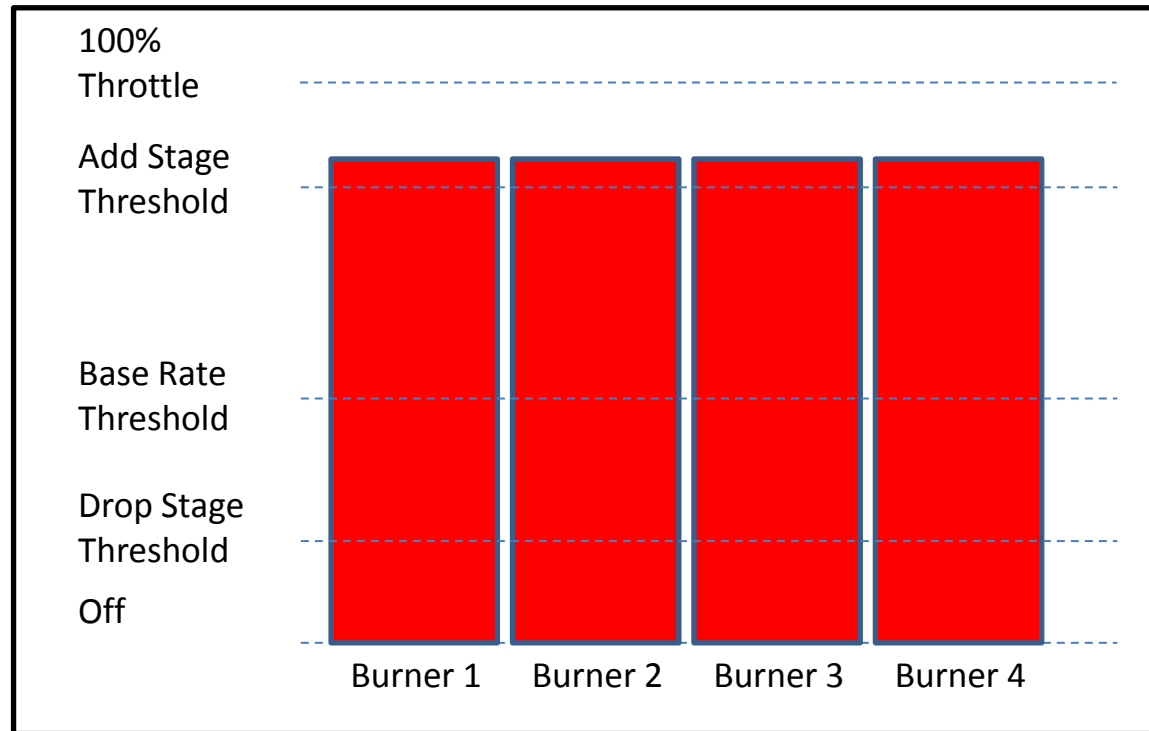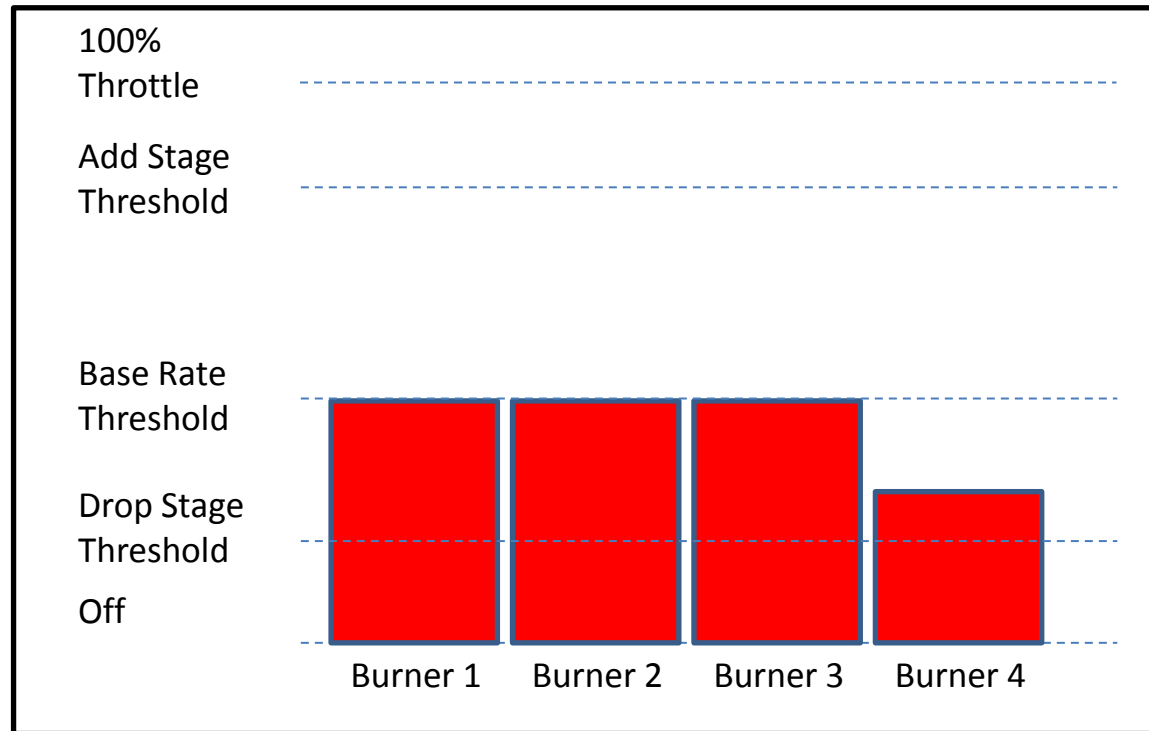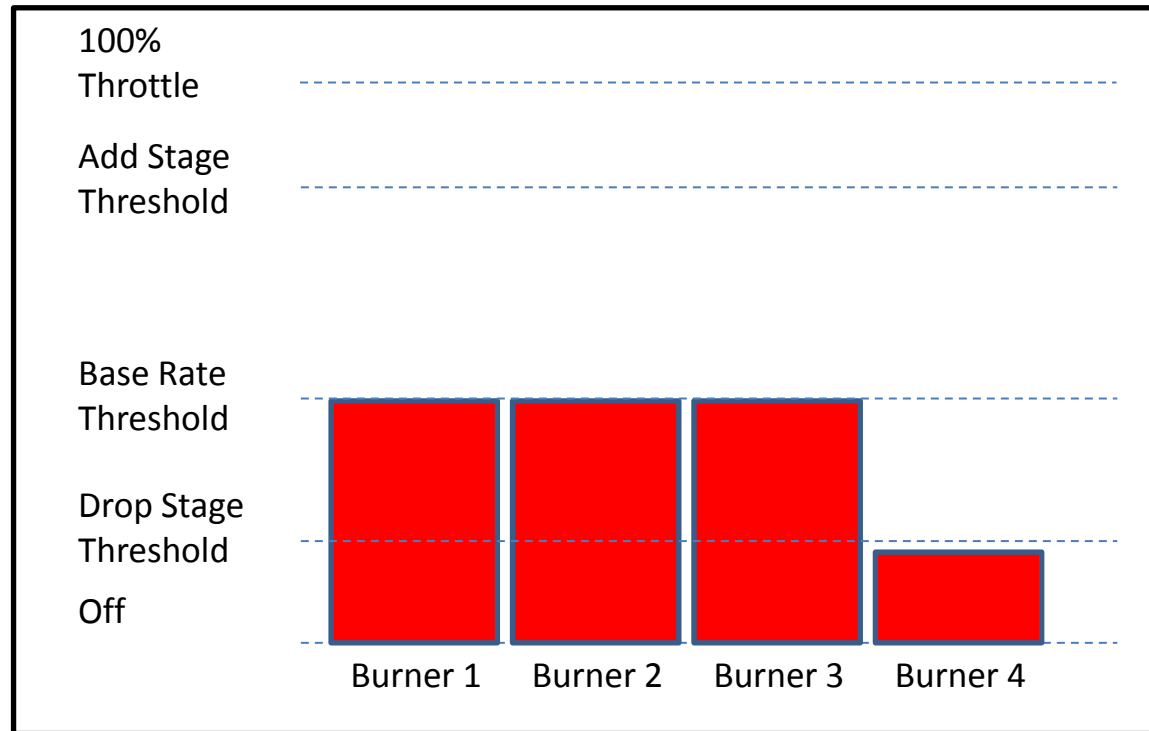
Sequence-adding stages

If the system throttle remains above or exceeds the Add Stage Threshold and the inter-stage delay has expired, Burner 1 is released from the Base Rate Threshold and allowed to modulate freely with Burner 2, Burner 3 and Burner 4. All four burners now can modulate freely up to 100% and as low as the Base Rate Threshold.

Sequence-Dropping stages

As the system throttle drops down below the Base Rate Threshold Burner 4 (the highest number burner) is allowed to throttle freely while Burners 2-4 (all other firing burners) are once again held at the Base Rate Threshold.

Sequence-Dropping stages

As the system throttle drops down below the Drop Stage Threshold the inter-stage timer is started. If once the inter-stage timers elapses the throttle remains below the Drop Stage Threshold, Burner 4 is dropped off.

Sequence-Dropping stages

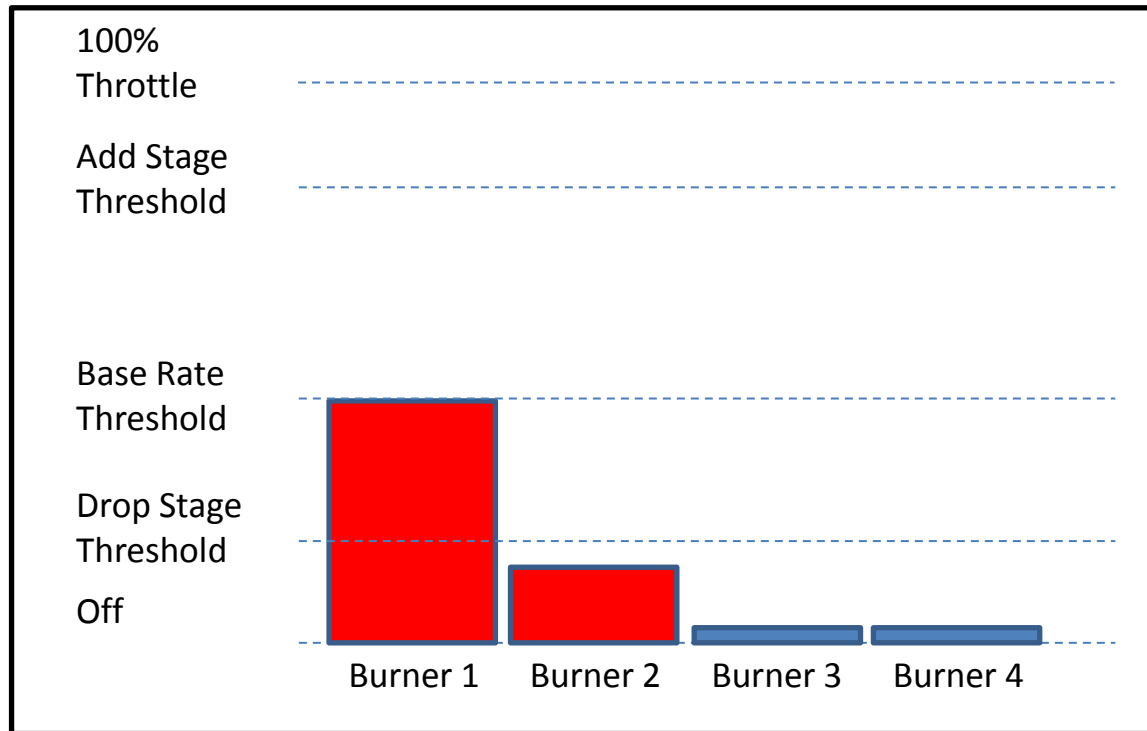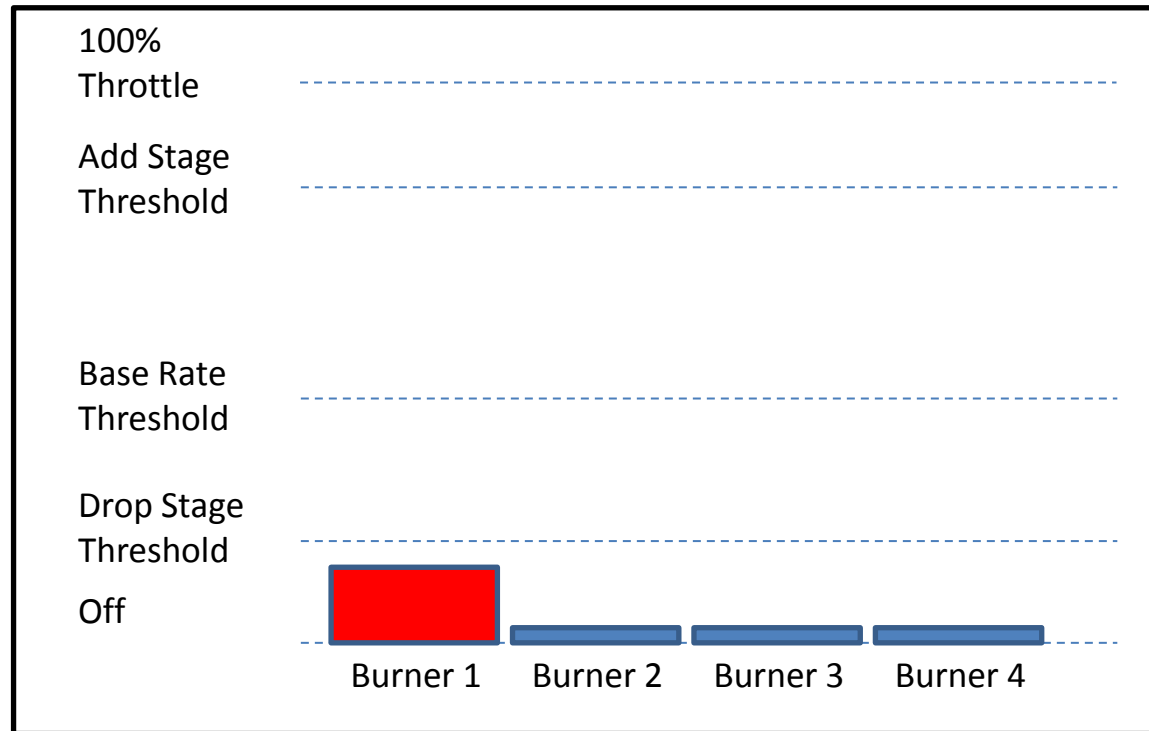Once Burner 4 is dropped off the inter-stage delay timer begins. Burner 3 is allowed to modulate freely while Burner 1 and Burner 2 are held at the Base Rate Threshold. Burner 3 remains throttling freely. If the system throttle surpasses the Add Stage Threshold, Burner 4 is brought back on line. If the system throttle remains or drops below the Drop Stage Threshold, Burner 3 is next to drop out.

Sequence-Dropping stages

Once Burner 3 is dropped off the inter-stage delay timer begins. Burner 2 is allowed to modulate freely while Burner 1 is held at the Base Rate Threshold. Burner 2 remains throttling freely. If the system throttle surpasses the Add Stage Threshold, Burner 3 is brought back on line. If the system throttle remains or drops below the Drop Stage Threshold, Burner 2 is next to drop out.

Sequence-Dropping stages

If the system throttle drops below or remains below the Drop Stage Threshold and the inter-stage timer has elapsed, Burner 2 is dropped off, Burner 1 (the last firing burner) is allowed to modulate freely until the system throttle either surpasses the Next Stage Threshold where Burner 2 is brought back on line or the burner demand is ended.

Special Handling

A burner may be either in a lockout state or manually removed from the lead lag group. Burners outside of the lead lag group may operate autonomously as needed. A burner that is either in lockout or outside of the lead lag group is skipped by the Lead Lag Master. If a skipped burner is returned to the lead lag group it will go to the end of the line of available in-lead lag burners for demand.

If communication between the Master and any of the Slave panels is interrupted, that Slave panel may operate autonomously based on its own settings and sensors. When communication is re-established, the burner returns to the Lead Lag group and is placed at the end of the line of available in-group burners for demand processing.

If there is a system demand (temp controller requesting) and Burner 1 is either in lockout or out of the lead lag group, the next available burner will be called upon. This continues until the first burner answers the burner demand request.

This Lead Lag algorithm also includes Assured Low Fire Shutdown as well as Low Fire Hold.

All parameters, timers, and thresholds are user adjustable via HMI.