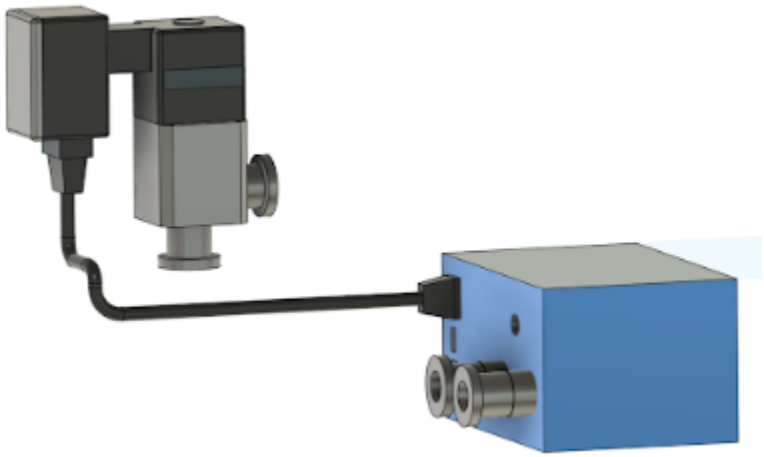
DigiVac
Scientific Measurement & Control

DIGIVAC SNAP External Valve Mode

Fast Pumpdown Documentation



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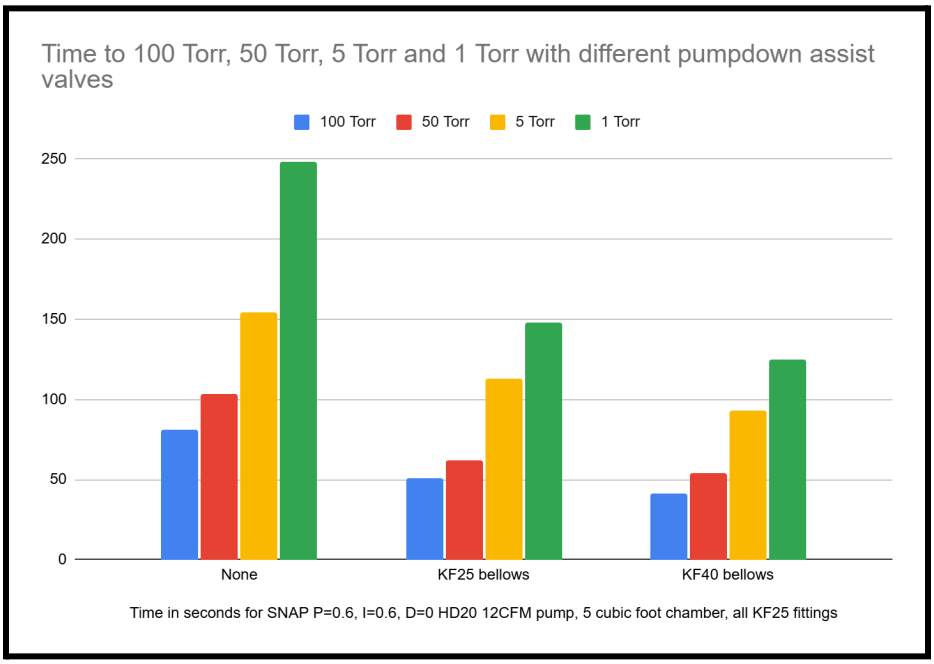
Overview

The DIGIVAC SNAP External Valve Mode features Time-Based Vacuum Differential Control, a sophisticated functionality designed to optimize pumpdown performance by dynamically regulating an external valve based on vacuum differentials (VD) within predefined time intervals (VDW). This optional add-on feature significantly reduces pumpdown times by placing a larger external valve in parallel with the SNAP between the chamber and the pump, increasing pumping orifice for faster chamber evacuation and enhanced process efficiency.

Key Features

- **Enhanced Pumpdown Speed:** Time-Based Vacuum Differential Control
- **Parallel Flow Path:** External valve added in parallel with SNAP — between chamber and pump

- **Precision Valve Modulation:** Precision valve modulation accelerates pumpdown without overshooting or instability
- **Intelligent Operation:** Valve activates only when vacuum level fails to decrease by specified differential within time interval
- **Seamless Integration:** Works in conjunction with SNAP's full recipe system and dual-mode pressure control
- **DVCUP Configuration:** Full parameter control through DVCUP command interface
- **Wide Compatibility:** Compatible with most 24V actuated valves on the market; controls systems of almost any size



System Requirements

Hardware Requirements

- DIGIVAC SNAP Vacuum Controller
- External Valve (KF25 or KF40 configuration) — 24V actuated
- Appropriate vacuum fittings and connections
- Vacuum chamber with suitable mounting location
- Vacuum pump

Software Requirements

- SNAP firmware supporting external valve functionality
- DVCUP command interface access for configuration

Installation

Physical Installation

1. Valve Mounting

- Mount the external valve in-line between the vacuum chamber and the vacuum pump
- The external valve sits in parallel with the SNAP's built-in valve — both connect between chamber and pump
- Ensure proper orientation as specified in the valve manual
- Verify the valve is accessible for cable routing and future maintenance

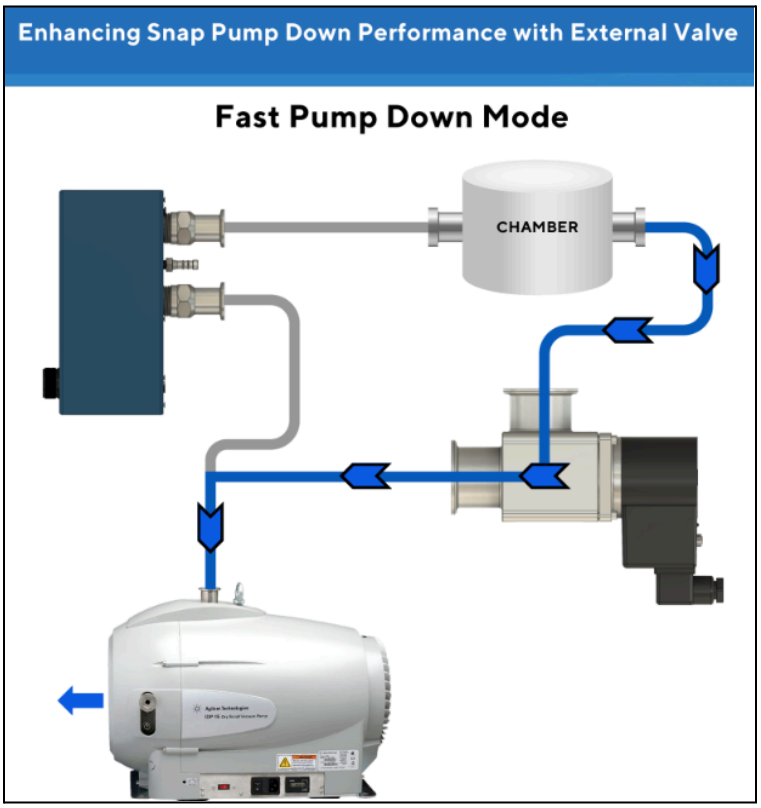
> **Important: Plumbing Configuration**
> The external valve is installed in PARALLEL with the SNAP, not in series. Both the SNAP's internal valve and the external valve connect between the same chamber port and pump inlet. When the external valve opens, both flow paths are active simultaneously, increasing total pumping orifice.

2. Electrical Connection

- Connect the external valve control cable to the SNAP controller's external valve output
- The SNAP supplies 24VDC control voltage to the valve (< 5W)
- Verify secure connections and proper cable routing
- Ensure cable routing does not interfere with chamber or pump movement

3. Vacuum Connections

- Use appropriate KF25 or KF40 fittings based on valve specification
- Ensure all connections are properly sealed with appropriate O-rings
- Check all fittings for leaks before initial operation



System Verification

- Power on the SNAP controller
- Verify external valve appears in system diagnostics
- Test valve operation through manual commands via DVCUP
- Confirm valve opens and closes on command with proper pressure response
- Perform a brief pumpdown test to verify improved evacuation speed

Configuration

DVCUP Command Setup

The Time-Based Vacuum Differential Control system is configured using two primary parameters through the DVCUP command interface. When configured, the system continuously monitors the vacuum level against the user-defined setpoint and triggers the external valve when the pumpdown rate is insufficient.

Key Parameters

VD (Vacuum Differential Threshold)

Parameter	Value / Description
Definition	Minimum pressure drop required within the time interval (in Torr)
Function	Specifies how much the pressure must decrease during the VDW period before the setpoint is reached
Query Command	VD?
Set Command	VD=(value) where value is in Torr

VDW (Time Interval)

Parameter	Value / Description
Definition	Time period within which the vacuum level must drop by VD amount (in seconds)
Function	Maximum time allowed for pressure to decrease by VD amount toward the setpoint
Query Command	VDW?
Set Command	VDW=(value) where value is in seconds

Operational Logic

Trigger Condition — Pumpdown

If the pressure has NOT dropped to the target differential level (Current SP + VD) by the time VDW elapses, the controller opens the external valve to increase pumping orifice, accelerating evacuation toward the setpoint.

For pumpdown: pressure must DECREASE (lower Torr = deeper vacuum). VD represents how many Torr the pressure must drop within VDW seconds. If it has not dropped that amount, the external valve opens.

> **Note: DVCUP Command Behavior**
> DVCUP will not echo the command back; it will only display the response value.
>
> Full Vac Button: When the user presses "Full Vac" on the touchscreen, the external valve will also open automatically to allow maximum throughput for fastest possible evacuation.

Accessing DVCUP Commands

- Connect to SNAP via USB or RS232
- Open terminal software (PuTTY, etc.) at 115200 baud, 8N1
- Enter commands as shown below
- Verify settings with query commands

Configuration Examples

Example 1: Standard Fast Pumpdown

```
VD=10      // Pressure must drop by 10 Torr
VDW=10     // Within 10 seconds
```

If pressure has not fallen by at least 10 Torr within 10 seconds, the external valve opens to accelerate evacuation toward the setpoint.

Example 2: Rapid Response Pumpdown

```
VD=5       // Pressure must drop by 5 Torr
VDW=5      // Within 5 seconds
```

More aggressive pumpdown for faster process cycles and smaller chambers.

Example 3: Conservative Pumpdown

```
VD=20     // Pressure must drop by 20 Torr
VDW=20    // Within 20 seconds
```

Less frequent valve activation for gentler processes or larger systems.

Querying and Verifying Settings

```
VD?       // Returns current vacuum differential threshold
VDW?      // Returns current time window setting
```

Operation Modes

Fast Pumpdown Operation

The Time-Based Vacuum Differential Control operates automatically during any pumpdown process by continuously monitoring vacuum level changes against the target setpoint:

Monitoring Process

- System begins pumping toward lower pressure setpoint
- Controller monitors pressure decrease rate vs. time
- Compares actual pressure drop against VD threshold within VDW timeframe

Activation Conditions

- Pressure has NOT dropped by at least VD Torr within VDW seconds
- System is actively pumping toward a lower pressure setpoint
- External valve is available and operational

Operation Sequence

- User initiates pumpdown or sets a lower pressure setpoint
- SNAP begins normal pumping using its internal valve
- System continuously monitors pressure decrease rate
- If pressure has not dropped by VD amount within VDW time period:
  - External valve opens automatically in parallel with SNAP
  - Increased pumping orifice accelerates evacuation
  - Valve modulation performed with precision to prevent overshoot
  - System returns to normal control when setpoint is achieved

Integration with SNAP Control Modes

Recipe Mode Integration

- External valve operates automatically during recipe steps
- VD and VDW parameters apply to all recipe pumpdown transitions
- No additional programming required in recipes
- Improves recipe repeatability and reduces cycle times

Setpoint Mode Integration

- Immediate activation when setpoint decreases require pumpdown
- Transparent operation with existing setpoint controls

Full Vac Integration

- External valve opens automatically when user presses the Full Vac button
- Provides maximum pumping throughput for fastest possible deep vacuum

Manual Pumpdown Integration

- External valve assists during manual pumpdown operations
- Provides fastest possible chamber evacuation

Operation Examples

Example 1: Vacuum Oven Pumpdown

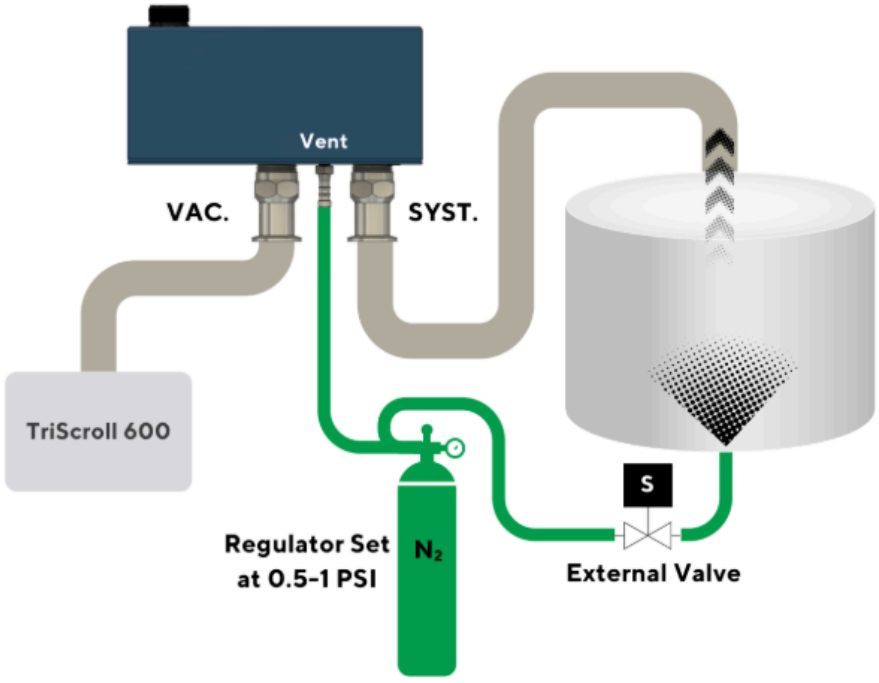
Scenario: Pumping down a 50L vacuum oven from atmosphere (760 Torr) to 50 Torr

Parameter	Value
Starting Pressure	760 Torr
Setpoint (SP)	50 Torr
Vacuum Differential (VD)	10 Torr
Time Interval (VDW)	10 seconds

Operation:

- User sets setpoint: 50 Torr
- SNAP begins pumping from 760 Torr using internal valve
- After 10 seconds, system checks: has pressure dropped by 10 Torr?
- If pressure is still above 750 Torr (760 - 10 = 750 Torr threshold):
    - External valve opens for accelerated pumpdown

- Rapid pressure decrease toward 50 Torr target
- External valve closes and SNAP takes over for precision control near setpoint



Example 2: Multi-Step Recipe Pumpdown

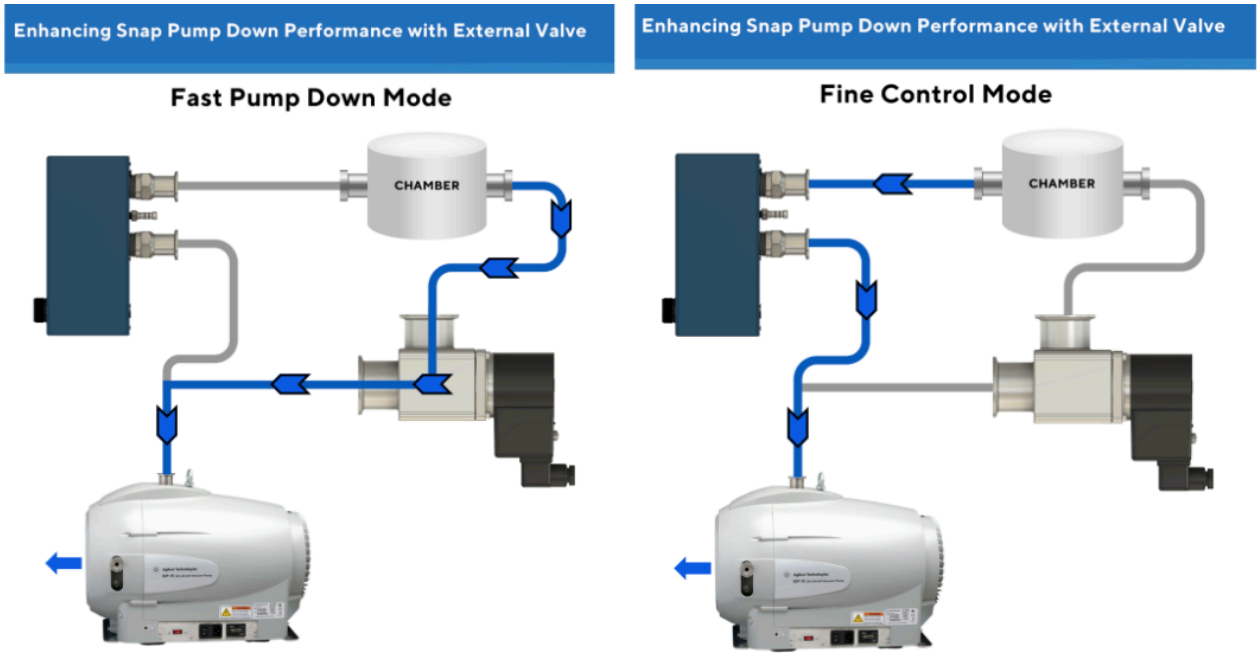
Scenario: Recipe step transitioning from 200 Torr to 10 Torr

Parameter	Value
Starting Pressure	200 Torr
Setpoint (SP)	10 Torr
Vacuum Differential (VD)	15 Torr
Time Interval (VDW)	8 seconds

Operation:

- Recipe initiates step change to 10 Torr
- Internal pumpdown begins from 200 Torr
- After 8 seconds, system evaluates progress
- If pressure has not reached 185 Torr (200 - 15) or lower:
  - External valve activates automatically
  - Faster transition toward 10 Torr setpoint

- Recipe continues with improved timing and repeatability



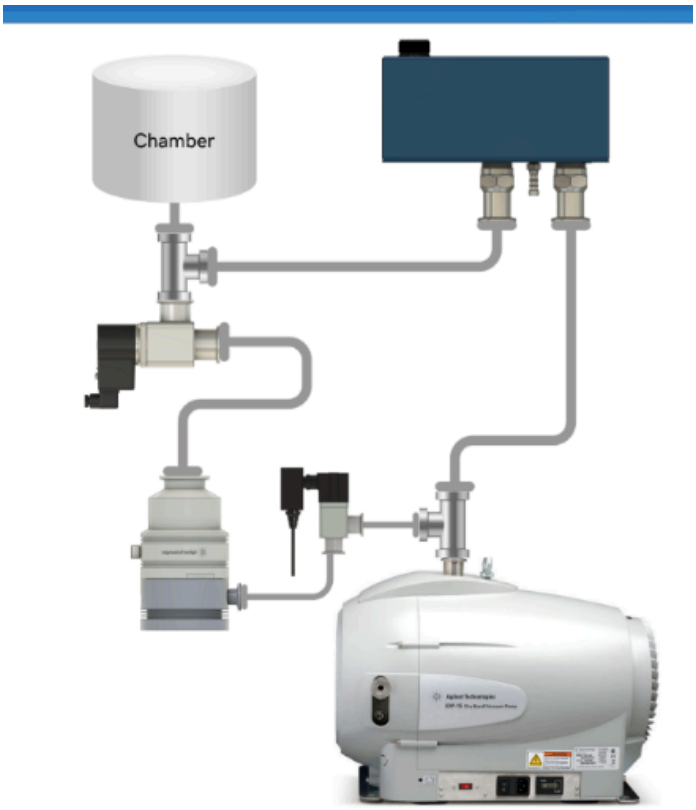
Example 3: Deep Vacuum Pumpdown

Scenario: Pumping from rough vacuum to deep process vacuum, e.g. 5 Torr to 0.1 Torr

Parameter	Value
Starting Pressure	5 Torr
Setpoint (SP)	0.1 Torr
Vacuum Differential (VD)	1 Torr
Time Interval (VDW)	15 seconds

Operation:

- Pumpdown initiated from 5 Torr
- Internal valve provides precise control
- After 15 seconds, if pressure is still above 4 Torr (5 - 1):
  - External valve opens to boost pumping speed
  - Conservative VD and VDW settings prevent instability at low pressures
  - System transitions smoothly to precision control as setpoint is approached



Safety Considerations

Operational Safety

- **Pressure Monitoring:** Continuously monitor chamber pressure during external valve operation
- **Emergency Stop:** Ensure emergency stop procedures include external valve closure
- **Personnel Safety:** Verify area is clear and equipment is secured before initiating rapid pumpdown operations
- **Pump Capacity:** Ensure the vacuum pump is rated for the increased gas load during external valve operation

System Protection

- **Pump Protection:** The external valve supplements pump capacity — avoid exceeding pump ultimate pressure limits
- **Chamber Protection:** Controlled pumpdown prevents sudden pressure changes that could damage chamber contents

- **Product Protection:** Use conservative VD and VDW settings for sensitive materials or fragile products
- **Fine Vacuum Caution:** For fine vacuum ranges (< 1 Torr), set conservative (larger) VD values to prevent overshoot

Maintenance Safety

- **Isolation:** Properly isolate system (vent to atmosphere) before external valve maintenance
- **Verification:** Test valve operation after any maintenance before resuming process work
- **Documentation:** Maintain records of valve service and any parameter changes

Troubleshooting

Common Issues

External Valve Not Activating

- Check: VD and VDW parameter settings (query with VD? and VDW?)
- Verify: Electrical connections between valve and SNAP controller
- Test: Manual valve operation through SNAP diagnostic menu
- Confirm: Firmware version supports external valve functionality
- Solution: Adjust parameters or inspect hardware connections

Excessive Valve Cycling

- Cause: VD parameter set too small — valve triggers on minor pressure fluctuations
- Solution: Increase VD value to require a larger pressure drop before triggering
- Prevention: Monitor system performance and tune VD to match typical pump speed

Slow Pumpdown Despite External Valve

- Check: Valve mounting and plumbing — verify valve is in PARALLEL with SNAP, not series
- Verify: No flow path obstructions (centering rings, O-rings seated correctly)
- Inspect: Valve mechanical operation — confirm it opens fully on command
- Pump: Verify vacuum pump is functioning properly and not restricted
- Solution: Clear obstructions or service valve

System Instability / Overshoot at Setpoint

- Cause: VDW parameter too short or VD too small — external valve opens too close to setpoint

- Solution: Increase VDW to allow more time for natural pressure decrease before intervening
- Adjustment: Increase VD so the valve only activates when significantly behind target rate

Pressure Oscillation

- Cause: External valve opening and closing rapidly near setpoint
- Solution: Increase VD significantly — this is typically a tuning issue
- Alternative: Check that the valve is not overshooting the setpoint (pump may be oversized)

Diagnostic Commands

```
VD?       // Check current vacuum differential threshold
VDW?      // Check current time window setting
```

Valve Testing

- Use SNAP diagnostic menus to manually trigger external valve open and closed
- Verify valve opens and closes on command with < 1 second response time
- Check for proper pressure response during manual valve test

Performance Optimization

Parameter Tuning

VD (Vacuum Differential) Tuning

Parameter	Value / Description
Small Values (1–3 Torr)	Aggressive operation — activates quickly; best for very large chambers or slow pumps
Medium Values (5–15 Torr)	Balanced performance for most vacuum oven and industrial applications
Large Values (15+ Torr)	Conservative operation — less frequent activation; good for sensitive processes

VDW (Time Window) Tuning

Parameter	Value / Description

Short Times (1–5 seconds)	Rapid activation; suitable for small chambers and fast pumps
Medium Times (5–15 seconds)	Standard operation for most systems
Long Times (15+ seconds)	Conservative approach; suitable for large chambers or slow-pump systems

Application-Specific Recommended Settings

Parameter	Value
Vacuum Ovens	VD=10–15 Torr, VDW=10–15 sec
Rotary Evaporators	VD=5–10 Torr, VDW=3–8 sec
Freeze Dryers	VD=10–20 Torr, VDW=15–25 sec
Industrial Process Chambers	VD=15–25 Torr, VDW=15–30 sec
Fine Vacuum (< 1 Torr)	VD=0.5–2 Torr, VDW=15–30 sec (use caution)

> **Tuning Tip**
> Start with larger VD and VDW values (conservative) and reduce them incrementally while monitoring pumpdown curves. This avoids overshoot and valve cycling during initial commissioning.

Maintenance

Regular Maintenance Schedule

Weekly Checks

- Verify valve operation through a manual test cycle via SNAP diagnostics
- Check electrical connections for tightness and chafing
- Inspect valve mounting and vacuum fittings for stability and leaks

Monthly Maintenance

- Clean valve housing and connections; inspect for particulate contamination

- Verify VD and VDW parameter settings have not drifted from expected values
- Test emergency stop procedures to confirm external valve closes
- Review pumpdown performance logs for signs of degraded valve response

Annual Service

- Complete valve disassembly and cleaning per manufacturer specifications
- Replace valve seals and O-rings
- Calibrate valve response timing
- Update parameter settings as needed based on system performance history

Service Records

Maintain detailed records of:

- Parameter changes (VD and VDW values) and rationale for any changes
- Valve maintenance activities and replacement parts used
- Performance issues encountered and resolutions applied
- System modifications or upgrades affecting the external valve circuit

Technical Specifications

Flow Characteristics

Parameter	Value / Description
KF25 External Valve	25mm nominal fitting; 20mm flow path
KF40 External Valve	40mm nominal fitting; 40mm flow path
Response Time	< 1 second activation
Maximum Operating Pressure	Atmospheric to high vacuum

Electrical Requirements

Parameter	Value / Description
Control Voltage	24VDC (supplied by SNAP controller)
Power Consumption	< 5W during operation
Connection	Standard valve control interface on SNAP

Valve Compatibility	Most 24V actuated valves on the market

Environmental Limits

Parameter	Value / Description
Temperature Range	-10°C to +40°C
Humidity	30% – 60% RH (non-condensing)
Altitude	Up to 2000 meters

Integration Examples

PLC Integration

The external valve system integrates seamlessly with PLC-controlled processes:

- Use analog input control for automated setpoint changes
- External valve responds automatically to PLC-commanded pressure changes
- No additional PLC programming required for valve operation — SNAP handles all logic

Data Logging Integration

- StrataCapture automatically logs external valve activity alongside pressure data
- VacuumNetwork.org displays valve status in real-time
- USB serial output includes valve state information

Recipe Integration

- No special programming required in recipes — external valve is fully transparent
- External valve operates automatically during any recipe pumpdown step
- Improves recipe repeatability and reduces cycle times without recipe modification

Support and Resources

Technical Support

Parameter	Value / Description
Email	tech_support@digivac.com
Phone	732-765-0900
Documentation	SNAP Operation Manual
Training	Application-specific setup assistance available

This documentation covers the external valve mode for fast pumpdown operations. For the complete SNAP system operation, refer to the full SNAP Vacuum Controller Operation Manual. For fast venting configuration, refer to the DIGIVAC SNAP External Valve Mode – Fast Venting Documentation.