



Master dMix128 Control Integration Specification

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1. Purpose

This document defines the mandatory and recommended practices for integrating the Violet Audio **dMix128** digital mixing platform into third-party control, automation, and monitoring systems.

It is intended for: - AV consultants - Control system programmers - System integrators - Broadcast and installation engineers

This specification applies equally to live, installed, broadcast, and hybrid environments.

2. Design Philosophy

The dMix128 is a **control-first, network-centric mixing system**. All external control systems interact with a **single authoritative internal state model**, regardless of protocol or client type.

Key principles: - Deterministic state - Multi-client concurrency - Protocol agnosticism - No controller ownership model

All external systems are treated as **peers**, not masters.

3. System Architecture Overview

The dMix128 control system is composed of four logical layers:

1. Mixer Engine (DSP & routing)
2. WebSocket Control Bridge
3. Central KeyStore (authoritative state)
4. External Control Protocol Daemons

External control systems **never communicate directly** with the mixer engine. All interaction occurs via internal keys exposed through supported protocols.

4. Internal Key System (Authoritative Reference)

4.1 Key Format

Keys are dot-delimited hierarchical strings.

Examples: - `i.0.mix` - `i.0.mute` - `i.0.eq.b2.gain` - `a.3.mix` - `m.mix` - `v.1.mute`

4.2 Object Classes

Prefix	Object Type
i	Input channels
a	Aux buses
m	Master bus
v	VCAs
r	FX returns
x	Matrix outputs

Prefix	Object Type
s	Subgroups

4.3 Indexing Rules

- All internal indices are **zero-based**
- One-based external protocols are translated automatically

4.4 Data Types

- Numeric (double precision)
- Boolean (1.0 = active, 0.0 = inactive)
- String

4.5 Action Keys

Some keys trigger actions rather than storing persistent state:

- `load.snapshot.N`
- `save.snapshot.N`

5. Supported Control Protocols

Protocol	Transport	Port	Typical Use
WebSocket	TCP	80	Internal bridge / monitoring
ECP (ASCII)	TCP	1702	Automation, scripting
VSKP	TCP	1703	Lightweight control & monitoring
QRC (JSON-RPC)	TCP	1710	Q-SYS integration
OSC (UDP)	UDP	10023	Touch controllers
OSC (TCP)	TCP	10024	Reliable OSC control

6. Network & Security Requirements

- Dedicated AV VLAN recommended
- No direct WAN exposure
- Firewall restrict ports to required protocols only
- VPN required for remote access
- Persistent TCP connections expected

7. State Synchronisation Model

7.1 INIT Phase

Upon connection, the external control client **must issue an INIT request**. The mixer responds with:

- Complete key list
- Current values
- Type information

No control or feedback is considered valid until INIT completes.

7.2 Real-Time Updates

After INIT: - All parameter changes are pushed via WebSocket - KeyStore updates authoritative state - Feedback is fanned out to all subscribed clients

7.3 Multi-Client Behaviour

- Any client may modify any key at any time
 - No priority or ownership exists
 - Last write wins
-
-

8. Normalised vs Native Values

Protocols may use: - Native values (dB, Hz) - Normalised values (0.0–1.0)

Rules: - Normalisation is **explicit** - UI layers may normalise - Automation logic should use native units

9. Control System Integration Profiles

9.1 Q-SYS Integration

- Protocol: QRC (JSON-RPC 2.0)
- Persistent TCP connection on port 1710
- Use Change Groups for feedback
- Polling interval: 50–100 ms max
- Prefer snapshots for macro state changes

9.2 Biamp Integration

- Protocol: ECP or OSC
- Stateless command execution

- No shadow state permitted
- Suitable for mute logic, routing, emergency overrides

9.3 Crestron Integration

- Protocols: VSKP (UI), ECP (logic)
- Subscriptions preferred over polling
- Touch panels treated as peers

9.4 HiQnet / Legacy Systems

- Indirect integration only
 - Middleware translates logic to dMix128 keys
 - dMix128 remains authoritative
-

10. Functional Control Scope

10.1 Inputs

- Gain
- Mute
- EQ (all bands)
- Aux send levels

10.2 Buses & Outputs

- Mix levels
- Mute
- Matrix routing

10.3 System

- Snapshot load/save
 - Metering
 - Fault and connection status
-

11. Best Practices

- Prefer subscriptions over polling
 - Avoid uncontrolled wildcard writes
 - Do not mirror mixer topology externally
 - Assume concurrent multi-client operation
 - Use snapshots for complex state transitions
-

12. Diagnostics & Troubleshooting

Common issues: - Missing INIT - No subscriptions or Change Groups - Normalisation mismatch - Excessive polling

13. Mandatory Specification Clauses

Deterministic State

All mixer parameters are represented by a single authoritative internal key.

Multi-Client Operation

No external control system shall assume exclusive ownership of mixer parameters.

Network Isolation

The dMix128 control system shall operate on a trusted, isolated network.

14. Conclusion

This specification defines the correct and supported method for integrating the Violet Audio dMix128 into professional control and automation environments. Any deviation from these principles may result in undefined behaviour and is not supported.

Appendix B – Example Key Tables

B.1 Input Channel Keys (Examples)

Function	Internal Key	Type	Notes
Input fader	i.N.mix	Numeric	dB, native
Input mute	i.N.mute	Boolean	1.0 = mute
Input gain	i.N.gain	Numeric	Pre-DSP
EQ band gain	i.N.eq.bX.gain	Numeric	X = band index
EQ band freq	i.N.eq.bX.freq	Numeric	Hz
Aux send	i.N.aux.M.value	Numeric	Send to aux M

B.2 Bus & Output Keys

Function	Internal Key	Type	Notes
Aux mix level	a.N.mix	Numeric	dB
Aux mute	a.N.mute	Boolean	1.0 = mute
Matrix output	x.N.mix	Numeric	dB

Function	Internal Key	Type	Notes
Master fader	m.mix	Numeric	dB

B.3 System & Action Keys

Function	Internal Key	Type	Notes
Load snapshot	load.snapshot.N	Action	Instant recall
Save snapshot	save.snapshot.N	Action	Maintenance only
VCA mute	v.N.mute	Boolean	Group mute

Appendix C – Snapshot Strategy

C.1 Snapshot Philosophy

Snapshots in the dMix128 are intended for **macro-level state changes**, not continuous control. Typical uses include: - Room configuration changes - Event mode selection - Emergency / override states - System startup or shutdown conditions

Snapshots are not intended to replace real-time control of faders or EQ.

C.2 Snapshot Ownership Rules

- Snapshots are owned by the **system designer**, not operators
- Snapshot creation and modification shall be restricted to commissioning or maintenance phases
- External automation systems may **recall** snapshots but shall not overwrite them during normal operation

C.3 Snapshot Granularity

Recommended snapshot contents: - Mute states - Routing changes - VCA assignments - Global EQ enable/disable

Avoid storing: - Fine fader moves - Rapidly changing parameters

C.4 Snapshot Recall Best Practices

- Use snapshots for predictable transitions only
 - Avoid chaining multiple snapshot recalls
 - Allow sufficient settling time between recalls
-

Appendix D – Control System Responsibility Matrix

D.1 Responsibility Overview

The following matrix defines **recommended responsibility boundaries** between the dMix128 and external control systems.

Function	dMix128	Q-SYS	Biamp	Crestron	HiQnet
Audio DSP	✓	✗	✗	✗	✗
Routing	✓	UI only	Limited	UI only	Supervisory
Fader control	✓	✓	✓	✓	✗
Snapshot storage	✓	Recall only	Recall only	Recall only	✗
Automation logic	✗	✓	✓	✓	✓
UI rendering	✗	✓	✓	✓	✓
State authority	✓	✗	✗	✗	✗

D.2 Key Rules

- dMix128 is always the **authoritative source of truth**
- External systems may request changes but never assume ownership
- UI systems reflect state; they do not define it

Appendix E – Example Control Sequences

E.1 System Power-Up Sequence

Objective: Bring the dMix128 and all connected control systems into a known, safe operational state after power is applied.

Sequence Overview: 1. Network infrastructure powers up (switches, VLANs active) 2. dMix128 boots and exposes control services 3. External control systems establish connections 4. State synchronisation completes 5. System enters default standby state

Detailed Steps:

Step	Actor	Action
1	dMix128	Boot DSP engine and initialise KeyStore
2	dMix128	Open WebSocket, ECP, VSKP, QRC services
3	Control system	Establish TCP connection
4	Control system	Issue INIT request
5	dMix128	Respond with full key/value state

Step	Actor	Action
6	Control system	Populate UI from returned state
7	Control system	Recall "Power-Up / Safe" snapshot

Notes: - No control commands shall be issued prior to INIT completion - Power-up snapshot should mute all outputs and disable non-essential routing

E.2 Show Start / Event Start Sequence

Objective: Transition the system from standby into an active show or event configuration in a predictable, repeatable manner.

Typical Trigger Sources: - Q-SYS control panel - Crestron touch panel - Automation scheduler

Sequence Overview: 1. Operator initiates show start 2. Snapshot recall establishes baseline 3. Selected channels and buses unmute 4. Operator assumes real-time control

Detailed Steps:

Step	Actor	Action
1	Operator / Control UI	Trigger "Show Start"
2	Control system	Recall Show snapshot (load.snapshot.N)
3	dMix128	Apply routing, mute, VCA states
4	Control system	Verify key state feedback
5	Operator	Begin live mixing

Notes: - Avoid additional automation immediately after snapshot recall - Allow brief settling time before unmuting PA

E.3 Emergency Mute / All-Stop Sequence

Objective: Immediately silence all outputs in response to an emergency condition.

Typical Triggers: - Fire alarm interface - Safety system - Dedicated emergency button

Sequence Overview: 1. Emergency trigger asserted 2. Global mute keys set 3. System remains muted until manual reset

Detailed Steps:

Step	Actor	Action
1	Safety system	Assert emergency signal

Step	Actor	Action
2	Control system	Issue mute commands or recall Emergency snapshot
3	dMix128	Mute master, buses, matrices
4	Control system	Confirm mute state via feedback
5	Operator	Perform manual reset when safe

Recommended Implementation: - Use a dedicated Emergency snapshot containing only mute states - Do not rely on wildcard writes in safety-critical paths - Emergency logic should be independent of UI availability

Appendix F – Network Topology & VLAN Examples

F.1 Network Design Objectives

The network architecture supporting dMix128 shall: - Ensure deterministic, low-latency control communication - Isolate audio and control traffic from general IT services - Support multi-client control without broadcast congestion - Allow safe expansion for future services (e.g. Dante, AES67)

The dMix128 control system assumes a **trusted, managed network environment**.

F.2 Recommended VLAN Segmentation

VLAN	Purpose	Typical Devices
VLAN 10	Control & Automation	dMix128, Q-SYS, Crestron, Biamp
VLAN 20	Audio Transport	Dante, AES67, stageboxes
VLAN 30	User Interfaces	Touch panels, tablets
VLAN 40	Management	Monitoring PCs, service laptops

Rules: - dMix128 control ports shall be reachable only from VLAN 10 and VLAN 40 - Inter-VLAN routing must be explicit and firewall-controlled - No internet gateway access required for VLAN 10

F.3 Small System – Single Switch Topology

Use Case: Small venue, single rack, minimal external control

Topology Description: - One managed Layer-2 or Layer-3 switch - dMix128 and control systems connected locally - Logical VLAN separation implemented on same hardware

Characteristics: - Simple deployment - Low cost - Suitable for theatres, houses of worship, rehearsal spaces

Notes: - Ensure switch supports VLAN tagging and QoS - Disable unused services (STP edge ports recommended)

F.4 Medium System – Distributed Control Topology

Use Case: Performance venue or corporate install with multiple control endpoints

Topology Description: - Core switch with VLAN routing - Edge switches for FOH, racks, and control rooms - Dedicated Control VLAN for dMix128 protocols

Characteristics: - Scalable - Supports multiple operators - Clean separation of responsibilities

Notes: - Use managed switches only - Avoid unmanaged switches or consumer Wi-Fi routers

F.5 Large / Campus System – Core–Edge Architecture

Use Case: Broadcast facilities, campuses, theme parks

Topology Description: - Redundant core switches - Multiple edge switches per zone - Centralised monitoring and automation

Characteristics: - High availability - Supports remote control rooms - Future-proof for audio networking expansion

Notes: - Control VLAN must be prioritised - Consider redundant power for network infrastructure

F.6 Quality of Service (QoS) Recommendations

- Prioritise control TCP traffic over general data
- Reserve bandwidth for audio transport VLANs
- Avoid rate limiting on control VLAN

Recommended: - DSCP tagging where available - Separate queues for audio vs control

F.7 Wireless Access Considerations

- Wi-Fi is suitable for **non-critical UI only**

- Avoid placing dMix128 itself on Wi-Fi
 - Tablets and mobile devices should bridge into Control VLAN via firewall rules
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F.8 Common Network Errors to Avoid

- Flat networks with no VLAN separation
 - Consumer switches lacking proper buffering
 - Wi-Fi control for safety-critical functions
 - Direct WAN exposure of control ports
-

Appendix G – Redundancy & Failover Models

G.1 Redundancy Design Objectives

Redundancy and failover strategies for dMix128-based systems shall: - Prevent single points of failure where practical - Ensure predictable behaviour during fault conditions - Preserve deterministic control state - Fail safely, not silently

The dMix128 control architecture supports **graceful degradation**, even when full redundancy is not deployed.

G.2 Control Path Redundancy (Recommended)

Model: Multi-client peer control

Description: - Multiple control systems (e.g. Q-SYS, Crestron, local web UI) connect simultaneously - Loss of any single control client does not affect mixer operation

Behaviour on Failure: - Audio continues uninterrupted - Remaining control clients retain full access - No state rollback or reset occurs

Best Practice: - Always provide at least two independent control paths (e.g. fixed panel + browser access)

G.3 Network Infrastructure Redundancy

Model: Redundant switching and power

Recommended Elements: - Managed switches with redundant power supplies - Dual power feeds where possible - UPS for network and control infrastructure

Behaviour on Failure: - Temporary control loss may occur during switch reconvergence - Audio processing within dMix128 continues unaffected

Notes: - Control VLANs should converge faster than general IT VLANs - Avoid spanning tree topologies with long reconvergence times

G.4 Snapshot-Based Recovery Model

Model: Deterministic state recovery via snapshots

Description: - Known-good snapshots define safe and operational states - Used after power restoration or system reset

Recommended Snapshots: - Power-Up / Safe - Show Start / Event Mode - Emergency Mute

Behaviour: - Snapshots reassert intended state - No reliance on external system memory

G.5 External Control System Failure

Scenario: Loss of Q-SYS, Crestron, or automation host

Result: - dMix128 continues audio processing - Current mixer state is preserved - Remaining control clients continue operation

Recovery: - Failed control system reconnects - INIT resynchronises full state - No manual reconciliation required

G.6 Network Partition or VLAN Failure

Scenario: Temporary loss of control VLAN connectivity

Result: - Audio continues in last valid state - Control unavailable until network restored

Recovery: - Control systems reconnect automatically - INIT restores state visibility

Design Rule: - Emergency mute must not rely solely on IP networks

G.7 Emergency & Safety Failover

Model: Hardwired or dedicated logic trigger

Recommendations: - Emergency mute logic independent of UI availability - Dedicated snapshot or direct key set - Physical emergency interfaces preferred

Fail-Safe Behaviour: - System defaults to muted state on critical failure - Manual reset required to restore audio

G.8 What dMix128 Is Not

To avoid incorrect assumptions: - dMix128 does not require primary/secondary control masters - dMix128 does not rely on controller state memory - dMix128 does not lose audio on control failure

G.9 Redundancy Design Summary

Failure Type	Audio Impact	Control Impact	Recovery Method
Control client loss	None	Reduced	Automatic
Network switch failure	None	Temporary	Automatic
VLAN outage	None	Temporary	Automatic
Emergency trigger	Muted	Restricted	Manual reset

Appendix H – Commissioning & Acceptance Test Checklist

H.1 Purpose

This checklist defines the minimum commissioning and acceptance tests required to validate a dMix128 installation prior to handover. All items should be verified jointly by the system integrator and client representative.

H.2 Pre-Commissioning Verification

Physical & Power - dMix128 mounted securely and labelled - Primary and secondary power sources connected (if applicable) - UPS operational and tested (where specified)

Network Infrastructure - Managed switches installed - VLANs configured as per Appendix F - QoS enabled where required - No control ports exposed to WAN

H.3 Network & Connectivity Tests

- dMix128 reachable on Control VLAN

- Control protocol ports accessible (ECP, VSKP, QRC, OSC as specified)
 - INIT sequence completes successfully for each control system
 - Reconnection tested after cable disconnect
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-

H.4 Control System Integration Tests

General Control - Input fader control verified - Input mute control verified - Bus and master fader control verified - EQ parameter control verified

Feedback & State - UI reflects real-time mixer state - Multi-client control tested concurrently - No shadow state observed

H.5 Snapshot Verification

- Power-Up / Safe snapshot recall verified
 - Show Start / Event snapshot recall verified
 - Emergency snapshot recall verified
 - Snapshots do not overwrite live adjustments unexpectedly
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-

H.6 Operational Sequence Tests

- Full power-cycle test completed
 - Show start sequence executed successfully
 - Emergency mute triggers tested
 - Manual reset required and verified after emergency
-
-

H.7 Redundancy & Failure Tests

- Control system disconnected – audio continues
 - Network switch reboot – audio continues
 - Control reconnection restores full state via INIT
-
-

H.8 Documentation & Handover

- Network diagrams supplied
 - Snapshot list and descriptions supplied
 - Control system source files archived
 - Operator training completed
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H.9 Acceptance Sign-Off

Role	Name	Signature	Date
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Integrator			
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Client			
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End of Specification