



LMP SH-IP & HRNL-25W SW-P-08 PRO-BEL PROTOCOL GUIDE

Public protocol integration guide

DATASHEET

PRO-BEL

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Purpose

This guide explains how an LMPSH-IP or HRNL-25W device accepts and reports SW-P-08 Pro-Bel crosspoints. It covers the exact public wire format, target mapping, state meanings, ordered TCP exchange and a working sender example.

NOTE This is a public integration guide for the implemented SW-P-08 interface. Check the firmware version through the device health page before relying on version-specific behaviour.



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LMP SH-IP & HRNL-25W

SW-P-08 PRO-BEL PROTOCOL GUIDE

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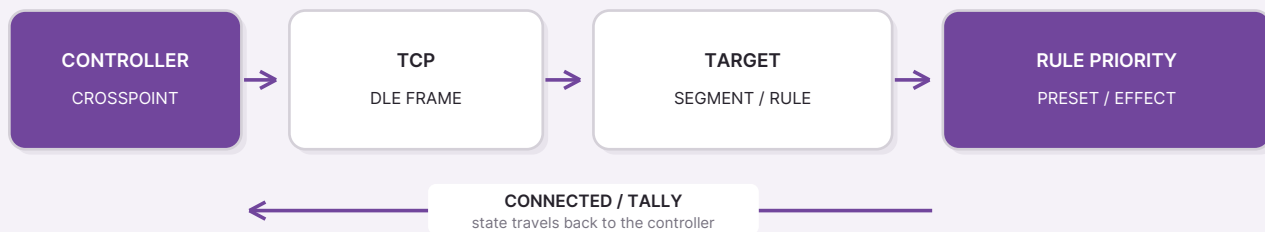
01 • Overview

What the interface does

A controller opens a TCP connection and addresses crosspoints by Matrix, Destination and Source. Each Destination maps to one device rule. Source 0 requests that rule Off; Source 1 requests it On. The rule's configured preset/effect and segment priority determine the visible LED result.

FROM ROUTER CROSSPOINT TO LIGHT OUTPUT

CONNECT selects a target state. Rules and priority determine the visible LED result.



Pro-Bel changes Rule Active only; it does not carry an LED colour or effect value.

ITEM	IMPLEMENTED CONTRACT
Role	Bidirectional crosspoint control and state reporting for Rule Active.
Transport	Plain TCP server on the configured Pro-Bel port; stored default 2000.
Connections	0 disables the service; request 1–7 slots. Runtime availability is shared with other enabled network services.
Matrix	Only matrix level 0 maps to LMPSH-IP and HRNL-25W rule targets.
Target plane	Five consecutive destinations per active segment; up to 225 active targets on supported HRNL-25W configurations.
State	Source 0 = Off; Source 1 = On. Send only these two canonical source values.
Visible output	The destination changes one Rule Active value; it does not carry a colour, preset or effect.

NOTE The public wire contract and the XICHTEE target/LED mapping are distinct. A protocol-level On state may be hidden by a higher-priority active rule on the same segment.



02 · Configure the device

Enable the TCP service

Open Socket Config in the device web interface. Set a Pro-Bel TCP port, request at least one Pro-Bel socket, save the settings, and restart when requested. The listener becomes available after normal operation resumes.

SETTING	VALUE / GUIDANCE
Pro-Bel Port	Stored default 2000. Choose an unused TCP port from 1 to 65535.
Pro-Bel Sockets	Stored default 0 (disabled). Request 1–7 slots and review Free Sockets with the other enabled services.
Active segments	The selected hardware/licence mode determines the contiguous target count.
Rules	Each active segment contributes Rules 1–5 automatically; there is no separate Pro-Bel target assignment.
Preset / effect	Configure the visible behaviour for each rule that the controller will set On.
Restart	Apply the requested restart before testing a changed port or socket allocation.

Connection behaviour

One configured slot accepts one controller. On connection, the device sends one CONNECTED frame for every active destination in ascending order before it processes new requests. A connection with no receive or transmit progress may be closed after 15 minutes.

NOTE The configured count is a request, not a guaranteed dedicated capacity. HTTP, Ember+, TSL, Cluster and other enabled services share the device's network sockets.

IMPORTANT SW-P-08 has no application authentication or encryption. Keep the listener on an isolated, trusted control network or behind a trusted security boundary.



03 · Routing matrix

Five targets per segment

The crosspoint view places targets across the top and the two logical sources down the left. Each active segment contributes five consecutive targets. The target label is one-based for operators; the protocol Destination value is zero-based. For example, Segment 2 Rule 2 is Target 7 and Destination 6.

EXAMPLE - THREE-SEGMENT PRO-BEL CROSSPOINT MATRIX

Targets run from left to right; sources run from top to bottom. A purple dot marks each selected crosspoint.

TARGETS	SEGMENT 1					SEGMENT 2					SEGMENT 3				
	T01 D0	T02 D1	T03 D2	T04 D3	T05 D4	T06 D5	T07 D6	T08 D7	T09 D8	T10 D9	T11 D10	T12 D11	T13 D12	T14 D13	T15 D14
SOURCE 0 OFF		●	●		●	●		●	●		●		●	●	
SOURCE 1 ON	●			●			●			●		●			●

Reading the matrix

Read down from a target to the purple crosspoint. T01 / D0 is routed to Source 1, so that rule is On.

Each segment adds five targets. Source 0 reports Off and Source 1 reports On.

SEGMENT	OPERATOR TARGET LABELS	SW-P-08 DESTINATION VALUES
1	T01 – T05	0 – 4
2	T06 – T10	5 – 9
3	T11 – T15	10 – 14
N	T(5N-4) – T(5N)	5(N-1) – 5N-1

IMPORTANT LMPSH-IP supports up to 2 active segments (10 targets). HRNL-25W normally supports 5 (25 targets) and up to 45 (225 targets) with Extended Segments. A destination outside the active map is not applied.



04 • Packet anatomy

Frame, length and integrity

TCP is a byte stream: one frame may arrive across several reads, and one read may contain several frames or an ACK followed by a framed reply. Reassemble DLE-delimited messages and do not treat a TCP read boundary as a packet boundary.

SW-P-08 • DLE-FRAMED MESSAGE

Field sizes below are before DLE byte stuffing. Delimiters are not part of BTC or checksum.

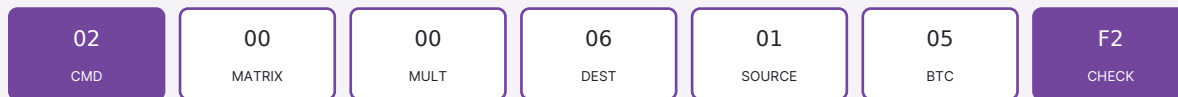


BTC = payload byte count before stuffing

Checksum covers PAYLOAD + BTC

$(\text{sum}(\text{payload}) + \text{BTC} + \text{checksum}) \bmod 256 = 0$

WORKED CONNECT BODY • DESTINATION 6 ON



DLE BYTE STUFFING

body 10 → wire 10 10

Stuff payload, BTC and checksum only.

Complete example: 10 02 02 00 00 06 01 05 F2 10 03

RULE	DETAIL
Envelope	10 02 starts a frame; 10 03 ends it. ACK 10 06 and NAK 10 15 are separate unframed control pairs.
BTC	Exactly the unstuffed payload length. It excludes BTC, checksum and both delimiters.
Checksum	Two's complement of BTC plus all unstuffed payload bytes; the total including checksum is 00 modulo 256.
Stuffing	Double each 10 byte inside payload, BTC or checksum. Stuffing does not change BTC or checksum.
Request destination	$D = (((\text{Multiplier} \gg 4) \& 7) \times 128) + \text{Destination}$. Send unused Multiplier bits as zero and $\text{Destination} = D \bmod 128$.
Device response target	Multiplier is 00; Destination carries the full product target byte, including 80-E0 hex for D128-D224.

IMPORTANT Send the canonical payload sizes shown in this guide. If a DLE escape or stream boundary becomes uncertain, close the connection, reconnect, and rebuild state from the new initial snapshot.



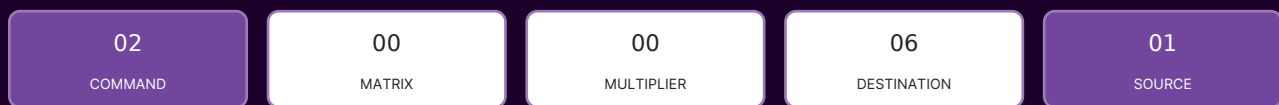
05 • Commands and state

CONNECT maps a Source to Rule Active

Use Matrix 0 and an active Destination. Source 1 requests On; Source 0 requests Off. The device returns an unframed ACK for a valid outer frame before it evaluates the command.

CONNECT • TARGET 7 / DESTINATION 6

The Source byte requests the Rule Active state. It does not select an LED colour.



VISIBLE RESULT The target changes one rule. A lower-numbered active rule may still be visible instead.

After CONNECT, use INTERROGATE → TALLY when the current Rule Active value must be confirmed.

Response outcomes

CONTROLLER MESSAGE	DEVICE STREAM	MEANING
Mapped Matrix 0 CONNECT	10 06, then CONNECTED	Frame is valid; the response reflects the request in writable mode.
Mapped Matrix 0 INTERROGATE	10 06, then TALLY	TALLY reports the current Rule Active state.
Wrong matrix, inactive target or unsupported command	10 06 only	Frame is valid, but no command result is produced.
Completed frame with bad BTC/checksum or too-short body	10 15	Correct the frame before retrying.
Broken delimiter/escape or no complete frame	No reply is guaranteed	Reconnect when stream alignment is uncertain.

IMPORTANT ACK proves only frame-level validity. If a maintained Follow GPI or Logic input owns the rule, CONNECT does not change it even though writable-mode CONNECTED echoes the requested Source. Use INTERROGATE and TALLY for decisive Rule Active readback.



06 · Working sender example

Worked CONNECT frame

This example requests Segment 2 / Rule 2 On. Its operator label is Target 7 and its zero-based wire Destination is 6.

PART	CALCULATION	HEX
Payload	CONNECT · Matrix 0 · Multiplier 0 · Destination 6 · Source 1	02 00 00 06 01
BTC	Five unstuffed payload bytes	05
Checksum	$-(02 + 00 + 00 + 06 + 01 + 05) \bmod 256$	F2
Wire	DLE STX + body + DLE ETX; no body byte needs stuffing	10 02 ... F2 10 03

Minimal Python 3 sender

```
import socket

DEVICE, PORT = "192.0.2.10", 2000 # documentation-only address

def sw_p08_frame(payload):
    payload = bytes(payload)
    if not 1 <= len(payload) <= 255:
        raise ValueError("payload must contain 1..255 bytes")
    btc = len(payload)
    checksum = (-btc - sum(payload)) & 0xFF
    body = payload + bytes([btc, checksum])
    body = body.replace(b"\x10", b"\x10\x10")
    return b"\x10\x02" + body + b"\x10\x03"

destination = 6
multiplier = (destination // 128) << 4
payload = bytes([0x02, 0x00, multiplier,
                 destination % 128, 0x01])
wire = sw_p08_frame(payload)
expected_wire = bytes.fromhex("10 02 02 00 00 06 01 05 F2 10 03")
expected_reply = bytes.fromhex("10 06 10 02 04 00 00 06 01 05 F0 10 03")
assert wire == expected_wire

with socket.create_connection((DEVICE, PORT), timeout=3) as peer:
    peer.sendall(wire)
    stream = bytearray()
    while expected_reply not in stream:
        chunk = peer.recv(4096)
        if not chunk: raise ConnectionError("device closed the connection")
        stream.extend(chunk)
        if b"\x10\x15" in stream: raise RuntimeError("DLE NAK")
    print("CONNECTED D6 ON")
```

NOTE Run this example against the writable current master. It keeps reading across TCP boundaries until the exact unframed ACK and following CONNECTED frame appear after the initial snapshot. A production controller should use a general stream decoder for all snapshot, control and framed messages.

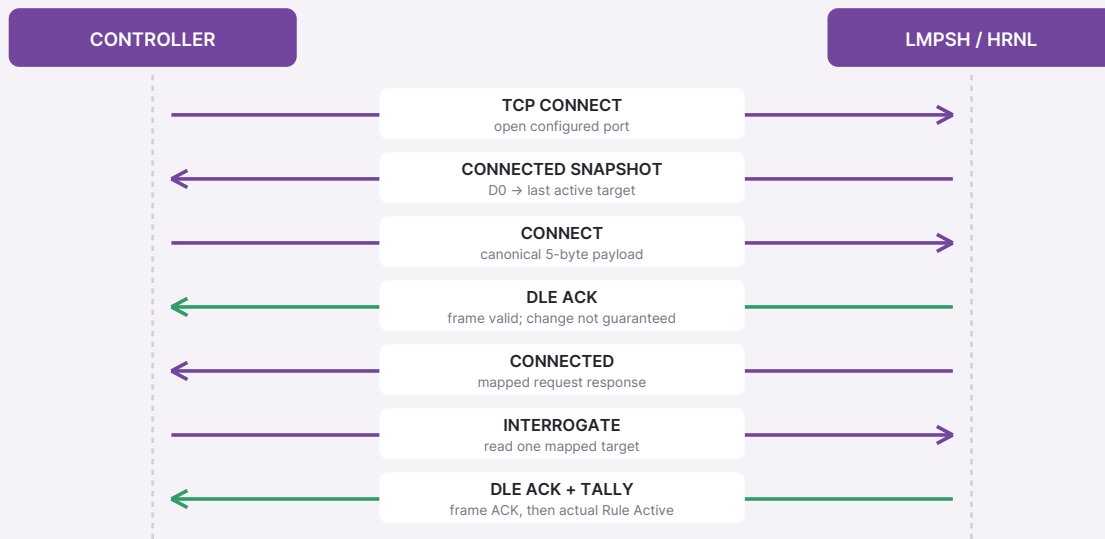
07 • TCP exchange

Snapshot, request and readback

Consume the complete initial snapshot before correlating later request results. Serialize commands unless your client can match the ordered ACK and application replies in a continuous TCP stream.

NORMAL TCP EXCHANGE

Read the TCP byte stream continuously: one read may contain part of a frame, several frames, or ACK plus a frame.



UNSOLICITED CONNECTED

Locally generated Rule Active changes are reported while the connection remains open.

SITUATION	CONTROLLER ACTION
New connection	Read CONNECTED for every active destination, D0 through the last active target.
Set a route	Send one canonical CONNECT; expect ACK, then CONNECTED only for a valid mapped Matrix 0 target.
Confirm Rule Active	Send INTERROGATE; expect ACK, then TALLY with Source 0 or 1.
Other local state change	Accept unsolicited CONNECTED updates and refresh the matching target.
15-minute idle interval	Send a periodic INTERROGATE before the idle limit, or reconnect and accept a fresh snapshot.
Disconnect / restart	Reconnect, read the snapshot and reconcile it with current controller intent. A restart can restore an older saved Active state.

Keep reading the TCP stream. During a brief receive pause, pending state reports retain the latest state for each destination; intermediate changes may be coalesced. If output cannot progress, the device closes the stalled connection. Reconnect, consume the complete initial snapshot, then use INTERROGATE/TALLY to reconcile current state with controller intent.

NOTE Initial snapshots and unsolicited updates use CONNECTED. TALLY is sent only as the response to a valid mapped INTERROGATE. These responses report running state; they do not acknowledge that the latest CONNECT has been saved.



08 • Operational guidance

Interpret each response in context

SIGNAL	WHAT IT PROVES
DLE ACK	The complete frame passed BTC and checksum validation. It does not prove that a destination mapped or changed.
CONNECTED after initial connection	Current Rule Active state at the time the initial snapshot was built.
CONNECTED after writable CONNECT	The interpreted requested Source. Use TALLY if maintained-input ownership may block the change.
Unsolicited CONNECTED	A locally generated Rule Active update while the client is connected.
TALLY after INTERROGATE	Current Rule Active state for the mapped destination.
Visible LEDs	The highest-priority active rule's configured preset/effect, not necessarily the last target set On.

Clustered systems

Send CONNECT only to the current active master. A Follower keeps Pro-Bel available for readback but does not apply CONNECT; its reply reports the current local rule state. A standby Backup does not keep the Pro-Bel service open until it is promoted. Reconnect after authority changes. On a Follower, use INTERROGATE or a new snapshot for fresh state rather than relying on unsolicited Cluster-origin updates.



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Troubleshooting

SYMPTOM	CHECK
No TCP connection	Confirm the port, requested and available Pro-Bel sockets, applied restart, network reachability and Cluster role.
ACK but no state frame	Check Matrix 0, active destination and supported command. ACK alone confirms only the outer frame.
CONNECTED but rule did not change	Issue INTERROGATE. Check maintained Follow GPI/Logic ownership and whether this member can accept writes.
Rule is On but LEDs show another effect	Check lower-numbered active rules; Rule 1 has the highest segment priority.
NAK	Recalculate BTC and checksum from unstuffed bytes, then check DLE stuffing.
No reply and alignment is uncertain	Close the TCP connection, reconnect, and accept the new initial snapshot.

Rule Active retention

Rule Active states are saved automatically and restored at startup from the last verified save. Accepted manual, protocol, input and Cluster changes are included. Maintained GPI/Logic inputs and current Cluster authority can replace the restored state.

After an idle period, an unchanged Active state is normally saved after about 30 seconds. Further background Active saves are spaced at least 120 seconds apart; continuing changes become eligible after about 120 seconds of unsaved changes. Busy traffic, saving, updates or recovery can delay this, while a configuration save can capture Active sooner.

A controlled restart saves and verifies the Active state captured for that restart; stop sending changes once it is requested. Later changes are outside that snapshot. If saving cannot finish, the restart can remain pending. Sudden power loss or an unexpected reset restores the last verified save, which may be older than the displayed state.

IMPORTANT Use one authoritative writer per target. Retain current controller intent, reconcile it after reconnect or failover, and verify effective Rule state and output. Neither readback nor a fixed wait proves that a particular Active change has been saved.



09 • Reference

Quick reference

TOPIC	VALUE
Protocol	Implemented Pro-Bel SW-P-08 crosspoint subset over TCP
TCP service	Stored port 2000; sockets 0 disabled or 1–7 requested, subject to shared runtime capacity
Matrix	0
Targets	Five per active segment; active Destination range 0 through (5 × active segments) – 1; maximum D224
Sources	Send 00 for Off or 01 for On
Frame	10 02 + stuffed payload/BTC/checksum + 10 03
Checksum	Two's complement of unstuffed payload plus BTC
Control pairs	ACK 10 06; NAK 10 15
Idle policy	Connection may close after 15 minutes with no receive or transmit progress

Canonical payloads

DIRECTION	MESSAGE	PAYLOAD FIELD ORDER
Controller → device	INTERROGATE 01	01 · Matrix · Multiplier · Destination
Controller → device	CONNECT 02	02 · Matrix · Multiplier · Destination · Source
Device → controller	TALLY 03	03 · 00 · 00 · full Destination byte · Source
Device → controller	CONNECTED 04	04 · 00 · 00 · full Destination byte · Source

Validated examples

MESSAGE	WIRE HEX
CONNECT D6 On	10 02 02 00 00 06 01 05 F2 10 03
ACK + CONNECTED D6 On	10 06 · 10 02 04 00 00 06 01 05 F0 10 03
INTERROGATE D6	10 02 01 00 00 06 04 F5 10 03
TALLY D6 On	10 02 03 00 00 06 01 05 F1 10 03
CONNECT D16 On · stuffed	10 02 02 00 00 10 10 01 05 E8 10 03

Compatibility

This guide applies to LMPSH-IP and HRNL-25W firmware v1.3.0 Release (build 310). It documents the implemented INTERROGATE/CONNECT/TALLY/CONNECTED subset and product-specific TCP, target and Cluster behaviour.

IMPORTANT The protocol is unauthenticated and unencrypted. Its checksum detects accidental frame corruption; it is not cryptographic integrity or replay protection. Restrict access to authorised control systems.