Digitrax Notes

Paul C. L. Willmott

November 12, 2021

Contents

Chapter 1

Loconet Protocol

1.1 Opcodes

OPC_BUSY

Operation: Indicates that the master is busy.

Group: 2-Byte Message

Direction: ↔ Command Station

Encoding:

Byte 0:

1	0	0	0	0	0	0	1	0x81	Opcode.

Byte 1:

0	1	1	1	1	1	1	0	0x7E	Checksum.

Description:

This message indicates that the master is busy. When sent to a command station it responds with an OPC_PEER_XFER message.

Response:

None.

Notes:

None.

OPC_GPOFF

Operation: Global power off request.

Group: 2-Byte Message

Direction: → Command Station

Encoding:

Byte 0:

1	0	0	0	0	0	1	0	0x82	Opcode.

Byte 1:

0	1	1	1	1	1	0	1	0x7D	Checksum.

Description:

This command turns off the track power.

Response:

None.

Notes:

None.

OPC_GPON

Operation: Global power on request.

Group: 2-Byte Message

Direction: → Command Station

Encoding:

Byte 0:

1	0	0	0	0	0	1	1	0x83	Opcode.

Byte 1:

0	1	1	1	1	1	0	0	0x7C	Checksum.

Description:

This command sends a global power on request.

Response:

The command station sends an OPC_RQ_SL_DATA message for slot 0x7F. It also sends a sequence of OPC_SW_REQ messages with the following values of SW1 and SW2:

SW1	SW2
0x78	0x27
0x79	0x27
0x7A	0x27
0x7B	0x27
0x78	ox07
0x79	0x07
0x7A	0x07
0x7B	0x07

Notes:

None.

OPC_IDLE

Operation: Force idle state and broadcast emergency stop.

Group: 2-Byte Message

Direction: → Command Station

Encoding:

Byte 0:

1	0	0	0	0	1	0	1	0x85	Opcode.

Byte 1:

0	1	1	1	1	0	1	0	0x7A	Checksum.

Description:

This command forces Loconet into the idle state and broadcasts an emergency stop.

Response:

None

Notes:

None.

OPC_INPUT_REP

Operation: General sensor input report.

Group: 4-Byte Message

Direction: General sensor →

Encoding:

Byte 0:

1	0	1	1	0	0	1	0	0xB2	Opcode.

Byte 1:

0	d6	d5	d4	d3	d2	d1	d0	<IN1>	Sensor address A7 to A1.

d6 A7.
d5 A6.
d4 A5.
d3 A4.
d2 A3.
d1 A2.
d0 A1.

Byte 2:

0	1	d5	d4	d3	d2	d1	d0	<IN2>	Switch address A11 to A8 and sensor input state.

d5 A0.
d4 Input state. 1 means sensor input >= 6V, and 0 means sensor input = 0V.
d3 A11.
d2 A10.
d1 A9.
d0 A8.

Byte 3:

0	n	n	n	n	n	n	n	<CHK>	Checksum.

Description:

General sensor report.

Response:

None.

Notes:

None.

OPC_LOCO_ADR

Operation: Request a slot number for a locomotive.

Group: 4-Byte Message

Direction: → Command Station

Encoding:

Byte 0:

1	0	1	1	1	1	1	1	0xBF	Opcode.

Byte 1:

0	n	n	n	n	n	n	n	<ADR2>	High address.

Byte 2:

0	n	n	n	n	n	n	n	<ADR>	Low address.

Byte 3:

0	n	n	n	n	n	n	n	<CHK>	Checksum.

Description:

This message requests the slot number for the selected locomotive address. If the locomotive is found in the slot table then the command station returns an OPC_SL_RD_DATA message with the slot information. If it is not found then the command station will put the locomotive into a free slot and then return an OPC_SL_RD_DATA message with the slot information. If there are no free slots then the command station returns an OPC_LONG_ACK error code.

Response:

OPC_SL_RD_DATA if success, otherwise OPC_LONG_ACK.

Notes:

The Loconet 1.1 specification specifies that <ADR2> value is 0x00.

OPC_LOCO_DIRF

Operation: Set locomotive direction and function F0 to F4 states.

Group: 4-Byte Message

Direction: → Command Station

Encoding:

Byte 0:

1	0	1	0	0	0	0	1	0xA1	Opcode.

Byte 1:

0	n	n	n	n	n	n	n	<SLOT#>	Slot number in the range 0x00 to 0x7F.

Byte 2:

0	d6	d5	d4	d3	d2	d1	d0	<DIRF>	Locomotive's direction and state of functions F0 to F4.

d6 Reserved. Set to 0.
d5 Locomotive direction. 1 means forward, 0 means backwards.
d4 F0 state. 1 means on, and 0 means off.
d3 F4 state. 1 means on, and 0 means off.
d2 F3 state. 1 means on, and 0 means off.
d1 F2 state. 1 means on, and 0 means off.
d0 F1 state. 1 means on, and 0 means off.

Byte 3:

0	n	n	n	n	n	n	n	<CHK>	Checksum.

Description:

This function sets the locomotive's direction and function F0 to F4 states.

Response:

None.

Notes:

None.

OPC_LOCO_SND

Operation: Set locomotive sound functions.

Group: 4-Byte Message

Direction: → Command Station

Encoding:

Byte 0:

1	0	1	0	0	0	1	0	0xA2	Opcode.

Byte 1:

0	n	n	n	n	n	n	n	<SLOT#>	Slot number in the range 0x00 to 0x7F.

Byte 2:

0	d6	d5	d4	d3	d2	d1	d0	<SND>	Locomotive's function F5 to F8 states.

d6 Reserved. Set to 0.
d5 Reserved. Set to 0.
d4 Reserved. Set to 0.
d3 Reserved. Set to 0.
d3 Sound 4 / F8.
d2 Sound 3 / F7.
d1 Sound 2 / F6.
d0 Sound 1 / F5.

Byte 3:

0	n	n	n	n	n	n	n	<CHK>	Checksum.

Description:

This function sets the locomotive's function F5 to F8 states.

Response:

None.

Notes:

None.

OPC_LOCO_SPD

Operation: Set locomotive speed.

Group: 4-Byte Message

Direction: → Command Station

Encoding:

Byte 0:

1	0	1	0	0	0	0	0	0xA0	Opcode.

Byte 1:

0	n	n	n	n	n	n	n	<SLOT#>	Slot number in the range 0x00 to 0x7F.

Byte 2:

0	n	n	n	n	n	n	n	<SPD>	Locomotive speed in the range 0x00 to 0x7F. 0x00 means inertial stop and 0x01 means emergency stop. Other values mean increasing speed.

Byte 3:

0	n	n	n	n	n	n	n	<CHK>	Checksum.

Description:

This function sets the locomotive's speed.

Response:

None.

Notes:

None.

OPC_LONG_ACK

Operation: Long acknowledge.

Group: 4-Byte Message

Direction: → Command Station

Encoding:

Byte 0:

1	0	1	1	0	1	0	0	0xB4	Opcode.

Byte 1:

0	n	n	n	n	n	n	n	<LOPC>	Opcode that this message is a response to with the most significant bit set to 0.

Byte 2:

0	n	n	n	n	n	n	n	<ACK1>	Response code.

Byte 3:

0	n	n	n	n	n	n	n	<CHK>	Checksum.

Description:

This message provides a response code from a command.

Response:

None, it is the response.

Notes:

Responding Opcode	<LOPC>	<ACK1>	Meaning
OPC_SW_ACK	0x3D	0x00	DCS100 FIFO is full, command rejected.
OPC_SW_ACK	0x3D	0x7F	DCS100 command accepted.
OPC_MOVE_SLOTS	0x3A	0x00	Illegal move.
OPC_LINK_SLOTS	0x39	0x00	Invalid link, link failed.
OPC_SW_REQ	0x30	0x00	Command failed.
OPC_LOCO_ADR	0x3F	0x00	No free slot, command failed.

OPC_SL_RD_DATA

Operation: Returns slot data.

Group: Variable-Byte Message

Direction: Command Station →

Encoding:

Byte 0:

1	1	1	0	0	1	1	1	0xE7	Opcode.

Byte 1:

0	1	1	1	1	1	1	0	0x0E	Message length (14 bytes).

Byte 2:

0	n	n	n	n	n	n	n	<SLOT#>	Slot number in the range 0x00 to 0x7F. Slot 0x00 is a special slot, and slots in the range 0x70 to 0x7F are reserved to Digitrax.

Byte 3:

d7	d6	d5	d4	d3	d2	d1	d0	<STAT1>	Slot status 1.

d7	d6	
0	0	Free, no consist linking.
0	1	Consist sub-member.
1	0	Consist top-member.
1	1	Consist Mid-Consist member.

Note: d7 is set to 0 in the message by the command station and so may not correctly reflect the actual setting in the slot table.

d5	d4	
0	0	Free slot, no valid data. Not refreshed.
0	1	Common. Locomotive address in this slot. Refreshed.
1	0	Idle. Locomotive address in this slot. Not refreshed.
1	1	In Use. Locomotive address in this slot. Refreshed.

d3	
0	No slot consist linked into this slot.
1	Slot consist linked into this slot.

d2	d1	d0	
0	0	0	28 step decoder. 3-byte packet regular mode
0	0	1	28 step decoder. Generate trinary packets for this mobile address
0	1	0	14 step decoder.
0	1	1	128 step decoder.
1	0	0	28 step decoder. Allow advanced consisting
1	0	1	reserved
1	1	0	reserved
1	1	1	128 step decoder. Allow advanced consisting

Byte 4:

0	n	n	n	n	n	n	n	<ADR>	Low address.

Byte 5:

0	n	n	n	n	n	n	n	<SPD>	Speed in the range 0x00 to 0x7F. 0x00 means inertial stop and 0x01 means emergency stop. Other values mean increasing speed.

Byte 6:

0	d6	d5	d4	d3	d2	d1	d0	<DIRF>	Locomotive direction and state of functions F0 to F4.

d6 Reserved. Set to 0.
d5 Locomotive direction. 1 means forward, 0 means backwards.
d4 F0 state. 1 means on, and 0 means off.
d3 F4 state. 1 means on, and 0 means off.
d2 F3 state. 1 means on, and 0 means off.
d1 F2 state. 1 means on, and 0 means off.
d0 F1 state. 1 means on, and 0 means off.

Byte 7:

0	d6	d5	d4	d3	d2	d1	d0

<TRK> Global system track status.

d6 Reserved. Set to 0.
d5 Reserved. Set to 0.
d4 Reserved. Set to 0.
d3 1 means the programming track is busy.
d2 1 means this master implements Loconet version 1.1 capability, 0 means the master is a DT200.
d1 0 means the track is paused, broadcast an emergency stop.
d0 1 means the DCC packets are on in the master, global power up.

Byte 8:

0	d6	d5	d4	d3	d2	d1	d0

<SS2> Slot status 2.

d6 Reserved. Set to 0.
d5 Reserved. Set to 0.
d4 Reserved. Set to 0.
d3 1 means expansion in ID1/2, 0 means encoded alias.
d2 1 means expansion ID1/2 is not ID usage.
d1 Reserved. Set to 0.
d0 1 means this slot has suppressed advanced consist.

Byte 9:

0	n	n	n	n	n	n	n

<ADR2> High address.

Byte 10:

0	d6	d5	d4	d3	d2	d1	d0

<SND> Slot sound / function mode II packets.

d6 Reserved. Set to 0.
d5 Reserved. Set to 0.
d4 Reserved. Set to 0.
d3 Sound 4 / F8.
d2 Sound 3 / F7.
d1 Sound 2 / F6.
d0 Sound 1 / F5.

Byte 11:

0	n	n	n	n	n	n	n	<ID1>	7-bit ls ID code written by throttle when STAT2.4 = 1.

Byte 12:

0	n	n	n	n	n	n	n	<ID2>	7-bit ms ID code written by throttle when STAT2.4 = 1.

Byte 13:

0	n	n	n	n	n	n	n	<CHK>	Checksum.

Description:

This message is sent by the command station in response to a slot data request.

Response:

None.

Notes:

None.

OPC_SLOT_STAT1

Operation: Set slot status 1.

Group: 4-Byte Message

Direction: → Command Station

Encoding:

Byte 0:

1	0	1	1	0	1	0	1	0xB5	Opcode.

Byte 1:

0	n	n	n	n	n	n	n	<SLOT#>	Slot number in the range 0x00 to 0x7F.

Byte 2:

0	n	n	n	n	n	n	n	<STAT1>	Slot status 1. See OPC_SL_RD_DATA for bit encoding details.

Byte 3:

0	n	n	n	n	n	n	n	<CHK>	Checksum.

Description:

This function sets the slot's status 1 values.

Response:

None.

Notes:

None.

OPC_SW_ACK

Operation: Request switch command with acknowledge.

Group: 4-Byte Message

Direction: → Turnout controller

Encoding:

Byte 0:

1	0	1	1	1	1	0	1	0xBD	Opcode.

Byte 1:

0	d6	d5	d4	d3	d2	d1	d0	<SW1>	Switch address A6 to A0.

d6 A6.
d5 A5.
d4 A4.
d3 A3.
d2 A2.
d1 A1.
d0 A0.

Byte 2:

0	d6	d5	d4	d3	d2	d1	d0	<SW2>	Switch address A10 to A7 and switch control bits.

d6 Reserved. Set to 0.
d5 Direction. 1 means closed/green, and 0 means thrown/red.
d4 Output. 1 means on, and 0 means off.
d3 A10.
d2 A9.
d1 A8.
d0 A7.

Byte 3:

0	n	n	n	n	n	n	n	<CHK>	Checksum.

Description:

Command a turnout controller to a specified state and send acknowledge.

Response:

OPC_LONG_ACK.

Notes:

None.

OPC_SW_REP

Operation: Turnout sensor report.

Group: 4-Byte Message

Direction: Turnout sensor →

Encoding:

Byte 0:

1	0	1	1	0	0	0	1

0xB1 Opcode.

Byte 1:

0	d6	d5	d4	d3	d2	d1	d0

<SN1> Sensor address.

SN2.d6 = 1

- d6 A7.
- d5 A6.
- d4 A5.
- d3 A4.
- d2 A3.
- d1 A2.
- d0 A1.

SN2.d6 = 0

- d6 A6.
- d5 A5.
- d4 A4.
- d3 A3.
- d2 A2.
- d1 A1.
- d0 A0.

Byte 2:

0	d6	d5	d4	d3	d2	d1	d0

<SN2> Sensor address and sensor state.

SN2.d6 = 1

- d6 Report type. 1 means the report is an input report, and 0 means the report is an output report.
- d5 A0.
- d4 Input sensor state, 1 means sensor >= 6V, 0 means sensor = 0V.
- d3 A11.
- d2 A10.
- d1 A9.
- d0 A8.

SN2.d6 = 0

- d6 Report type. 1 means the report is an input report, and 0 means the report is an output report.
- d5 0 means closed output line is off, 1 means the closed output line is on.
- d4 0 means thrown output line is off, 1 means the thrown output line is on.
- d3 A10.
- d2 A9.
- d1 A8.
- d0 A7.

Byte 3:

0	n	n	n	n	n	n	n

<CHK> Checksum.

Description:

Turnout sensor report.

Response:

None.

Notes:

None.

OPC_SW_REQ

Operation: Request switch command.

Group: 4-Byte Message

Direction: → Turnout controller

Encoding:

Byte 0:

1	0	1	1	0	0	0	0	0xB0	Opcode.

Byte 1:

0	d6	d5	d4	d3	d2	d1	d0	<SW1>	Switch address A6 to A0.

d6 A6.
d5 A5.
d4 A4.
d3 A3.
d2 A2.
d1 A1.
d0 A0.

Byte 2:

0	d6	d5	d4	d3	d2	d1	d0	<SW2>	Switch address A10 to A7 and switch control bits.

d6	Reserved. Set to 0.
d5	Direction. 1 means closed/green, and 0 means thrown/red.
d4	Output. 1 means on, and 0 means off.
d3	A10.
d2	A9.
d1	A8.
d0	A7.

Byte 3:

0	n	n	n	n	n	n	n	<CHK>	Checksum.

Description:

Command a turnout controller to a specified state.

Response:

OPC_LONG_ACK if command failed, otherwise no response.

Notes:

None.

OPC_WR_SL_DATA

Operation: Write slot data.

Group: Variable-Byte Message

Direction: → Command Station

Encoding:

Byte 0:

1	1	1	0	1	1	1	1	0xEF	Opcode.

Byte 1:

0	1	1	1	1	1	1	0	0x0E	Message length (14 bytes).

Byte 2:

0	n	n	n	n	n	n	n	<SLOT#>	Slot number in the range 0x00 to 0x7F. Slot 0x00 is a special slot, and slots in the range 0x70 to 0x7F are reserved to Digitrax.

Bytes 3 to 12 encode the same as bytes 3 to 12 of OPC_SL_RD_DATA.

Byte 13:

0	n	n	n	n	n	n	n	<CHK>	Checksum.

Description:

This command sends the slot data to the command station.

Response:

Returns OPC_LONG_ACK.

Notes:

None.