Specification of LIN bus for Use by LINAK A/S

Contents

History.

Rev	Date	Init	Changes
1.0	20060309	MF	Initial version
1.1	20060420	MF	Added website where to purchase LIN specification. Corrected description for ID11, ID12 and ID13.
1.2	20070108	BIK	Twindrive functions (ID35) added to document
1.3	20090225	BIK	Twindrive ID35 command 145 added
1.4	20090227	BIK	Twindrive ID35 command 146-151 added
1.5	20090629	BIK	Twindrive ID35 extra DC commands added (146-165)
1.6	20090804	BIK	Twindrive ID35 extra commands 68-69 & 166-169 added
1.7	20091028	BIK	Twindrive ID35 Snore renamed to User functions
1.8	20100305	MF	Added new ID used for TD parallel in LIN bus Identifiers table
1.9	20101122	BIK	Corrected status byte in ID0-3
2.0	20120112	MF	Added new ID's for CBD6S and description of safety concept
2.1	20130215	BIK	Added Forced initialization for Ref 0 in ID37
2.2	20130614	MF	Renamed REFx to start from 1 to 8 instead of 0 to 7.
2.3	20130709	MF	Further corrected reference numbering
2.4	20140130	MF	Added length for master slave packages
2.5	20140514	MF	Removed reference to obsolete document in Identifier 28.
2.6	20140811	MF	Clarify function for ID39 and ID40. Specified use of ID37 over ID35.
2.7	20140819	MF	Cleaned up in never defined ID's and moved Twindrive ID's to new
2.8	20160112	MF	Added info about 255 is no movement command as well as wakeup
2.9	20160523	BIK	Added new "Reset down" command to ID37 (command = 76)
3.0	20160605	BIK	Added "Impulse toggle" and "Reset to defaults" to ID37
3.1	20160819	MF	Added ID21, ID22, ID23 and ID24 to used ID's list

Scope

The purpose of this document is to describe the LIN bus interface used by LINAK A/S and to make it possible for 3rd party to design devices to operate LINAK systems.

It is recommended to purchase a copy of the LIN Protocol Specification, revision 2.0, for better understanding of the concept. A free copy of the specification can be purchased on http://www.lin-subbus.org/.

The LIN Frame

LINAK LIN specification is based on LIN 2.0 but changed from the standard description to fit our needs. The biggest changes are that frame header does not contain sync field, frame timing requirement are different and we only use protocol and physical layer.

Frame Structure

The LIN bus always contains 1 master who keep the master schedule and one or more slaves. The basic message frame structure consists of a Header sent by the Master and a response section sent by one of the Slaves. All units connected to LIN bus receive all information's on the bus.

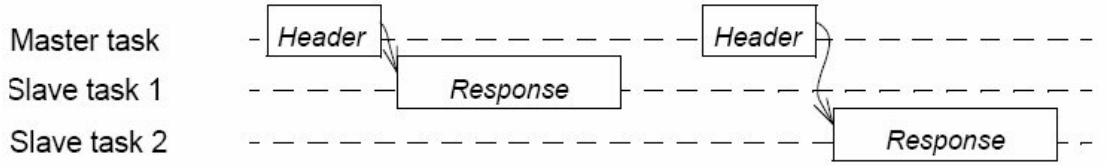

Figure 1

The Message frame itself is divided into several small pieces, each having its own well-defined function.

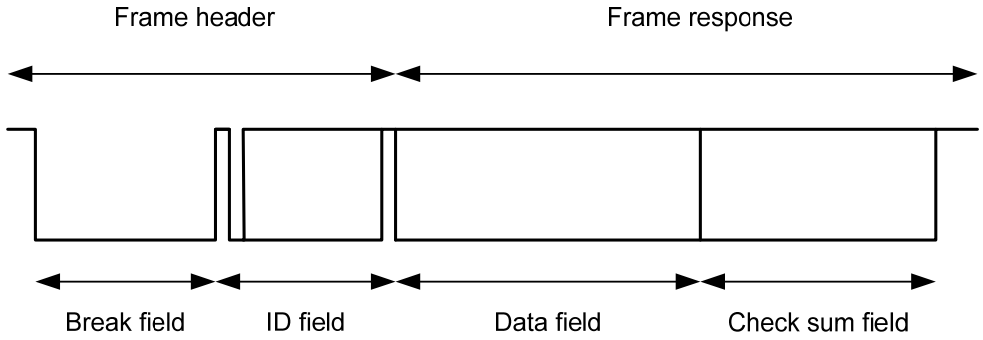

Figure 2

1. **BREAK FIELD** consists of a 13 bit dominant field followed by 1 bit Break Delimiter of at least 1 bit and is used to signal the beginning of a new frame.
2. **ID FIELD** is used by the Master to indicate the type of slave that should respond. The 6 LSB are for the Identifier itself and the 2 MSB are parity for the Identifier.
3. **DATA FIELD** contains the slave's respond. The amount of data can range from 1 to 8 bytes.

4. **CHECK SUM** is of type “modulus 255” and is used to check for data corruption. It is done in accordance with the LIN 2.0 Specification and therefore covers both ID and Data.

Note: LINAK does not transmit sync field as described in LIN specification.

All bytes are transmitted as serial bytes with LSB sent first.

Error handling

When a slave receives a break field then any pending transmission should be aborted and a new frame started.

It is recommended that each byte transmitted on LIN bus is verified and transmission of package is aborted on differences.

Frame timeout are used in some identifiers to indicate certain values or states.

Timing Characteristics

The LIN system keeps 2 timers, a frame timer and a bus timer.

Frame timer starts when a valid break followed by valid ID field are received. Depend on the expected numbers of characters the timer is set to elapse n*0.5 + 1 ms (±0.5ms). Where n is number of character expected for given identifier including check sum. If frame timer elapse any pending frame are aborted.

Bus timer resets every time a character is received (legal or illegal) and should timeout after 12ms without activity. Bus timer does not necessary needs to be implemented.

The Baud Rate used in the system is 19200 bit/sec (slave tolerance required ±2% maximum ±3.5%).

Electrical Characteristics

All LIN connectors use a standard RJ-45 connector with following layout.

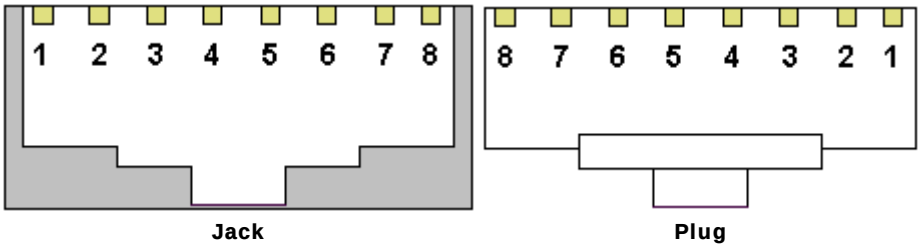

Figure 3

1. GND
2. HB01 Passive Keyboard Scan Input (optional, not part of LIN bus)
3. HB02 Passive Keyboard Scan Input (optional, not part of LIN bus)
4. HB03 Passive Keyboard Scan Input (optional, not part of LIN bus)
5. HB07 Passive Keyboard Scan Output (optional, not part of LIN bus)
6. LIN Bus signal
7. 12 Volt Out. Maximum 25mA Source
8. HB04 Passive Keyboard Scan Output / Mains Cut-Off Activation (optional, not part of LIN bus)

Supply

The supply voltage is between 9 and 14V.

LIN bus signal

Only the master on LIN bus has a 1kOhm pull up. Dominant level is below 0.4*supply voltage and the Recessive level is above 0.6* supply voltage.

Passive matrix

Deskline systems have a 2x3 passive matrix with support for 6 switches. HB04 and HB07 are outputs while HB01, HB02 and HB03 are inputs. The matrix is scanned with a rate of 5ms of each output line. If the matrix needs to be activated with other then a mechanical switch then construction must allow bidirectional current to flow.

The 3 input lines can have a resistor to GND pin to enable special functions used in plugs. Currently only one plug is defined with 4.7kOhm between GND and HB01 (anti-collision plug).

Other plugs are defines but not with resistors. Programming plug where GND-HB01-HB02-HB03-HB04 are connected. Simulator plug where HB01-HB02-HB04-HB07 are connected.

Mains cut-off and activation

HB04 also have the function to wake up the system when it is equipped with mains cut-off (wall plug). By pulling down the signal to GND with a minimum a current of 250uA powers up the system. The signal should be released when 12V supply appear to not interfere with passive matrix scanning.

LIN devices can also use this signal to supply themselves when mains are off. Up to 3 devices are intended and each allowed to draw maximum 15uA current and can expect a voltage of between 6 and 7.5V.

LIN bus Identifiers

A control box usually contains the Master in the system. The identifiers currently defined by LINAK and their appropriate responses are shown in the table's below.

New systems

A new system has been defined that is going to be used in all future systems. System has been designed so that both comfort/furniture systems and Deskline systems can share same LIN bus.

Two new input commands (ID37 and ID38) similar Twindrive ID35, and expanded to include both Twindrive and Deskline set of commands, and allows up to 8 references in one system. ID35 will no longer be used. Two commands is to allow two handsets to operate system simultaneously most likely only for separate functions like left/right bed or done for Deskline one for Twindrive. <TBD>

Existing Deskline reference inputs (ID10-13) can still be used.

Two new ID's (ID39 and ID 40) are used to tell a safety function that a key is pressed. This is a new safety concept that is required to operate standard CBD6S systems.

3 new ID's are used for a new configuration system that can configure system without the need to enter boot mode. System is also used for information sharing. <TBD>

Deskline and Twindrive use a common system to do Multiparallel where master always controls common reference.

ID	ID with parity bits	Data bytes	Source of information	Description
0	0x80	4	Control box	Ref1 position and status
1	0xC1	4	Control box	Ref2 position and status
2	0x42	4	Control box	Ref3 position and status
3	0x03	4	Control box	Ref4 position and status
4	0xC4	*4*	Control box	Ref5 position and status
5	*0x85*	*4*	Control box	Ref6 position and status
6	0x06	4	Control box	Ref7 position and status
7	0x47	4	Control box	Ref8 position and status
8	0x08	3	Control box	Master reference output
9	0x49	-	-	*Undefined*
10	0xCA	2	Handset/desk control	Ref1 input
11	0x8B	2	Handset/desk control	Ref2 input
12	0x4C	2	Handset/desk control	Ref3 input
13	0x0D	2	Handset/desk control	Ref4 input
14	0x8E	4	Control box	Set compare serial # [1]
15	0xCF	6	Control box	Get compare result [1]
16	0x50	5	Control box	Define slave # [1]
17	0x11	1	Program unit	Enter boot load mode
18	0x92	5	Control box	Slave 1 reference response
19	0xD3	5	Control box	Slave 2 reference response

…continued

ID	ID with parity bits	Data bytes	Source of information	Description
20	0x14	5	Control box	Slave 3 reference response
21	0x55	*6*	Control box	Master bed reference outputs
22	0xD6	*6*	Control box	Slave 1 bed reference outputs
23	0x97	*6*	Control box	Slave 2 bed reference outputs
24	0xD8	*6*	Control box	Slave 3 bed reference outputs
25	0x99	-		*Undefined*
26	0x1A	-		*Undefined*
27	0x5B	4	Control box	Master serial [1]
28	0x9C	8	Control box	Diagnostic message
29	*0xDD*	*7*	Control box	TD slave 1 max speeds, status and positions [1]
30	*0x5E*	*8*	Control box	TD reference information *[1]*
31	*0x1F*	*2*	Control box	TD slave 0 max speeds *[1]*
32	*0x20*	*6*	Control box	TD slave 1 serial [1]
33	*0x61*	-		*Undefined*
34	*0xE2*	-		*Undefined*
35	0xA3	1	Handset/desk control	Only used for backward compatibility
36	0x64	1	Handset/desk control	Request power
37	0x25	2	Handset 1	Handset 1 command
38	0xA6	2	Handset 2	Handset 2 command
39	0xE7	1	Handset 1	Handset 1 safety sequence
40	0xA8	1	Handset 2	Handset 2 safety sequence
41	0xE9	3	Control box/Program unit	Configuration request
42	0x6A	8	Any	Configuration response
43	0x2B	1	Program unit	Configuration take control

1 Used in Twindrive systems

Older systems

Old existing systems will not be updated and continue to use old system. Only handsets will be updated and are backward compatible.

ID	ID with parity bits	Data bytes	Source of information	Description
0	0x80	3(4)	Control box	Ref1 position and status ([1])
1	0xC1	3(4)	Control box	Ref2 position and status ([1])
2	0x42	3(4)	Control box	Ref3 position and status ([1])
3	0x03	3(4)	Control box	Ref4 position and status ([1])
4	*0xC4*	*8*	Control box	TD reference information [2]
5	*0x85*	*2*	Control box	TD slave 0 max speeds [2]
6	0x06	1	Control box	CBD0 max speed [1]
7	0x47	2	Control box	CBD1 status and max speed [1]
8	0x08	2	Control box	CBD2 status and max speed [1]
9	0x49	2	Control box	CBD3 status and max speed [1]
10	0xCA	2	Handset/desk control	Ref1 input
11	0x8B	2	Handset/desk control	Ref2 input
12	0x4C	2	Handset/desk control	Ref3 input
13	0x0D	2	Handset/desk control	Ref4 input
14	0x8E	4	Control box	Set compare serial # [1]
15	0xCF	4(6)	Control box	Get compare result [1] ([2])
16	0x50	5	Control box	Define slave # [1]
17	0x11	1	Control box	Enter boot load mode
18	0x92	4	Control box	CBD1 serial [1]
19	0xD3	4	Control box	CBD2 serial [1]
20	0x14	4	Control box	CBD3 serial [1]
21	0x55	8	Control box	CBD1 positions [1]
22	0xD6	8	Control box	CBD2 positions [1]
23	0x97	8	Control box	CBD3 positions [1]
24	0xD8	6	Control box	CBD1 channel info [1]
25	0x99	6	Control box	CBD2 channel info [1]
26	0x1A	6	Control box	CBD3 channel info [1]
27	0x5B	4	Control box	CBD0(master) serial [1]
28	0x9C	8	Control box	Diagnostic message
29	*0xDD*	*7*	Control box	TD slave 1 max speeds, status and positions [2]
30	*0x5E*	-		*Undefined*
31	*0x1F*	-		*Undefined*
32	*0x20*	*6*	Control box	TD slave 1 serial [2]
33	*0x61*	-		*Undefined*
34	*0xE2*	-		*Undefined*
35	0xA3	1	Handset/desk control	TD function code [2]
36	0x64	1	Handset/desk control	Request power

[1] Used in multi-parallel systems
[2] Used in Twindrive systems

Only identifiers that are suppose to be used by 3rd party are described in the following section.

Identifier 0

This identifier carries information about reference0 position and status bits. The default data length is 3 bytes but in multi-parallel systems and new systems 4 bytes are expected. For compatibility for all systems data length 3 can be used and ignoring check sum errors.

The position is 16 bit signed with resolution in 1/10mm and relative to virtual end stop downwards.

Data bytes	Description							
1	LSB of Reference position [1/10mm]							
2	MSB of Reference position [1/10mm]							
3	Status byte							
	Bit 7 Direction[1] / Speed[2] bit 11	Bit 6 Fail flag[1] / Speed[2] bit 10	Bit 5 Reg. active[1] / Speed[2] bit 9	Bit 4 Hall power[1] / Speed[2] bit 8	Bit 3 Overload up	Bit 2 Overload down	Bit 1 Anti-collision	Bit 0 Position lost
4	Speed[1]							

[1] Only used in multi-parallel systems
[2] Used in new systems

Identifier 1

This identifier carries information about reference1 position and status bits. The default data length is 3 bytes but in multi-parallel systems and new systems 4 bytes are expected. For compatibility for all systems data length 3 can be used and ignoring check sum errors.

The position is 16 bit signed with resolution in 1/10mm and relative to virtual end stop downwards.

Data bytes	Description							
1	LSB of Reference position [1/10mm]							
2	MSB of Reference position [1/10mm]							
3	Status byte							
	Bit 7 Direction[1] / Speed[2] bit 11	Bit 6 Fail flag[1] / Speed[2] bit 10	Bit 5 Reg. active[1] / Speed[2] bit 9	Bit 4 Hall power[1] / Speed[2] bit 8	Bit 3 Overload up	Bit 2 Overload down	Bit 1 Anti-collision	Bit 0 Position lost
4	Speed[1]							

[1] Only used in multi-parallel systems
[2] Used in new systems

Identifier 2

This identifier carries information about reference2 position and status bits. The default data length is 3 bytes but in multi-parallel systems and new systems 4 bytes are expected. For compatibility for all systems data length 3 can be used and ignoring check sum errors.

The position is 16 bit signed with resolution in 1/10mm and relative to virtual end stop downwards.

Data bytes	Description
1	LSB of Reference position [1/10mm]
2	MSB of Reference position [1/10mm]

3	Status byte							
	Bit 7 Direction[1] / Speed[2] bit 11	Bit 6 Fail flag[1] / Speed[2] bit 10	Bit 5 Reg. active[1] / Speed[2] bit 9	Bit 4 Hall power[1] / Speed[2] bit 8	Bit 3 Overload up	Bit 2 Overload down	Bit 1 Anti-collision	Bit 0 Position lost
4	Speed[1]							

[1] Only used in multi-parallel systems

[2] Used in new systems

Identifier 3

This identifier carries information about reference3 position and status bits. The default data length is 3 bytes but in multi-parallel systems and new systems 4 bytes are expected. For compatibility for all systems data length 3 can be used and ignoring check sum errors.

The position is 16 bit signed with resolution in 1/10mm and relative to virtual end stop downwards.

Data bytes	Description							
1	LSB of Reference position [1/10mm]							
2	MSB of Reference position [1/10mm]							
3	Status byte							
	Bit 7 Direction[1] / Speed[2] bit 11	Bit 6 Fail flag[1] / Speed[2] bit 10	Bit 5 Reg. active[1] / Speed[2] bit 9	Bit 4 Hall power[1] / Speed[2] bit 8	Bit 3 Overload up	Bit 2 Overload down	Bit 1 Anti-collision	Bit 0 Position lost
4	Speed[1]							

[1] Only used in multi-parallel systems
[2] Used in new systems

Identifier 4

This identifier carries information about reference4 position and status bits. The default data length is 3 bytes but in multi-parallel systems and new systems 4 bytes are expected. For compatibility for all systems data length 3 can be used and ignoring check sum errors.

The position is 16 bit signed with resolution in 1/10mm and relative to virtual end stop downwards.

Data bytes	Description							
1	LSB of Reference position [1/10mm]							
2	MSB of Reference position [1/10mm]							
3	Status byte							
	Bit 7 Direction[1] / Speed[2] bit 11	Bit 6 Fail flag[1] / Speed[2] bit 10	Bit 5 Reg. active[1] / Speed[2] bit 9	Bit 4 Hall power[1] / Speed[2] bit 8	Bit 3 Overload up	Bit 2 Overload down	Bit 1 Anti-collision	Bit 0 Position lost
4	Speed[1]							

[1] Only used in multi-parallel systems
[2] Used in new systems

Identifier 5

This identifier carries information about reference5 position and status bits. The default data length is 3 bytes but in multi-parallel systems and new systems 4 bytes are expected. For compatibility for all systems data length 3 can be used and ignoring check sum errors.

The position is 16 bit signed with resolution in 1/10mm and relative to virtual end stop downwards.

Data bytes	Description							
1	LSB of Reference position [1/10mm]							
2	MSB of Reference position [1/10mm]							
3	Status byte							
	Bit 7 Direction[1] / Speed[2] bit 11	Bit 6 Fail flag[1] / Speed[2] bit 10	Bit 5 Reg. active[1] / Speed[2] bit 9	Bit 4 Hall power[1] / Speed[2] bit 8	Bit 3 Overload up	Bit 2 Overload down	Bit 1 Anti-collision	Bit 0 Position lost
4	Speed[1]							

[1] Only used in multi-parallel systems
[2] Used in new systems

Identifier 6

This identifier carries information about reference6 position and status bits. The default data length is 3 bytes but in multi-parallel systems and new systems 4 bytes are expected. For compatibility for all systems data length 3 can be used and ignoring check sum errors.

The position is 16 bit signed with resolution in 1/10mm and relative to virtual end stop downwards.

Data bytes	Description							
1	LSB of Reference position [1/10mm]							
2	MSB of Reference position [1/10mm]							
3	Status byte							
	Bit 7 Direction[1] / Speed[2] bit 11	Bit 6 Fail flag[1] / Speed[2] bit 10	Bit 5 Reg. active[1] / Speed[2] bit 9	Bit 4 Hall power[1] / Speed[2] bit 8	Bit 3 Overload up	Bit 2 Overload down	Bit 1 Anti-collision	Bit 0 Position lost
4	Speed[1]							

[1] Only used in multi-parallel systems
[2] Used in new systems

Identifier 7

This identifier carries information about reference7 position and status bits. The default data length is 3 bytes but in multi-parallel systems and new systems 4 bytes are expected. For compatibility for all systems data length 3 can be used and ignoring check sum errors.

The position is 16 bit signed with resolution in 1/10mm and relative to virtual end stop downwards.

Data bytes	Description							
1	LSB of Reference position [1/10mm]							
2	MSB of Reference position [1/10mm]							
3	Status byte							
	Bit 7 Direction[1] / Speed[2] bit 11	Bit 6 Fail flag[1] / Speed[2] bit 10	Bit 5 Reg. active[1] / Speed[2] bit 9	Bit 4 Hall power[1] / Speed[2] bit 8	Bit 3 Overload up	Bit 2 Overload down	Bit 1 Anti-collision	Bit 0 Position lost
4	Speed[1]							

[1] Only used in multi-parallel systems
[2] Used in new systems

Identifier 10

This identifier is used to move reference0 up, down or towards a specified position. To support multiple control units this identifier is only replied while a key is pressed and the control unit wants to control the reference. Frame timeout is needed to be handled for this identifier to reset the value to 0x8001.

Data bytes	Description
1	LSB of function code
2	MSB of function code

Function code	Description
0x7FFF	Move reference down
0x8000	Move reference up
0x8001	Do not move reference
All others	Move reference towards value (function code is position in 1/10mm)

Identifier 11

This identifier is used to move reference1 up, down or towards a specified position. To support multiple control units this identifier is only replied while a key is pressed and the control unit wants to control the reference. Frame timeout is needed to be handled for this identifier to reset the value to 0x8001.

Data bytes	Description
1	LSB of function code
2	MSB of function code

Function code	Description
0x7FFF	Move reference down
0x8000	Move reference up
0x8001	Do not move reference
All others	Move reference towards value (function code is position in 1/10mm)

Identifier 12

This identifier is used to move reference2 up, down or towards a specified position. To support multiple control units this identifier is only replied while a key is pressed and the control unit wants to control the reference. Frame timeout is needed to be handled for this identifier to reset the value to 0x8001.

Data bytes	Description
1	LSB of function code
2	MSB of function code

Function code	Description
0x7FFF	Move reference down
0x8000	Move reference up
0x8001	Do not move reference
All others	Move reference towards value (function code is position in 1/10mm)

Identifier 13

This identifier is used to move reference3 up, down or towards a specified position. To support multiple control units this identifier is only replied while a key is pressed and the control unit wants to control the reference. Frame timeout is needed to be handled for this identifier to reset the value to 0x8001.

Data bytes	Description
1	LSB of function code
2	MSB of function code

Function code	Description
0x7FFF	Move reference down
0x8000	Move reference up
0x8001	Do not move reference
All others	Move reference towards value (function code is position in 1/10mm)

Identifier 17

This identifier is used to command a unit to go into boot loader mode. Replying to this identifier with data value of 0x55 will make master go into boot loader mode and replying with data 0xAA will make a slave go into boot mode. Frame timeout for this identifier should be ignored.

This identifier is not used during normal operation and should be used with care with multiple units on LIN bus.

Data bytes	Description
1	0x55 for LIN master and 0xAA for LIN slave

Identifier 28

This identifier is used to report diagnostic messages. The 16 bit diagnostic type defines format of the 6 data bytes.

Data bytes	Description
1	LSB of diagnostic type
2	MSB of diagnostic type
3	Diagnostic data0
4	Diagnostic data1
5	Diagnostic data2
6	Diagnostic data3
7	Diagnostic data4
8	Diagnostic data5

Only diagnostic type 0x0001 is defined. Each data byte can contain a value allowing up to 6 different diagnostic errors. The value 0 is no error.

Identifier 35

This identifier carry a function code used to control functions in a Twindrive system.

Data bytes	Description
1	Function code

The function codes used in TwinDrive systems are:

Code	Description
0	Initialize Down (Run all channels down)
1	Initialize Up (Only run internal channels up)
2	Ref 3 Down
3	Ref 3 Up
4	Ref 4 Down
5	Ref 4 Up
6	Ref 5 Down
7	Ref 5 Up
8	Ref 2 Down
9	Ref 2 Up
10	Ref 1 Down
11	Ref 1 Up
12	Mem 3
13	Store
14	Mem 1
15	Mem 2
16	Ref 5 Down + Ref 4 Down
17	Ref 5 Down + Ref 3 Down
18	Ref 5 Down + Ref 2 Down
19	Ref 5 Down + Ref 1 Down
20	Ref 5 Down + Ref 4 Up
21	Ref 5 Down + Ref 3 Up
22	Ref 5 Down + Ref 2 Up
23	Ref 5 Down + Ref 1 Up
24	Ref 5 Up + Ref 4 Down
25	Ref 5 Up + Ref 3 Down
26	Ref 5 Up + Ref 2 Down
27	Ref 5 Up + Ref 1 Down
28	Ref 5 Up + Ref 4 Up
29	Ref 5 Up + Ref 3 Up
30	Ref 5 Up + Ref 2 Up
31	Ref 5 Up + Ref 1 Up
32	Ref 4 Down + Ref 3 Down
33	Ref 4 Down + Ref 2 Down

34	Ref 4 Down + Ref 1 Down
35	Ref 4 Down + Ref 3 Up
36	Ref 4 Down + Ref 2 Up
37	Ref 4 Down + Ref 1 Up
38	Ref 4 Up + Ref 3 Down
39	Ref 4 Up + Ref 2 Down
40	Ref 4 Up + Ref 1 Down
41	Ref 4 Up + Ref 3 Up
42	Ref 4 Up + Ref 2 Up
43	Ref 4 Up + Ref 1 Up
44	Ref 3 Down + Ref 2 Down
45	Ref 3 Down + Ref 1 Down
46	Ref 3 Down + Ref 2 Up
47	Ref 3 Down + Ref 1 Up
48	Ref 3 Up + Ref 2 Down
49	Ref 3 Up + Ref 1 Down
50	Ref 3 Up + Ref 2 Up
51	Ref 3 Up + Ref 1 Up
52	Ref 2 Down + Ref 1 Down
53	Ref 2 Down + Ref 1 Up
54	Ref 2 Up + Ref 1 Down
55	Ref 2 Up + Ref 1 Up
56	Store + Mem 1[1]
57	Store + Mem 2[1]
58	Store + Mem 3[1]
59	Ref 1 Up + Ref 1 Down[1]
60	Ref 2 Up + Ref 2 Down[1]
61	Ref 3 Up + Ref 3 Down[1]
62	Ref 4 Up + Ref 4 Down[1]
63	Ref 5 Up + Ref 5 Down[1]
64	User function 1[2]
65	User function 2[2]
66	User function 3[2]
67	User function 4[2]
68	Mem 4
69	Store+Mem 4[1]
70	

[1] Currently not used

[2] User function are used differently according to application software

Ref 1 is back-rest motor
Ref 2 is leg-rest motor
Ref 3 is external channel 1
Ref 4 is external channel 2
Ref 5 is external channel 3

The following codes are for massage systems only:

128	Massage Off
129	Next Massage Mode
130	Store Massage
131	Massage Memory 1
132	Massage Memory 2
133	Store + Massage Memory 1
134	Store + Massage Memory 2
135	Massage Freq Up
136	Massage Freq Down
137	Massage Motor 1 On
138	Massage Motor 1 Off
139	Massage Motor 2 On
140	Massage Motor 2 Off
141	Massage Intens 1 Up
142	Massage Intens 1 Down
143	Massage Intens 2 Up
144	Massage Intens 2 Down
145	Massage On/Off Toggle
146	DC 1 On
147	DC 1 Off
148	DC 1 Toggle On/Off
149	DC 2 On
150	DC 2 Off
151	DC 2 Toggle On/Off
152	DC 3 On
153	DC 3 Off
154	DC 3 Toggle On/Off
155	DC 4 On
156	DC 4 Off
157	DC 4 Toggle On/Off
158	DC 1 Dim Up
159	DC 1 Dim Down
160	DC 2 Dim Up
161	DC 2 Dim Down
162	DC 3 Dim Up
163	DC 3 Dim Down
164	DC 4 Dim Up
165	DC 4 Dim Down
166	Massage Motor 1 Toggle
167	Massage Motor 2 Toggle
168	Massage Intens Both Up
169	Massage Intens Both Down
255	Wakeup / No movement

Identifier 36

This identifier is used to request that power of the system is kept on. No reply indicates that no unit requests the power to be kept on. Checksum error and frame timeout need to be ignored or handled special.

Data bytes	Description
1	Any data when a unit request power to be kept on

Identifier 37

Input from first handset. This identifier carries function codes to operate both Twindrive and Deskline in new systems. To ease implementation codes used in ID35 have similar function here but reference numbers changed to Deskline numbering where Twindrive start backwards.

Data bytes	Description
1	Function code
2	bit 6-7 – Undefined bit 4-5 – Code set: 0 = default, 1 = right side, 2 = left side, 3 – undefined bit 0-3 – Undefined

The function codes used are:

Code	Description
0	Initialize Down (Run all channels down)[3]
1	Initialize Up (Only run internal channels up)
2	Head-rest Down / Ref 6 Down
3	Head-rest Up / Ref 6 Up
4	Foot-rest Down / Ref 5 Down
5	Foot-rest Up / Ref 5 Up
6	Extra Down / Ref 4 Down
7	Extra Up / Ref 4 Up
8	Leg-rest Down / Ref 7 Down
9	Leg-rest Up / Ref 7 Up
10	Back-rest Down / Ref 8 Down
11	Back-rest Up / Ref 8 Up
12	Mem 3
13	Store
14	Mem 1
15	Mem 2
16	Extra Down + Foot-rest Down
17	Extra Down + Head-rest Down
18	Extra Down + Leg-rest Down
19	Extra Down + Back-rest Down
20	Extra Down + Foot-rest Up
21	Extra Down + Head-rest Up
22	Extra Down + Leg-rest Up
23	Extra Down + Back-rest Up

24	Extra Up + Foot-rest Down
25	Extra Up + Head-rest Down
26	Extra Up + Leg-rest Down
27	Extra Up + Back-rest Down
28	Extra Up + Foot-rest Up
29	Extra Up + Head-rest Up
30	Extra Up + Leg-rest Up
31	Extra Up + Back-rest Up
32	Foot-rest Down + Head-rest Down
33	Foot-rest Down + Leg-rest Down
34	Foot-rest Down + Back-rest Down
35	Foot-rest Down + Head-rest Up
36	Foot-rest Down + Leg-rest Up
37	Foot-rest Down + Back-rest Up
38	Foot-rest Up + Head-rest Down
39	Foot-rest Up + Leg-rest Down
40	Foot-rest Up + Back-rest Down
41	Foot-rest Up + Head-rest Up
42	Foot-rest Up + Leg-rest Up
43	Foot-rest Up + Back-rest Up
44	Head-rest Down + Leg-rest Down
45	Head-rest Down + Back-rest Down
46	Head-rest Down + Leg-rest Up
47	Head-rest Down + Back-rest Up
48	Head-rest Up + Leg-rest Down
49	Head-rest Up + Back-rest Down
50	Head-rest Up + Leg-rest Up
51	Head-rest Up + Back-rest Up
52	Leg-rest Down + Back-rest Down
53	Leg-rest Down + Back-rest Up
54	Leg-rest Up + Back-rest Down
55	Leg-rest Up + Back-rest Up
56	Store + Mem 1
57	Store + Mem 2
58	Store + Mem 3
59	Back-rest Up + Back-rest Down[1]
60	Leg-rest Up + Leg-rest Down[1]
61	Head-rest Up + Head-rest Down[1]
62	Foot-rest Up + Foot-rest Down[1]
63	Extra Up + Extra Down[1]
64	User function 1[2]
65	User function 2[2]
66	User function 3[2]
67	User function 4[2]
68	Mem 4
69	Store+Mem 4
70	Ref 1 Down
71	Ref 1 Up

72	Ref 2 Down
73	Ref 2 Up
74	Ref 3 Down
75	Ref 3 Up
76	Initialize Down – without impulse (Run all channels down)[3]
77	Toggle impulse
78	Reset to defaults

[1] Currently not used
[2] User function are used differently according to application software
[3] Function “0” runs all channels down using impulse if configured for this. “76” always runs WITHOUT impulse. So for systems NOT configured for impulse operation, function “0” and “76” are the same.

Ref 8 is Back-rest motor
Ref 7 is Leg-rest motor
Ref 6 is Head-rest
Ref 5 is Foot-rest
Ref 6 is Extra

The following codes are for massage systems only:

128	Massage Off
129	Next Massage Mode
130	Store Massage
131	Mem 5
132	Mem 6
133	Store + Mem 5
134	Store + Mem 6
135	Massage Freq Up
136	Massage Freq Down
137	Massage Motor 1 On
138	Massage Motor 1 Off
139	Massage Motor 2 On
140	Massage Motor 2 Off
141	Massage Intens 1 Up
142	Massage Intens 1 Down
143	Massage Intens 2 Up
144	Massage Intens 2 Down
145	Massage On/Off Toggle
146	DC 1 On
147	DC 1 Off
148	DC 1 Toggle On/Off
149	DC 2 On
150	DC 2 Off
151	DC 2 Toggle On/Off
152	DC 3 On
153	DC 3 Off
154	DC 3 Toggle On/Off
155	DC 4 On
156	DC 4 Off
157	DC 4 Toggle On/Off
158	DC 1 Dim Up
159	DC 1 Dim Down
160	DC 2 Dim Up
161	DC 2 Dim Down
162	DC 3 Dim Up
163	DC 3 Dim Down
164	DC 4 Dim Up
165	DC 4 Dim Down
166	Massage Motor 1 Toggle
167	Massage Motor 2 Toggle
168	Massage Intens Both Up
169	Massage Intens Both Down
255	Wakeup / No movement

Identifier 38

Input from second handset. This identifier carries function codes to operate both Twindrive and Deskline in new systems. To ease implementation codes used in ID35 have similar function here but reference numbers changed to Deskline numbering where Twindrive start backwards.

Data bytes	Description
1	Function code
2	bit 6-7 – Undefined bit 4-5 – Code set: 0 = default, 1 = right side, 2 = left side, 3 – undefined bit 0-3 – Undefined

See Identifier 37 for definition of function codes.

Identifier 39

Input from first handset. This identifier carries a sequence to indicating a key is pressed as part of safety system.

Data bytes	Description
1	PBRS sequence

The PRBS sequence is defined as 63 223 207 215 195 221 204 85 128. The sequence starts with first value if previous number is unknown. Each transmitter listens to valid received packages and continues with next number in sequence when a key is pressed.
The sequence carries over to Identifier 40 so one handset should listen to both but only reply to one.

Identifier 40

Input from second handset. This identifier carries a sequence to indicating a key is pressed as part of safety system.

Data bytes	Description
1	PBRS sequence

See Identifier 39 for a description of the sequence.

Application concept

Which type of information's present on the LIN bus is defined by the Master. Depend on the state of the system the message schedule changes. Typically there are at least two states, idle when system is passive and active when key is pressed and motors are running.

Safety concept

On new systems a new safety concept is implemented where new ID39 or ID40 needs to be replied to activate motor outputs. Concept is that handsets only reply when a key is pressed. A predefined number sequence needs to be followed by all handsets by listening and keeps track of sequence so that they can reply with next one. One handset is required to listen to both ID39 and ID40 since they use the same sequence but only reply to one. If the number is unknown if for example the handset is new in system a sequence of 3 valid numbers is needed to open up the motor outputs.

Note: Implementation of safety concept is required to control systems with new safety concept.

Deskline

The basic Deskline system with one reference has an idle schedule ID37, ID39, ID0, ID10 and ID36 and an active schedule ID37 or ID10, ID39, and ID0. In systems with more then one reference then the idle state would expand with ID1, ID2, ID3, ID11, ID12 and ID13 but active schedule will change according to what reference are active.

Twindrive

The basic Twindrive system uses ID35 as input from handset and does not use references. The typical idle schedule looks like ID17, ID35, ID36 and active ID35 and ID36.
More advanced systems can use the new handset commands ID37 and ID38 and have reference outputs similar to Deskline, ID37 should be used over ID35.