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Understanding 3C and 3D Commands in the NCV7748 Devices



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APPLICATION NOTE

LIN protocol works using nodes in a cluster with communication with frames via a transceiver. The master decides which slave device will be addressed and when by the data transported by each frame. Frames are made up of the Master Header and the Slave Response. In this case the master is a microprocessor based device and the slave is the NCV7748 device. The header from the Master consists of a break field and sync field followed by a frame identifier. It is the frame identifier which uniquely defines the purpose of the frame.

The frame identifiers, as defined by the LIN specification, are in the range from 0 to 63 and are categorized into 3 categories.

1. Values 0 to 59 (0x3B) are used for signal carrying frames.
2. **60 (0x3C) and 61 (0x3D) are used to carry diagnostic and configuration data.**
3. As defined in LIN2.x and SAE J2602.
 - a. LIN 2.x – 62 (0x3E) and 63 (0x3F) are reserved for future protocol enhancements.
 - b. J2602–1 – A NAD of \$6E may be used with its message IDs assigned via \$3C or \$3E.

The frame identifiers 0x3C and 0x3D of the NCV7748 are the topic of this paper.

The master request frame is 0x3C and the slave response frame is 0x3D. It is important for the software engineer to understand the functionality and priorities of the 3C and 3D frames.

When using a master request frame (0x3C) in the NCV7748, the device is set to request one of the following application specific items:

1. Targeted Reset Master Request.
2. Read By Identifier Master Request

A master request frame (0x3C) is also used for the following without the expectation of a response.

3. Broadcast Reset
4. Goto Sleep

0x3C, 0x3D Step Procedure

Step One

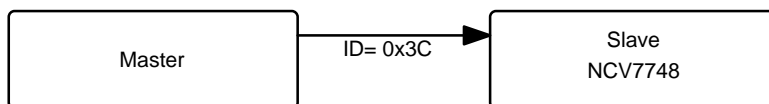


Figure 1. Master Request Frame

Step Two

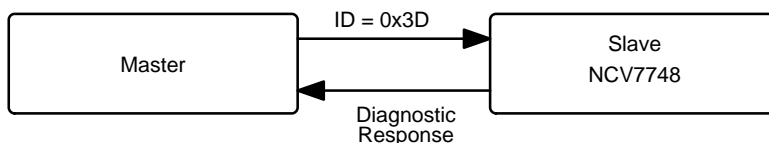


Figure 2. Diagnostic Frame Response

Multiple 3D commands can be sent, but only the last addressed node will respond.

There are other important criteria to consider when using the NCV7748.

Examples follow highlighting the NCV7748 responses following a 0x3C frame request.

Frame sent and Frame received is referenced to the Master device.

Example 1

Message ID	Frame Data	Check-sum	Target	Source	Configura-tion	Comment
3C	frame sent 62 06 B2 20 FF 7F FF FF	45	Node 62		20 = A	Read By Identifier request command, \$62 = NAD \$62
0A	frame received 00 55 55 00 00 00 00 00	8A	Node 62			Get Status response command, \$0A = NAD 62 No Error, APPINFO no failure. All outputs on per setting (55, 55).
9	frame sent 99 66 55 55 55 55 55 55	4B	Node 62			Output Control command, \$9 = NAD \$62. Bad Checksum.
8	frame received 00 00 00 24 60 48 01 00	2A	Node 62			Get_Node_ID response command, \$8 = NAD \$62. No Error, APPINFO no failure (00). Index Byte (00). Supplier ID (00 24). Function ID (60 48). Version (01). Unused (00).
3D	frame received 62 06 F2 24 00 48 60 01	D6		Node 62		Response command

*Keep in mind LSB is sent 1st for Data Bytes.

55 is represented by 1010, not 0101 in the tables of the datasheet.

Example 1 Command Sequence

1. A 3C Read By Identifier command is sent
2. Get Status is sent (\$0A) and a response is received (00 55 55 00 00 00 00 00).
3. A message with a bad checksum is sent.
4. Get Node ID is sent (\$8) and a response is received (00 00 00 24 60 48 01 00).

5. A 3D command is sent and the response from the line #1 is received (62 06 F2 24 00 48 60 01).

Resolution

The slave remembered the 3C request from line #1 even with additional commands in between.

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Example 2

Message ID	Frame Data	Check-sum	Target	Source	Configuration	Comment
3C	frame sent 62 06 B2 20 FF 7F FF FF	45	Node 62		20 = A	Read By Identifier request command, \$62=NAD \$62
3C	frame sent 62 01 B5 FF FF FF FF FF	E6	Node 62			Targeted Reset Command, \$62=NAD \$62
3D	frame received 62 06 F5 24 00 48 60 01	D3	unknown			Response command, \$62=NAD\$62 Supplier ID (24 00) Function ID (48 60) Version (01)
3D	No Response		Unknown			Response command

Example 2 Command Sequence

1. A 3C Read By Identifier Command is sent.
2. A 3C Targeted Reset Command is sent.
3. A 3D Response Command is sent and a response frame is received.
4. An additional 3D command is sent.

Resolution

Only the last 3C command is responded to (Targeted Reset Command).
The initial 3C Read By Identifier Command is ignored.
There are no additional responses to any 3D commands.

Example 3

Message ID	Frame Data	Check-sum	Target	Source	Configuration	Comment
3C	frame sent 62 06 B2 20 FF 7F FF FF	45	Node 62		20=A	Read By Identifier request command, \$62=NAD \$62.
3C	frame sent 64 X X X X X X X	43	Node 64			Master request for NAD \$64. NAD \$64 is not connected to the bus.
3D	No Response		Unknown			Response Command

3C	frame sent 62 06 B2 20 FF 7F FF FF	45	Node 62		20=A	Read By Identifier request command, \$62=NAD \$62
3C	frame sent 64 X X X X X X X	D3	Node 64			Master request for NAD \$64. NAD \$64 is not connected to the bus.
3D	frame received 62 06 F2 24 00 48 60 01	D6		Node 62		Response command.

3C	frame sent 62 06 B2 20 FF 7F FF FF	45	Node 62		20=A	Read By Identifier request command, \$62=NAD \$62.
3C	frame sent 7E X X X X X X X					
3D	frame received 62 06 F2 24 00 48 60 01	D6		Node 62		Response command.

X=don't care

Example 3 Command Sequence

1. A 3C Read By Identifier Command for Node 62 is sent.
2. A 3C Read By Identifier Command for Node 64 is sent (Node 64 is not connected to the bus).
3. A 3D command is sent to try to get a response for a 3C Read By Identifier.
4. No response is received because the last 3C command was to Node 64 which doesn't exist on the network.
5. A 3C Read By Identifier Command for Node 62 is sent.
6. A 3C Read By Identifier Command for Node 64 is sent (Node 64 is not connected to the bus). Note there is a bad checksum.
7. A 3D command is sent and a response is received by the Master for Node 62. Node 62 received the last valid 3C command.

8. A 3C Read By Identifier Command for Node 62 is sent.
9. A 7E command is sent.
10. A 3D command is sent and a response is received by the Master for Node 62. The 3D answers to 3C which is before 3C 7E XXXXXX command.

Resolution

The slave forgets the initial 3C command if another slave is addressed with subsequent 3C command (only the last addressed slave should send a response) except for the case when NAD=7E. With the case of a 3C command with NAD=7E following an initial 3C command, the response to the 3D will be for the initial 3C command.

Example 4

Message ID	Frame Data	Check-sum	Target	Source	Configuration	Comment
3C	frame sent 62 06 B2 20 FF 7F FF FF	45	Node 62		20=A	Read By Identifier request command, \$62=NAD \$62.
3C	frame sent 62 15 03 6D FF 8F AA AA	33	Node 62			Unknown Command.
3D	No Response		Unknown			Response Command

3C	frame sent 62 06 B2 20 FF 7F FF FF	45	Node 62		20=A	Read By Identifier request command, \$62=NAD \$62
3C	frame sent 62 15 03 6D FF 8F AA AA	D8	Node 62			Unknown Command.
3D	frame received 62 06 F2 24 00 48 60 01	D6		Node 62		Response command.

Example 4 Command Sequence

1. A 3C Read By Identifier Command for Node 62 is sent.
2. An unknown command for Node 62 is sent.
3. A 3D command is sent. There is no response because the last 3C command was an unknown command.
4. A 3C Read By Identifier Command for Node 62 is sent.

5. The same unknown command for Node 62 is sent, but has an invalid checksum.
6. A 3D command is sent. This time there is a response because the previous command was invalid due to the status of the checksum.

Resolution

The NCV7748 forgets a 3C if a new 3C with unknown command is received.

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Example 5

Message ID	Frame Data	Check-sum	Target	Source	Configuration	Comment
3C	frame sent 62 06 B2 20 FF 7F FF FF	45	Node 62		20=A	Read By Identifier request command, \$62=NAD \$62.
3D	frame received 62 06 F2 24 00 48 60 01	D6		Node 62		Response command.
3D	No Response		Unknown			Response Command

3C	frame sent 62 01 B5 FF FF FF FF FF	E6	Node 62			Command, \$62=NAD \$62
3D	frame received 62 06 F5 24 00 48 60 01	D3	Unknown			Targeted Reset Response command, \$62=NAD\$62 Supplier ID (24 00) Function ID (48 60) Version (01)
3D	No Response					Response command

Example 5 Command Sequence

1. A 3C Read By Identifier Command for Node 62 is sent.
2. A 3D command is sent and a response frame is received.
3. A second 3D command is sent. There is no response to the second 3D command.
4. A 3C Targeted Reset Command is sent.

5. A 3D Targeted Reset Response Command is sent and a response frame is received.
6. A second 3D command is sent. There is no response to the second 3D command.

Resolution

A slave will only respond once with a 3D command when its precursor was a 3C.

Example 6

Message ID	Frame Data	Check-sum	Target	Source	Configuration	Comment
3C	frame sent 62 06 B2 20 FF 7F FF FF	45	Node 62		20=A	Read By Identifier request command, \$62=NAD \$62.
3E	frame sent X X X X X X X X	43	Unknown			3E command
3D	No Response		Unknown			Response Command

3C	frame sent 62 06 B2 20 FF 7F FF FF	45	Node 62		20=A	Read By Identifier request command, \$62=NAD \$62.
3E	frame sent X X X X X X X X	43	Unknown			3E command
3D	frame received 62 06 F2 24 00 48 60 01	D6		Node 62		Response command

X = don't care

Example 6 Command Sequence

1. A 3C Read By Identifier Command for Node 62 is sent.
2. A 3E Command is sent.
3. A 3D Command is sent. There is no response because the 3E cancelled the 3C command.
4. A 3C Read By Identifier Command for Node 62 is sent.

5. A 3E Command is sent but this time with a bad checksum.
6. A 3D Command is sent. There is a response to the 3C because the 3E command was invalid due to the checksum status.

Resolution

A valid 3E command negates a previous sent 3C Command.

Example 7

Message ID	Frame Data	Check-sum	Target	Source	Configuration	Comment
3C	frame sent 7F 06 B2 20 FF 7F FF FF	28	All		20=A	Read By Identifier request command using 7F wildcard node address.
3D	frame received 62 06 F2 24 00 48 60 01	D6	Unknown			Response command.
3D	No Response		Unknown			Response Command

3C	frame sent 7F 01 B5 FF FF FF FF FF	C9	All			Broadcast Reset Command.
3D	No Response		Unknown			Response command.
3D	No Response		Unknown			Response Command

Example 7 Command Sequence

1. A 3C Read By Identifier Command with a wildcard for the NAD is sent.
2. A 3D Command is sent. The response is received. In this case the wildcard shows the NAD is 62.
3. A 2nd 3D Command is sent. There is no response since the device has already responded.
4. A 3C Broadcast Reset Command is sent.

5. A 3D Command is sent. There is no response. No response is expected after a Broadcast Reset.
6. A 2nd 3D Command is sent. There is no response. No response is expected after a Broadcast Reset.

Resolution

A single populated node on the bus responds to the wildcard address. Conflicts may occur if there is more than one node on the bus.

Example 8

Message ID	Frame Data	Check-sum	Target	Source	Configuration	Comment
3C	frame sent 7F 01 B5 FF FF FF FF FF	C9	All			Broadcast Reset Command.
3D	No Response		Unknown			Response command.
3C	frame sent 00 00 00 00 00 00 00 00	FF	All			Goto Sleep Command
3D	No Response		Unknown			Response Command

Example 8 Command Sequence

1. A 3C Broadcast Reset Command is sent.
2. A 3D Command is sent. There is no response. No response is expected after a Broadcast Reset.

3. A Goto Sleep Command is sent.
4. A 3D Command is sent. There is no response. No response is expected after a Goto Sleep Command.

Summary of Example 0x3C Requests

1. The slave will remember the last 3C command when interrupted by other messages which are not 3C.
2. The Slave will remember the last 3C command when multiple 3C commands are sent.
3. The slave will forget a 3C command if another slave is subsequently addressed with a 3C command (exception for 3C command with NAD=7E). Only the last slave addressed will respond to the appropriate 3D command.
4. The slave will forget a 3C command if a new 3C with an unknown command is received.
5. The slave will only respond once for a received 3C command.
6. The slave should forget the 3C if the master sends a 3E message.
7. The slave will respond to Targeted reset 3C commands.
8. Broadcast reset and GoTo Sleep commands are 3C commands. The slave will not respond to 3D commands for these specific 3C commands.


Additional Communication Formats

(outside of the 3C and 3D structure described above)

The NCV7748 uses additional communication formats in addition to the 0x3C and 0x3D commands. There are three remaining commands used in the NCV7748 which use something other than the 0x3C and 0x3D structure. Consult the NCV7748 datasheet for exclusive tables of the PIDs for these commands.

The commands are:

- ◆ **Output Control** – The Output Control command only utilizes the use of the master header. There is no response from the NCV7748 when using this command. LIN protocol format is maintained in this transmission.
- ◆ **Get Node ID** – The Get Node ID command uses the master header and the slave provides a response in the LIN protocol format.
- ◆ **Get Status** – The Get Status command works the same as the Get Node ID command. It uses a master header and the slave provides a response in the LIN protocol format.

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