



# Opcode Specification

Version 0.99C

Compatible with CBUS ® 4.0 Rev 8j

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## 0.1 Table of Contents

0.1 Table of Contents	3
0.2 Document History	7
<b>1 Introduction</b>	<b>8</b>
<b>2 Opcodes</b>	<b>9</b>
2.1 Opcode bit checks	9
2.1.1 Message length	9
2.1.2 Event checks	9
2.1.3 Extension Checks	9
2.2 Opcodes ordered by Name	9
2.3 Opcodes ordered by Value	14
2.4 Opcodes by Mode	20
2.5 Opcodes by Service	27
2.6 Opcodes Extending CBUS	33
<b>3 Opcode detail</b>	<b>34</b>
3.1 OPCODES with 0 additional bytes	35
3.1.1 [00] ACK - General Acknowledgement	35
3.1.2 [01] NAK - General No Ack	36
3.1.3 [02] HLT - Bus Halt	37
3.1.4 [03] BON - Bus ON	38
3.1.5 [04] TOF - Track OFF	39
3.1.6 [05] TON - Track ON	40
3.1.7 [06] ESTOP - Emergency Stop	41
3.1.8 [07] ARST - System Reset	42
3.1.9 [08] RTOF - Request Track OFF	43
3.1.10 [09] RTON - Request Track ON	44
3.1.11 [0A] RESTP - Request Emergency Stop All	45
3.1.12 [0C] RSTAT - Request Command Station Status	46
3.1.13 [0D] QNN - Query Node Number	47
3.1.14 [10] RQNP - Request Node Parameters	48
3.1.15 [11] RQMN - Request Module Name	49
3.2 OPCODES with 1 additional bytes	50
3.2.1 [21] KLOC - Release Engine	50
3.2.2 [22] QLOC - Query Engine	51
3.2.3 [23] DKEEP - Session Keep Alive	52
3.2.4 [30] DBG1 - Debug with 1 Data Byte	53
3.2.5 [3F] EXTC - Extended Opcode 0 Additional Bytes	54
3.3 OPCODES with 2 additional bytes	55
3.3.1 [40] RLOC - Request Engine Session	55
3.3.2 [41] QCON - Query Consist	56
3.3.3 [42] SNN - Set Node Number	57
3.3.4 [43] ALOC - Allocate Loco to Activity	58
3.3.5 [44] STMOD - Set Cab Session Mode	59
3.3.6 [45] PCON - Consist Engine	60

3.3.7 [46] KCON - Remove Loco from Consist	61
3.3.8 [47] DSPD - Set Engine Speed/Dir	62
3.3.9 [48] DFLG - Set Engine Flags	63
3.3.10 [49] DFNON - Set Engine Function ON	64
3.3.11 [4A] DFNOF - Set Engine Function OFF	65
3.3.12 [4C] SSTAT - Service Mode Status	66
3.3.13 [4F] NNRSN - Reset to Manufacturer Settings	67
3.3.14 [50] RQNN - Request Node Number	68
3.3.15 [51] NNREL - Node Number Release	69
3.3.16 [52] NNACK - Node Number Acknowledge	70
3.3.17 [53] NNLRN - Set Node to Learn Mode	71
3.3.18 [54] NNULN - Node Out of Learn Mode	72
3.3.19 [55] NNCLR - Clear All Events	73
3.3.20 [56] NNEVN - Number of Events Available	74
3.3.21 [57] NERD - Read All Events	75
3.3.22 [58] RQEVN - Read number of Stored Events	76
3.3.23 [59] WRACK - Write Acknowledge	77
3.3.24 [5A] RQDAT - Request Data Event	78
3.3.25 [5B] RQDDS - Request Device Data - short mode	79
3.3.26 [5C] BOOTM - Enter Bootloader Mode	80
3.3.27 [5D] ENUM - Force Self Enumeration of CANID	81
3.3.28 [5E] NNRST - Node Reset	82
3.3.29 [5F] EXTC1 - Extended Opcode with 1 Additional Bytes	83
3.4 OPCODES with 3 additional bytes	84
3.4.1 [60] DFUN - Set Engine Functions	84
3.4.2 [61] GLOC - Get Engine Session	85
3.4.3 [63] ERR - Command Station Error	86
3.4.4 [6F] CMDERR - Configuration Error	87
3.4.5 [70] EVNLF - Number of Event Spaces Remaining	88
3.4.6 [71] NVRD - Node Variable Read	89
3.4.7 [72] NENRD - Read Event by Index	91
3.4.8 [73] RQNPN - Read Node Parameter By Index	92
3.4.9 [74] NUMEV - Number of Events	93
3.4.10 [75] CANID - Set CANID	94
3.4.11 [76] MODE - Set Operating Mode	95
3.4.12 [78] RQSD - Request Service Discovery	97
3.4.13 [7F] EXTC2 - Extended Opcode with 2 Additional Bytes	98
3.5 OPCODES with 4 additional bytes	99
3.5.1 [80] RDCC3 - Request 3 bytes DCC Packet	99
3.5.2 [82] WCVO - Write CV byte in OPS mode	100
3.5.3 [83] WCVB - Write CV Bit in OPS Mode	101
3.5.4 [84] QCVS - Read CV	102
3.5.5 [85] PCVS - Report CV	103
3.5.6 [87] RDGN - Request Diagnostic Data	104

3.5.8 [8E] NVSETRD - Set NV with Read	105
3.5.9 [90] ACON - Accessory ON Event	107
3.5.10 [91] ACOF - Accessory OFF Event	108
3.5.11 [92] AREQ - Accessory Request Event	109
3.5.12 [93] ARON - Accessory Response ON Event	110
3.5.13 [94] AROF - Accessory Response OFF Event	111
3.5.14 [95] EVULN - Event Unlearn	112
3.5.15 [96] NVSET - NV Set	113
3.5.16 [97] NVANS - NV Value Response	114
3.5.17 [98] ASON - Accessory ON Short Event	115
3.5.18 [99] ASOF - Accessory OFF Short Event	116
3.5.19 [9A] ASRQ - Accessory Request Short Event	117
3.5.20 [9B] PARAN - Node Parameter Response	118
3.5.21 [9C] REVAL - Request EV Read	119
3.5.22 [9D] ARSON - Accessory Response ON Short Event	120
3.5.23 [9E] ARSOF - Accessory Response OFF Short Event	121
3.5.24 [9F] EXTC3 - Extended Opcode with 3 Additional Bytes	122
3.6 OPCODES with 5 additional bytes	123
3.6.1 [A0] RDCC4 - Request 4 Byte DCC Packet	123
3.6.2 [A2] WCVS - Write CV in Service Mode	124
3.6.3 [AB] HEARTB - Module Heartbeat	125
3.5.7 [AC] SD - Service Discovery Response	126
3.6.4 [AF] GRSP - Generic Response	126
3.6.5 [B0] ACON1 - Accessory ON Event with 1 Data Byte	128
3.6.6 [B1] ACOF1 - Accessory OFF Event with 1 Data Byte	129
3.6.7 [B2] REQEV - Read Event Variable	130
3.6.8 [B3] ARON1 - Accessory ON Response Event with 1 Data Byte	131
3.6.9 [B4] AROF1 - Accessory OFF Response Event with 1 Data Byte	132
3.6.10 [B5] NEVAL - Response to Read EV	133
3.6.11 [B6] PNN - Presence of Node	134
3.6.12 [B8] ASON1 - Accessory ON Event with 1 Data Byte	135
3.6.13 [B9] ASOF1 - Accessory OFF Event with 1 Data Byte	136
3.6.14 [BD] ARSON1 - Accessory ON Response Event with 1 Data	137
3.6.15 [BE] ARSOF1 - Accessory OFF Response Event with 1 Data	138
3.6.16 [BF] EXTC4 - Extended Opcode with 4 Additional Bytes	139
3.7 OPCODES with 6 additional bytes	140
3.7.1 [C0] RDCC5 - Request 5 Byte DCC Packet	140
3.7.2 [C1] WCVOA - Write CV in OPS Mode by Address	141
3.7.3 [C2] CABDAT - Send data to CAB	142
3.7.4 [C7] DGN - Diagnostic Data Response	144
3.7.5 [CF] FCLK - Fast Clock	145
3.7.6 [D0] ACON2 - Accessory ON Event with 2 Data Bytes	146
3.7.7 [D1] ACOF2 - Accessory OFF Event with 2 Data Bytes	147
3.7.8 [D2] EVLRN - Teach an EV	148

3.7.9 [D3] EVANS - EV Read Response	149
3.7.10 [D4] ARON2 - Accessory Response ON Event with 2 Bytes	150
3.7.11 [D5] AROF2 - Accessory Response OFF Event with 2 Bytes	151
3.7.12 [D8] ASON2 - Accessory Short ON Event with 2 Bytes	152
3.7.13 [D9] ASOF2 - Accessory Short OFF Event with 2 Bytes	153
3.7.14 [DD] ARSON2 - Accessory Response ON Event with 2 Bytes	154
3.7.15 [DE] ARSOF2 - Accessory Response OFF Event with 2 Bytes	155
3.7.16 [DF] EXTC5 - Extended Opcode with 5 Additional Bytes	156
3.8 OPCODES with 7 additional bytes	157
3.8.1 [E0] RDCC6 - Request 6 bytes DCC Packet	157
3.8.2 [E1] PLOC - Engine Report	158
3.8.3 [E2] NAME - Request for Name Response	159
3.8.4 [E3] STAT - Command Station Status Report	160
3.8.5 [E6] ENACK - Event Acknowledge	161
3.8.6 [E7] ESD - Extended Service Discovery Response	162
3.8.7 [E9] DTXC- Streaming protocol	163
3.8.8 [EF] PARAMS - Response for Node Parameters	165
3.8.9 [F0] ACON3 - Accessory ON Event with 3 Data Bytes	166
3.8.10 [F1] ACOF3 - Accessory OFF Event with 3 Data Bytes	167
3.8.11 [F2] ENRSP - Read Event Response	168
3.8.12 [F3] ARON3 - Accessory Response ON Event with 3 Data	169
3.8.13 [F4] AROF3 - Accessory Response OFF Event with 3 Bytes	170
3.8.14 [F5] EVLRNI - Teach an EV using Event Indexing	171
3.8.15 [F6] ACDAT - Accessory Data Event	172
3.8.16 [F7] ARDAT - Accessory Data Response	173
3.8.17 [F8] ASON3 - Accessory Short ON Event with 3 Bytes	174
3.8.18 [F9] ASOF3 - Accessory Short OFF Event with 3 Bytes	175
3.8.19 [FA] DDES - Device Data Event (short mode)	176
3.8.20 [FB] DDRS - Device Data Response (short mode)	177
3.8.21 [FC] DDWS - Device Data Write	178
3.8.22 [FD] ARSON3 - Accessory Response ON Event with 3 Bytes	179
3.8.23 [FE] ASROF3 - Accessory Response OFF Event with 3 Bytes	180
3.8.24 [FF] EXTC6 - Extended Opcode with 6 Additional Bytes	181
<b>4 Appendix A - DCC ERR error codes</b>	<b>182</b>
<b>5 Appendix B - Module Parameters</b>	<b>183</b>
<b>6 Appendix C - CMDERR error codes</b>	<b>185</b>

## 0.2 Document History

Date	Changed by	Summary of changes
18th October 2022	Ian Hogg M.5144	Initial document
5th December 2022	Ian Hogg M.5144	Removed GSTOP
14th November 2022	Ian Hogg M.5144	Added placeholder ENACK
29th December 2022	Ian Hogg M.5144	Changed the RQSD/SD and RDGN/DGN for ServiceIndex
14 April 2023	Ian Hogg M.5144	Changed name to VLCB
15 May 2023	Ian Hogg M.5144	Allocated bit 6 of module parameter flags to support for service discovery. PNN also updated.
26 August 2023	Ian Hogg M.5144	AREQ updated to exclude short message check and NN check. EVULN, REQEV, EVLRN updated to also return GRSP.
29 August 2023	Ian Hogg M.5144	Updated Appendix C to include GRSP error codes. Updated RQSD and REQEV to align with Appendix C.
30 August 2023	Ian Hogg M.5144	Changed event being present condition for REQEV from event index to NN:EN
6 October 2023	Ian Hogg M.5144	Allow RQMN to be used in LEARN mode in addition to SETUP mode.
5 November 2023	Ian Hogg M.5144	Added a DGN response to RDGN when DiagnosticCode=0 indicating the number of following diagnostics.
23 November 2023	Ian Hogg M.5144	Added further clarification to RDGN.

# 1 Introduction

This document provides a detailed description of the VLCB opcodes.



## 2 Opcodes

### 2.1 Opcode bit checks

#### 2.1.1 Message length

CBUS uses the top 3 bits of the opcode to define the number of data bytes following the opcode. Whilst on CAN this is not necessary as the CAN DLC field also contains the data length, having the length could be beneficial for other protocols if messages are not wrapped using a format which is able to indicate the message length.

VLCB opcodes have maintained the top 3 bits length format for CBUS compatible opcodes but may not comply with this for new opcodes. It is recommended that the developer makes no assumptions about the length of the message based upon the top 3 bits of the opcode. If a module is targeted with a command message i.e. the NN matches its own node number and there are insufficient data bytes in the message then it should respond with a GRSP(Invalid Command). Otherwise if a message is received which has insufficient data bytes then it shall be ignored.

#### 2.1.2 Event checks

If the bits of the opcode equal 1xx10000 then the message is an ON long event.

If the bits of the opcode equal 1xx10001 then the message is an OFF long event.

If the bits of the opcode equal 1xx11000 then the message is an ON short event.

If the bits of the opcode equal 1xx11001 then the message is an OFF short event.

#### 2.1.3 Extension Checks

If the bits of the opcode equal xxx11111 with the exception of 00011111 (0x1F) then the opcode is an Extension Opcode.

## 2.2 Opcodes ordered by Name

Name	Value	
	Decimal	Hex
<a href="#">ACDAT</a>	246	F6
<a href="#">ACK</a>	0	00
<a href="#">ACOF</a>	145	91
ACOF1	177	B1
ACOF2	209	D1
ACOF3	241	F1

## VLCB Opcode specification

<a href="#">ACON</a>	144	90
ACON1	176	B0
ACON2	208	D0
ACON3	240	F0
<a href="#">ALOC</a>	67	43
<a href="#">ARDAT</a>	247	F7
<a href="#">AREQ</a>	146	92
<a href="#">AROF</a>	148	94
AROF1	180	B4
AROF2	213	D5
AROF3	244	F4
<a href="#">ARON</a>	147	93
ARON1	179	B3
ARON2	212	D4
ARON3	243	F3
ARSOF	158	9E
ARSOF1	190	BE
ARSOF2	222	DE
ARSOF3	254	FE
<a href="#">ARSON</a>	157	9D
ARSON1	189	BD
ARSON2	221	DD
ARSON3	253	FD
<a href="#">ARST</a>	7	07
ASOF	153	99
ASOF1	185	B9
ASOF2	217	D9

# VLCB Opcode specification

ASOF3	249	F9
<a href="#">ASON</a>	152	98
ASON1	184	B8
ASON2	216	D8
ASON3	248	F8
<a href="#">ASRQ</a>	154	9A
<a href="#">BON</a>	3	03
<a href="#">BOOTM</a>	92	5C
CABDAT	194	C2
<a href="#">CANID</a>	117	75
<a href="#">CMDERR</a>	111	6F
DBG1	48	30
<a href="#">DDES</a>	250	FA
DDRS	251	FB
DFLG	72	48
DFNOF	74	4A
DFNON	73	49
DFUN	96	60
<a href="#">DGN</a>	199	C7
DKEEP	35	23
DSPD	71	47
DTXC	233	E9
<a href="#">ENACK</a>	230	E6
<a href="#">ENRSP</a>	242	F2
<a href="#">ENUM</a>	93	5D
ERR	99	63
<a href="#">ESD</a>	231	E7

## VLCB Opcode specification

<a href="#">ESTOP</a>	6	06
<a href="#">EVANS</a>	211	D3
<a href="#">EVLRN</a>	210	D2
<a href="#">EVLRNI</a>	245	F5
<a href="#">EVNLF</a>	112	70
<a href="#">EVULN</a>	149	95
FCLK	207	CF
GLOC	97	61
<a href="#">GRSP</a>	175	AF
<a href="#">HEARTB</a>	163	AB
HLT	2	02
KCON	70	46
KLOC	33	21
<a href="#">MODE</a>	118	76
NAK	1	01
<a href="#">NAME</a>	226	E2
<a href="#">NENRD</a>	114	72
<a href="#">NERD</a>	87	57
<a href="#">NEVAL</a>	181	B5
<a href="#">NNACK</a>	82	52
<a href="#">NNCLR</a>	85	55
<a href="#">NNEVN</a>	86	56
<a href="#">NNLRN</a>	83	53
<a href="#">NNREL</a>	81	51
<a href="#">NNRSM</a>	79	4F
<a href="#">NNRST</a>	94	5E
<a href="#">NNULN</a>	84	54

## VLCB Opcode specification

<a href="#">NUMEV</a>	116	74
<a href="#">NVANS</a>	151	97
<a href="#">NVRD</a>	113	71
<a href="#">NVSET</a>	150	96
<a href="#">NVSETRD</a>	142	8E
<a href="#">PARAMS</a>	239	EF
<a href="#">PARAN</a>	155	9B
PCON	69	45
PCVS	133	85
PLOC	225	E1
<a href="#">PNN</a>	182	B6
QCON	65	41
QCVS	132	84
QLOC	34	22
<a href="#">QNN</a>	13	0D
RDCC3	128	80
RDCC4	160	A0
RDCC5	192	C0
RDCC6	224	E0
<a href="#">RDGN</a>	135	87
<a href="#">REQEV</a>	178	B2
RESTP	10	0A
<a href="#">REVAL</a>	156	9C
RLOC	64	40
<a href="#">RQDAT</a>	90	5A
RQDDS	91	5B
<a href="#">RQEVN</a>	88	58

## VLCB Opcode specification

<a href="#">RQMN</a>	17	11
<a href="#">RQNN</a>	80	50
<a href="#">RQNP</a>	16	10
<a href="#">RQNPN</a>	115	73
<a href="#">RQSD</a>	120	78
RSTAT	12	0C
RTOF	8	08
RTON	9	09
<a href="#">SD</a>	140	8C
<a href="#">SNN</a>	66	42
<a href="#">SQU</a>	102	66
SSTAT	76	4C
STAT	227	E3
STMOD	68	44
TOF	4	04
TON	5	05
WCVB	131	83
WCVO	130	82
WCVOA	193	C1
WCVS	162	A2
<a href="#">WRACK</a>	89	59

## 2.3 Opcodes ordered by Value

Name	Value	
	Decimal	Hex
ACK	0	00

## VLCB Opcode specification

NAK	1	01
HLT	2	02
BON	3	03
TOF	4	04
TON	5	05
ESTOP	6	06
ARST	7	07
RTOF	8	08
RTON	9	09
RESTP	10	0A
RSTAT	12	0C
QNN	13	0D
RQNP	16	10
RQMN	17	11
KLOC	33	21
QLOC	34	22
DKEEP	35	23
DBG1	48	30
RLOC	64	40
QCON	65	41
<a href="#">SNN</a>	66	42
ALOC	67	43
STMOD	68	44
PCON	69	45
KCON	70	46
DSPD	71	47
DFLG	72	48

## VLCB Opcode specification

DFNON	73	49
DFNOF	74	4A
SSTAT	76	4C
NNRSM	79	4F
<a href="#">RQNN</a>	80	50
NNREL	81	51
NNACK	82	52
NNLRN	83	53
NNULN	84	54
NNCLR	85	55
<a href="#">NNEVN</a>	86	56
<a href="#">NERD</a>	87	57
RQEVN	88	58
WRACK	89	59
RQDAT	90	5A
RQDDS	91	5B
BOOTM	92	5C
ENUM	93	5D
NNRST	94	5E
DFUN	96	60
GLOC	97	61
ERR	99	63
SQU	102	66
CMDERR	111	6F
EVNLF	112	70
NVRD	113	71
NENRD	114	72



## VLCB Opcode specification

RQNPN	115	73
NUMEV	116	74
CANID	117	75
MODE	118	76
RDGN	119	77
RQSD	120	78
RDCC3	128	80
WCVO	130	82
WCVB	131	83
QCVS	132	84
PCVS	133	85
<a href="#">SD</a>	140	AC
NVSETRD	142	8E
ACON	144	90
ACOF	145	91
<a href="#">AREQ</a>	146	92
<a href="#">ARON</a>	147	93
AROF	148	94
EVULN	149	95
NVSET	150	96
NVANS	151	97
ASON	152	98
ASOF	153	99
<a href="#">ASRQ</a>	154	9A
PARAN	155	9B
REVAL	156	9C
<a href="#">ARSON</a>	157	9D

## VLCB Opcode specification

ARSOF	158	9E
RDCC4	160	A0
WCVS	162	A2
<a href="#">HEARTB</a>	163	AB
GRSP	175	AF
ACON1	176	B0
ACOF1	177	B1
REQEV	178	B2
ARON1	179	B3
AROF1	180	B4
NEVAL	181	B5
<a href="#">PNN</a>	182	B6
ASON1	184	B8
ASOF1	185	B9
ARSON1	189	BD
ARSOF1	190	BE
RDCC5	192	C0
WCVOA	193	C1
CABDAT	194	C2
DGN	199	C7
FCLK	207	CF
ACON2	208	D0
ACOF2	209	D1
EVLRN	210	D2
EVANS	211	D3
ARON2	212	D4
AROF2	213	D5

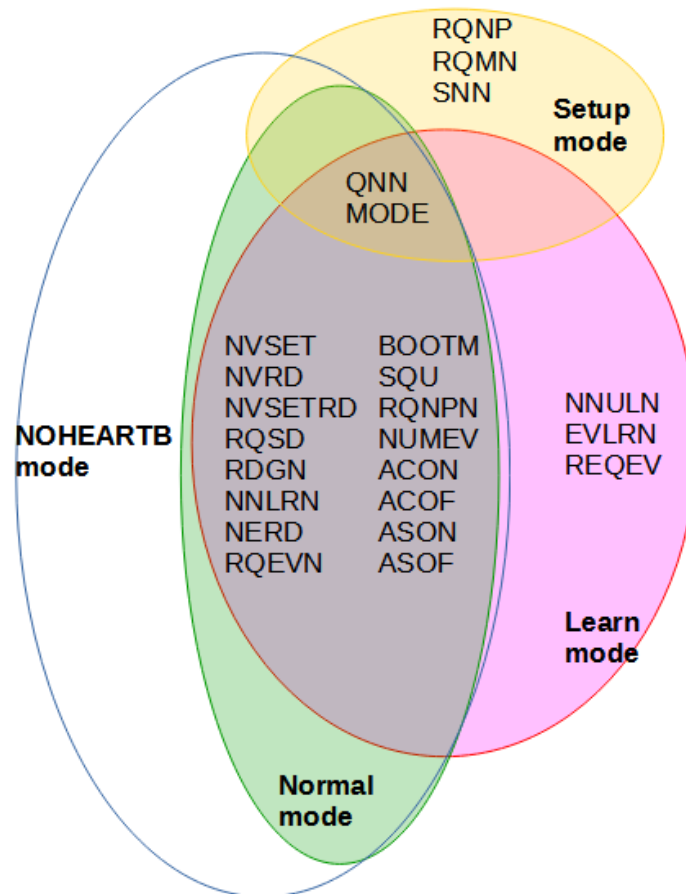
## VLCB Opcode specification

ASON2	216	D8
ASOF2	217	D9
ARSON2	221	DD
ARSOF2	222	DE
RDCC6	224	E0
PLOC	225	E1
NAME	226	E2
STAT	227	E3
ENACK	230	E6
ESD	231	E7
<a href="#">DTXC</a>	233	E9
PARAMS	239	EF
ACON3	240	F0
ACOF3	241	F1
ENRSP	242	F2
ARON3	243	F3
AROF3	244	F4
EVLINI	245	F5
ACDAT	246	F6
ARDAT	247	F7
ASON3	248	F8
ASOF3	249	F9
DDES	250	FA
DDRS	251	FB
ARSON3	253	FD
ARSOF3	254	FE

## 2.4 Opcodes by Mode

Not all of the opcodes are available in all modes. A limited number of opcodes are available in Setup mode as, generally the module has no node number whilst in Setup mode. Normal mode encompasses the majority of the opcodes, Learn mode adds opcodes specifically for event learning, on top of the Normal opcodes, many of which require additional parameters leaving no room for a node number.

A visual way of representing this is with a Venn diagram. The diagram below doesn't list of the opcodes available in each mode but gives an indication of the capabilities available in each mode



Name	Value		Modes
	Decimal	Hex	
NNULN	84	54	Learn
NNCLR	85	55	Learn
EVULN	149	95	Learn
<a href="#">REQEV</a>	178	B2	Learn
<a href="#">EVLRN</a>	210	D2	Learn

Name	Value		Modes
	Decimal	Hex	
EVANS	211	D3	Learn
<a href="#">EVLRN</a>	245	F5	Learn
<a href="#">ACK</a>	0	00	Normal, Learn, NOHEARTB, ENACK
<a href="#">NAK</a>	1	01	Normal, Learn, NOHEARTB, ENACK
<a href="#">HLT</a>	2	02	Normal, Learn, NOHEARTB, ENACK
<a href="#">BON</a>	3	03	Normal, Learn, NOHEARTB, ENACK
<a href="#">TOF</a>	4	04	Normal, Learn, NOHEARTB, ENACK
<a href="#">TON</a>	5	05	Normal, Learn, NOHEARTB, ENACK
<a href="#">ESTOP</a>	6	06	Normal, Learn, NOHEARTB, ENACK
<a href="#">ARST</a>	7	07	Normal, Learn, NOHEARTB, ENACK
<a href="#">RTOF</a>	8	08	Normal, Learn, NOHEARTB, ENACK
<a href="#">RTON</a>	9	09	Normal, Learn, NOHEARTB, ENACK
<a href="#">RESTP</a>	10	0A	Normal, Learn, NOHEARTB, ENACK
<a href="#">RSTAT</a>	12	0C	Normal, Learn, NOHEARTB, ENACK
KLOC	33	21	Normal, Learn, NOHEARTB, ENACK
QLOC	34	22	Normal, Learn, NOHEARTB, ENACK
DKEEP	35	23	Normal, Learn, NOHEARTB, ENACK
DBG1	48	30	Normal, Learn, NOHEARTB, ENACK
RLOC	64	40	Normal, Learn, NOHEARTB, ENACK
QCON	65	41	Normal, Learn, NOHEARTB, ENACK
ALOC	67	43	Normal, Learn, NOHEARTB, ENACK
STMOD	68	44	Normal, Learn, NOHEARTB, ENACK
PCON	69	45	Normal, Learn, NOHEARTB, ENACK
KCON	70	46	Normal, Learn, NOHEARTB, ENACK
DSPD	71	47	Normal, Learn, NOHEARTB, ENACK

Name	Value		Modes
	Decimal	Hex	
DFLG	72	48	Normal, Learn, NOHEARTB, ENACK
DFNON	73	49	Normal, Learn, NOHEARTB, ENACK
DFNOF	74	4A	Normal, Learn, NOHEARTB, ENACK
SSTAT	76	4C	Normal, Learn, NOHEARTB, ENACK
SQU	78	4E	Normal, Learn, NOHEARTB, ENACK
NNRSM	79	4F	Normal, Learn, NOHEARTB, ENACK
<a href="#">NNLRN</a>	83	53	Normal, Learn, NOHEARTB, ENACK
<a href="#">NNEVN</a>	86	56	Normal, Learn, NOHEARTB, ENACK
NERD	87	57	Normal, Learn, NOHEARTB, ENACK
RQEVN	88	58	Normal, Learn, NOHEARTB, ENACK
WRACK	89	59	Normal, Learn, NOHEARTB, ENACK
RQDAT	90	5A	Normal, Learn, NOHEARTB, ENACK
RQDDS	91	5B	Normal, Learn, NOHEARTB, ENACK
BOOTM	92	5C	Normal, Learn, NOHEARTB, ENACK
ENUM	93	5D	Normal, Learn, NOHEARTB, ENACK
NNRST	94	5E	Normal, Learn, NOHEARTB, ENACK
DFUN	96	60	Normal, Learn, NOHEARTB, ENACK
GLOC	97	61	Normal, Learn, NOHEARTB, ENACK
ERR	99	63	Normal, Learn, NOHEARTB, ENACK
CMDERR	111	6F	Normal, Learn, NOHEARTB, ENACK
EVNLF	112	70	Normal, Learn, NOHEARTB, ENACKCANID
NVRD	113	71	Normal, Learn, NOHEARTB, ENACK
NENRD	114	72	Normal, Learn, NOHEARTB, ENACK
RQNPN	115	73	Normal, Learn, NOHEARTB, ENACK
NUMEV	116	74	Normal, Learn, NOHEARTB, ENACK

Name	Value		Modes
	Decimal	Hex	
CANID	117	75	Normal, Learn, NOHEARTB, ENACK
RQSD	120	78	Normal, Learn, NOHEARTB, ENACK
RDCC3	128	80	Normal, Learn, NOHEARTB, ENACK
WCVO	130	82	Normal, Learn, NOHEARTB, ENACK
WCVB	131	83	Normal, Learn, NOHEARTB, ENACK
QCVS	132	84	Normal, Learn, NOHEARTB, ENACK
PCVS	133	85	Normal, Learn, NOHEARTB, ENACK
RDGN	135	87	Normal, Learn, NOHEARTB, ENACK
<a href="#">SD</a>	140	8C	Normal, Learn, NOHEARTB, ENACK
NVSE TRD	142	8E	Normal, Learn, NOHEARTB, ENACK
ACON	144	90	Normal, Learn, NOHEARTB, ENACK
ACOF	145	91	Normal, Learn, NOHEARTB, ENACK
AREQ	146	92	Normal, Learn, NOHEARTB, ENACK
ARON	147	93	Normal, Learn, NOHEARTB, ENACK
AROF	148	94	Normal, Learn, NOHEARTB, ENACK
NVSET	150	96	Normal, Learn, NOHEARTB, ENACK
NVANS	151	97	Normal, Learn, NOHEARTB, ENACK
ASON	152	98	Normal, Learn, NOHEARTB, ENACK
ASOF	153	99	Normal, Learn, NOHEARTB, ENACK
ASRQ	154	9A	Normal, Learn, NOHEARTB, ENACK
PARAN	155	9B	Normal, Learn, NOHEARTB, ENACK
REVAL	156	9C	Normal, Learn, NOHEARTB, ENACK
ARSON	157	9D	Normal, Learn, NOHEARTB, ENACK
ARSOF	158	9E	Normal, Learn, NOHEARTB, ENACK
RDCC4	160	A0	Normal, Learn, NOHEARTB, ENACK

Name	Value		Modes
	Decimal	Hex	
WCVS	162	A2	Normal, Learn, NOHEARTB, ENACK
<a href="#">HEARTB</a>	163	AB	Normal, Learn, NOHEARTB, ENACK
GRSP	175	AF	Normal, Learn, NOHEARTB, ENACK
ACON1	176	B0	Normal, Learn, NOHEARTB, ENACK
ACOF1	177	B1	Normal, Learn, NOHEARTB, ENACK
ARON1	179	B3	Normal, Learn, NOHEARTB, ENACK
AROF1	180	B4	Normal, Learn, NOHEARTB, ENACK
<a href="#">NEVAL</a>	181	B5	Normal, Learn, NOHEARTB, ENACK
<a href="#">PNN</a>	182	B6	Normal, Learn, NOHEARTB, ENACK
ASON1	184	B8	Normal, Learn, NOHEARTB, ENACK
ASOF1	185	B9	Normal, Learn, NOHEARTB, ENACK
ARSON1	189	BD	Normal, Learn, NOHEARTB, ENACK
ARSOF1	190	BE	Normal, Learn, NOHEARTB, ENACK
RDCC5	192	C0	Normal, Learn, NOHEARTB, ENACK
WCVOA	193	C1	Normal, Learn, NOHEARTB, ENACK
CABDAT	194	C2	Normal, Learn, NOHEARTB, ENACK
<a href="#">DGN</a>	199	C7	Normal, Learn, NOHEARTB, ENACK
FCLK	207	CF	Normal, Learn, NOHEARTB, ENACK
ACON2	208	D0	Normal, Learn, NOHEARTB, ENACK
ACOF2	209	D1	Normal, Learn, NOHEARTB, ENACK
ARON2	212	D4	Normal, Learn, NOHEARTB, ENACK
AROF2	213	D5	Normal, Learn, NOHEARTB, ENACK
ASON2	216	D8	Normal, Learn, NOHEARTB, ENACK
ASOF2	217	D9	Normal, Learn, NOHEARTB, ENACK
ARSON2	221	DD	Normal, Learn, NOHEARTB, ENACK



Name	Value		Modes
	Decimal	Hex	
ARSOF2	222	DE	Normal, Learn, NOHEARTB, ENACK
RDCC6	224	E0	Normal, Learn, NOHEARTB, ENACK
PLOC	225	E1	Normal, Learn, NOHEARTB, ENACK
STAT	227	E3	Normal, Learn, NOHEARTB, ENACK
ESD	231	E7	Normal, Learn, NOHEARTB, ENACK
DTXC	233	E9	Normal, Learn, NOHEARTB, ENACK
ACON3	240	F0	Normal, Learn, NOHEARTB, ENACK
ACOF3	241	F1	Normal, Learn, NOHEARTB, ENACK
ENRSP	242	F2	Normal, Learn, NOHEARTB, ENACK
ARON3	243	F3	Normal, Learn, NOHEARTB, ENACK
AROF3	244	F4	Normal, Learn, NOHEARTB, ENACK
ACDAT	246	F6	Normal, Learn, NOHEARTB, ENACK
ARDAT	247	F7	Normal, Learn, NOHEARTB, ENACK
ASON3	248	F8	Normal, Learn, NOHEARTB, ENACK
ASOF3	249	F9	Normal, Learn, NOHEARTB, ENACK
DDES	250	FA	Normal, Learn, NOHEARTB, ENACK
DDRS	251	FB	Normal, Learn, NOHEARTB, ENACK
ARSON3	253	FD	Normal, Learn, NOHEARTB, ENACK
ARSOF3	254	FE	Normal, Learn, NOHEARTB, ENACK
QNN	13	0D	Normal, Learn, NOHEARTB, ENACK, Setup
<a href="#">MODE</a>	118	76	Normal, Learn, NOHEARTB, ENACK, Setup
ENACK	230	E6	ENACK
<a href="#">NNREL</a>	81	51	Setup
<a href="#">RQNP</a>	16	10	Setup
<a href="#">RQMN</a>	17	11	Learn, Setup

## VLCB Opcode specification

Name	Value		Modes
	Decimal	Hex	
<a href="#">SNN</a>	66	42	Setup
<a href="#">RQNN</a>	80	50	Setup
<a href="#">NNACK</a>	82	52	Setup
<a href="#">NAME</a>	226	E2	Setup
<a href="#">PARAMS</a>	239	EF	Setup

## 2.5 Opcodes by Service

Name	Value		Implement when service included
	Decimal	Hex	
ACK	0	00	
NAK	1	01	
HLT	2	02	
<a href="#">BON</a>	3	03	
ARST	7	07	
DBG1	48	30	
RQDAT	90	5A	
RQDDS	91	5B	
NNRST	94	5E	
FCLK	207	CF	
ACDAT	246	F6	
ARDAT	247	F7	
BOOTM	92	5C	Boot
CABDAT	194	C2	CABDAT
ENUM	93	5D	CAN
<a href="#">CANID</a>	117	75	CAN
<a href="#">TOE</a>	4	04	DCC_CAB or DCC_CMD
TON	5	05	DCC_CAB or DCC_CMD
ESTOP	6	06	DCC_CAB or DCC_CMD
<a href="#">RTOE</a>	8	08	DCC_CAB or DCC_CMD
RTON	9	09	DCC_CAB or DCC_CMD
RESTP	10	0A	DCC_CAB or DCC_CMD
RSTAT	12	0C	DCC_CAB or DCC_CMD

# VLCB Opcode specification

KLOC	33	21	DCC_CAB or DCC_CMD
QLOC	34	22	DCC_CAB or DCC_CMD
DKEEP	35	23	DCC_CAB or DCC_CMD
RLOC	64	40	DCC_CAB or DCC_CMD
QCON	65	41	DCC_CAB or DCC_CMD
ALOC	67	43	DCC_CAB or DCC_CMD
STMOD	68	44	DCC_CAB or DCC_CMD
PCON	69	45	DCC_CAB or DCC_CMD
KCON	70	46	DCC_CAB or DCC_CMD
DSPD	71	47	DCC_CAB or DCC_CMD
DFLG	72	48	DCC_CAB or DCC_CMD
DFNON	73	49	DCC_CAB or DCC_CMD
DFNOF	74	4A	DCC_CAB or DCC_CMD
SSTAT	76	4C	DCC_CAB or DCC_CMD
DFUN	96	60	DCC_CAB or DCC_CMD
GLOC	97	61	DCC_CAB or DCC_CMD
ERR	99	63	DCC_CAB or DCC_CMD
RDCC3	128	80	DCC_CAB or DCC_CMD
WCVO	130	82	DCC_CAB or DCC_CMD
WCVB	131	83	DCC_CAB or DCC_CMD
QCVS	132	84	DCC_CAB or DCC_CMD
PCVS	133	85	DCC_CAB or DCC_CMD
RDCC4	160	A0	DCC_CAB or DCC_CMD
WCVS	162	A2	DCC_CAB or DCC_CMD
RDCC5	192	C0	DCC_CAB or DCC_CMD
WCVOA	193	C1	DCC_CAB or DCC_CMD
RDCC6	224	E0	DCC_CAB or DCC_CMD

PLOC	225	E1	DCC_CAB or DCC_CMD
STAT	227	E3	DCC_CAB or DCC_CMD
DDES	250	FA	DCC_CAB or DCC_CMD
DDRS	251	FB	DCC_CAB or DCC_CMD
<a href="#">ACON</a>	144	90	Producer or Consumer
ACOF	145	91	Producer or Consumer
<a href="#">AREQ</a>	146	92	Producer
<a href="#">ARON</a>	147	93	Producer
AROF	148	94	Producer
<a href="#">ASON</a>	152	98	Producer or Consumer
ASOF	153	99	Producer or Consumer
<a href="#">ASRQ</a>	154	9A	Producer
ARSON	157	9D	Producer
ARSOF	158	9E	Producer
ACON1	176	B0	Producer or Consumer
ACOF1	177	B1	Producer or Consumer
<a href="#">ARON1</a>	179	B3	Producer
AROF1	180	B4	Producer
ASON1	184	B8	Producer or Consumer
ASOF1	185	B9	Producer or Consumer
ARSON1	189	BD	Producer
ARSOF1	190	BE	Producer
ACON2	208	D0	Producer or Consumer
ACOF2	209	D1	Producer or Consumer
ARON2	212	D4	Producer
AROF2	213	D5	Producer
ASON2	216	D8	Producer or Consumer

ASOF2	217	D9	Producer or Consumer
ARSON2	221	DD	Producer
ARSOF2	222	DE	Producer
ACON3	240	F0	Producer or Consumer
ACOF3	241	F1	Producer or Consumer
ARON3	243	F3	Producer
AROF3	244	F4	Producer
ASON3	248	F8	Producer or Consumer
ASOF3	249	F9	Producer or ConsumerQNN
ARSON3	253	FD	Producer
ARSOF3	254	FE	Producer
<a href="#">ENACK</a>	230	E6	Consumer and EventAck
<a href="#">QNN</a>	13	0D	MNS
<a href="#">NNRSM</a>	79	4F	MNS
<a href="#">SQU</a>	102	66	MNS
<a href="#">RQNPN</a>	115	73	MNS
<a href="#">RQSD</a>	120	78	MNS
<a href="#">RDGN</a>	135	87	MNS
<a href="#">SD</a>	140	8C	MNS
DGN	199	C7	MNS
PARAN	155	9B	MNS
<a href="#">HEARTB</a>	163	AB	MNS
<a href="#">GRSP</a>	175	AF	MNS
PNN	182	B6	MNS
<a href="#">ESD</a>	231	E7	MNS
<a href="#">MODE</a>	118	76	MNS
<a href="#">NNREL</a>	81	51	MNS

## VLCB Opcode specification

<a href="#">RQNP</a>	16	10	MNS
<a href="#">RQMN</a>	17	11	MNS
SNN	66	42	MNS
RQNN	80	50	MNS
NNACK	82	52	MNS
NAME	226	E2	MNS
<a href="#">PARAMS</a>	239	EF	MNS
CMDERR	111	6F	MNS or Teach or NV
<a href="#">NVRD</a>	113	71	NV
<a href="#">NVSETRD</a>	142	8E	NV
NVSET	150	96	NV
<a href="#">NVANS</a>	151	97	NV
DTXC	233	E9	Stream
<a href="#">NNLRN</a>	83	53	Teach
NNULN	84	54	Teach
<a href="#">NNCLR</a>	85	55	Teach
<a href="#">NNEVN</a>	86	56	Teach
<a href="#">NERD</a>	87	57	Teach
<a href="#">RQEVN</a>	88	58	Teach
<a href="#">EVNLF</a>	112	70	Teach
<a href="#">NENRD</a>	114	72	Teach
<a href="#">NUMEV</a>	116	74	Teach
<a href="#">EVULN</a>	149	95	Teach
<a href="#">REVAL</a>	156	9C	Teach
REQEV	178	B2	Teach
NEVAL	181	B5	Teach
<a href="#">EVLRN</a>	210	D2	Teach

## VLCB Opcode specification

EVANS	211	D3	Teach
ENRSP	242	F2	Teach
EVLINI	245	F5	Teach
WRACK	89	59	Teach or NV



## 2.6 Opcodes Extending CBUS

Name	Value		Description
	Decimal	Hex	
<b>SQU</b>	102	66	Source Quench
<a href="#"><u>MODE</u></a>	118	76	Set Mode
<a href="#"><u>RQSD</u></a>	120	78	Request Service Discovery
<a href="#"><u>RDGN</u></a>	135	87	Request Diagnostics
<a href="#"><u>SD</u></a>	140	8C	Service Discovery Response
<a href="#"><u>NVSETRD</u></a>	142	8E	Set and Read NV
<a href="#"><u>HEARTB</u></a>	163	AB	Heartbeat
<a href="#"><u>GRSP</u></a>	175	AF	General Response
<a href="#"><u>DGN</u></a>	199	C7	Diagnostic Data
<a href="#"><u>ESD</u></a>	231	E7	Extended Service Discovery Response
<a href="#"><u>ENACK</u></a>	230	E6	Event Acknowledge

### 3 Opcode detail

Each opcode in Section 3 contains a table with the following information.

<b>Name</b>		A short name for the opcode's operation
<b>Value</b>	<b>Decimal</b>	The decimal (base 10) number of the opcode
	<b>Hex</b>	The hexadecimal (base 16) number of the opcode
<b>Priority</b>		Priority of the specific opcode (Low, Normal, Above Normal or High). Each transport (e.g. CAN) will detail the mapping to the message encoding
<b>Description</b>		A brief explanation of the opcode's operation
<b>Comment</b>		An explanation of the opcode's operation including any associated opcodes, parameter usage and points to note.
<b>Direction</b>		<p>The normal direction for the opcode:</p> <ul style="list-style-type: none"> <li>• To module - is usually sent from a configuration tool to a module.</li> <li>• From module - usually sent as a response to a configuration command.</li> <li>• To command station - usually sent by a configuration tool or Cab to a DCC command station.</li> <li>• Blank - communications between modules.</li> </ul>
<b>States/Modes</b>		The set of states that the module must be in in order for the opcode's message to be recognised.
<b>Services</b>		The Service which the module must support in order for the opcode's message to be processed
<b>Parameters</b>		The ordered list of parameters for the opcode. 16bit (2 byte) values are sent highest byte first.
<b>Conditions</b>		<p>An ordered list of conditions for the module to process the opcode's message. Each condition is described as a failure condition with the failure result. If none of the conditions match then the successful processing of the message continues.</p> <p>I.e. Pre-conditions.</p>
<b>Result</b>		<p>The result of successfully processing the message.</p> <p>I.e. post-conditions.</p>
<b>History</b>		Origin and changes for the opcode definition

## 3.1 OPCODES with 0 additional bytes

### 3.1.1 [00] ACK - General Acknowledgement

<b>Name</b>		ACK
<b>Value</b>	<b>Decimal</b>	0
	<b>Hex</b>	00
<b>Priority</b>		Normal
<b>Description</b>		General Acknowledgement
<b>Comment</b>		<p>Positive response to query/ request performed or report of availability on-line.</p> <p>Not used by VLCB so delete this?</p>
<b>Direction</b>		
<b>States / Modes</b>		Normal, Learn, NOHEARTB
<b>Services</b>		
<b>Parameters</b>		
<b>Conditions</b>		
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.1.2 [01] NAK - General No Ack

<b>Name</b>		NAK
<b>Value</b>	<b>Decimal</b>	1
	<b>Hex</b>	01
<b>Priority</b>		Normal
<b>Description</b>		General No Ack
<b>Comment</b>		<p>Negative response to query/ request denied.</p> <p>Not used by VLCB so delete this?</p>
<b>Direction</b>		
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		
<b>Parameters</b>		
<b>Conditions</b>		
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.1.3 [02] HLT - Bus Halt

<b>Name</b>		HLT
<b>Value</b>	<b>Decimal</b>	2
	<b>Hex</b>	02
<b>Priority</b>		High
<b>Description</b>		Bus Halt
<b>Comment</b>		Commonly broadcasted to all nodes to indicate CBUS is not available and no further packets should be sent until a <a href="#">BON</a> or <a href="#">ARST</a> is received. <b>Not used by VLCB so delete this?</b>
<b>Direction</b>		Both
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		
<b>Parameters</b>		
<b>Conditions</b>		Opcode is supported
<b>Result</b>		If conditions are met then disable transmission of all messages on all interfaces otherwise ignore the request.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.1.4 [03] BON - Bus ON

<b>Name</b>		BON
<b>Value</b>	<b>Decimal</b>	3
	<b>Hex</b>	03
<b>Priority</b>		Above Normal
<b>Description</b>		Bus ON
<b>Comment</b>		Commonly broadcasted to all nodes to indicate CBUS is available following a <a href="#">HLT</a> . Not used by VLCB so delete this?
<b>Direction</b>		Both
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		
<b>Parameters</b>		
<b>Conditions</b>		Opcode is supported
<b>Result</b>		If conditions are met then enable transmission of all messages on all interfaces otherwise ignore the request.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.1.5 [04] TOF - Track OFF

<b>Name</b>		TOF
<b>Value</b>	<b>Decimal</b>	4
	<b>Hex</b>	04
<b>Priority</b>		Above Normal
<b>Description</b>		Track OFF
<b>Comment</b>		Commonly broadcasted to all nodes by a command station to indicate track power is off and no further command packets should be sent, except inquiries.
<b>Direction</b>		From command station
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		DCC_CAB or DCC_CMD
<b>Parameters</b>		
<b>Conditions</b>		
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.1.6 [05] TON - Track ON

<b>Name</b>		TON
<b>Value</b>	<b>Decimal</b>	5
	<b>Hex</b>	05
<b>Priority</b>		Above Normal
<b>Description</b>		Track ON
<b>Comment</b>		Commonly broadcasted to all nodes by a command station to indicate track power is on.
<b>Direction</b>		From command station
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		DCC_CAB or DCC_CMD
<b>Parameters</b>		
<b>Conditions</b>		
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j



## 3.1.7 [06] ESTOP - Emergency Stop

<b>Name</b>		ESTOP
<b>Value</b>	<b>Decimal</b>	6
	<b>Hex</b>	06
<b>Priority</b>		Above Normal
<b>Description</b>		Emergency Stop
<b>Comment</b>		Commonly broadcast to all nodes by a command station to indicate all engines have been emergency stopped.
<b>Direction</b>		From command station
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		DCC_CAB or DCC_CMD
<b>Parameters</b>		
<b>Conditions</b>		
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.1.8 [07] ARST - System Reset

<b>Name</b>		ARST
<b>Value</b>	<b>Decimal</b>	7
	<b>Hex</b>	07
<b>Priority</b>		High
<b>Description</b>		System Reset
<b>Comment</b>		Commonly broadcasted to all nodes to indicate a full system reset. Similar to <a href="#">NNRST</a> which directs a single node to be reset. <b>Not used by VLCB so delete this?</b>
<b>Direction</b>		
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		
<b>Parameters</b>		
<b>Conditions</b>		Opcode is supported
<b>Result</b>		If conditions are met then perform a module reset as if power on has just been performed otherwise ignore request.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.1.9 [08] RTOF - Request Track OFF

<b>Name</b>		RTOF
<b>Value</b>	<b>Decimal</b>	8
	<b>Hex</b>	08
<b>Priority</b>		Above Normal
<b>Description</b>		Request Track OFF
<b>Comment</b>		Sent to request change of track power state to “off”.
<b>Direction</b>		Cab to command station
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		DCC_CAB or DCC_CMD
<b>Parameters</b>		
<b>Conditions</b>		
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.1.10 [09] RTON - Request Track ON

<b>Name</b>		RTON
<b>Value</b>	<b>Decimal</b>	9
	<b>Hex</b>	09
<b>Priority</b>		Above Normal
<b>Description</b>		Request Track ON
<b>Comment</b>		Sent to request change of track power state to “on”.
<b>Direction</b>		Cab to command station
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		DCC_CAB or DCC_CMD
<b>Parameters</b>		
<b>Conditions</b>		
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.1.11 [0A] RESTP - Request Emergency Stop All

<b>Name</b>		RESTP
<b>Value</b>	<b>Decimal</b>	10
	<b>Hex</b>	0A
<b>Priority</b>		High
<b>Description</b>		Request Emergency Stop ALL
<b>Comment</b>		Sent to request an emergency stop to all trains . Does not affect accessory control.
<b>Direction</b>		Cab to command station
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		DCC_CAB or DCC_CMD
<b>Parameters</b>		
<b>Conditions</b>		
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.1.12 [0C] RSTAT - Request Command Station Status

<b>Name</b>		RSTAT
<b>Value</b>	<b>Decimal</b>	12
	<b>Hex</b>	0C
<b>Priority</b>		Normal
<b>Description</b>		Request Command Station Status
<b>Comment</b>		Sent to query the status of the command station. See description of ( <a href="#">STAT</a> ) for the response from the command station.
<b>Direction</b>		Cab to command station
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		DCC_CAB or DCC_CMD
<b>Parameters</b>		
<b>Conditions</b>		
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.1.13 [0D] QNN - Query Node Number

<b>Name</b>		QNN
<b>Value</b>	<b>Decimal</b>	13
	<b>Hex</b>	0D
<b>Priority</b>		Low
<b>Description</b>		Query node number
<b>Comment</b>		<p>Requests a <a href="#">PNN</a> reply from each node on the bus.</p> <p>Can be used by management software to obtain a list of nodes on the network.</p>
<b>Direction</b>		To module
<b>States/Modes</b>		Setup, Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		MNS
<b>Parameters</b>		
<b>Conditions</b>		
<b>Result</b>		A <a href="#">PNN</a> response is sent.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.1.14 [10] RQNP - Request Node Parameters

<b>Name</b>		RQNP
<b>Value</b>	<b>Decimal</b>	16
	<b>Hex</b>	10
<b>Priority</b>		Low
<b>Description</b>		Request node parameters
<b>Comment</b>		Sent to a node while in Setup mode to read its parameter set. Used when initially configuring a node.
<b>Direction</b>		To module
<b>States/Modes</b>		Setup
<b>Services</b>		MNS
<b>Parameters</b>		
<b>Conditions</b>		If the module is not in setup mode then ignore the message.
<b>Result</b>		If conditions are met then send a <a href="#">PARAMS</a> message.
<b>History</b>		No change from CBUS revision 4 ver 8j



## 3.1.15 [11] RQMN - Request Module Name

<b>Name</b>		RQMN
<b>Value</b>	<b>Decimal</b>	17
	<b>Hex</b>	11
<b>Priority</b>		Normal
<b>Description</b>		Request module name
<b>Comment</b>		<p>Sent by a node to request the name of the type of module that is in setup mode or Learn mode. The module in setup mode or learn mode will reply with opcode <a href="#">NAME</a>.</p> <p>Note if there is a module in setup mode and a module in Learn mode then both will respond.</p>
<b>Direction</b>		To module
<b>States/Modes</b>		Learn, Setup
<b>Services</b>		MNS
<b>Parameters</b>		
<b>Conditions</b>		If the module is not in Setup mode or Learn mode then the message is ignored.
<b>Result</b>		If conditions are met then send a <a href="#">NAME</a> message otherwise.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.2 OPCODES with 1 additional bytes

### 3.2.1 [21] KLOC - Release Engine

<b>Name</b>		KLOC
<b>Value</b>	<b>Decimal</b>	33
	<b>Hex</b>	21
<b>Priority</b>		Normal
<b>Description</b>		Release Engine
<b>Comment</b>		Sent by a CAB to the Command Station. The engine with that Session number is removed from the active engine list.
<b>Direction</b>		Cab to command station
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		DCC_CAB or DCC_CMD
<b>Parameters</b>		Session (1 bytes)
<b>Conditions</b>		If the module is not a DCC command station then the message is ignored. If the module does not have an active session with the specified session identifier then an <a href="#">ERR</a> message is sent.
<b>Result</b>		If conditions are met then the loco for that session is removed from the active engine list.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.2.2 [22] QLOC - Query Engine

<b>Name</b>		QLOC
<b>Value</b>	<b>Decimal</b>	34
	<b>Hex</b>	22
<b>Priority</b>		Normal
<b>Description</b>		Query engine
<b>Comment</b>		Used to determine if the command station session is valid and to obtain information about the status of the locomotive.
<b>Direction</b>		Cab to command station
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		DCC_CAB or DCC_CMD
<b>Parameters</b>		Session (1 bytes)
<b>Conditions</b>		<p>If the module is not a DCC command station then the message is ignored.</p> <p>If the module does not have an active session with the specified session identifier then an <a href="#">ERR</a> message is sent.</p>
<b>Result</b>		If conditions are met then send a <a href="#">PLOC</a> message.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.2.3 [23] DKEEP - Session Keep Alive

<b>Name</b>		DKEEP
<b>Value</b>	<b>Decimal</b>	35
	<b>Hex</b>	23
<b>Priority</b>		Normal
<b>Description</b>		Session keep alive
<b>Comment</b>		The cab sends a keep alive at regular intervals for the active session. The interval between keep alive messages must be less than the session timeout implemented by the command station.
<b>Direction</b>		Cab to command station
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		DCC_CAB or DCC_CMD
<b>Parameters</b>		Session (1 bytes)
<b>Conditions</b>		If the module is not a DCC command station then the message is ignored.
<b>Result</b>		If conditions are met then Reset the session's keep alive timer.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.2.4 [30] DBG1 - Debug with 1 Data Byte

<b>Name</b>		DBG1
<b>Value</b>	<b>Decimal</b>	48
	<b>Hex</b>	30
<b>Priority</b>		Normal
<b>Description</b>		Debug with one data byte
<b>Comment</b>		Freeform status byte for debugging during CBUS module development. Not used during normal operation.
<b>Direction</b>		
<b>States/Modes</b>		
<b>Services</b>		
<b>Parameters</b>		Status (1 bytes)
<b>Conditions</b>		
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.2.5 [3F] EXTC - Extended Opcode 0 Additional Bytes

<b>Name</b>		EXTC
<b>Value</b>	<b>Decimal</b>	63
	<b>Hex</b>	3F
<b>Priority</b>		Low
<b>Description</b>		Extended opcode with zero additional bytes.
<b>Comment</b>		Reserved to allow the 0 additional bytes range to be extended by a further 256 opcodes.
<b>Direction</b>		
<b>States/Modes</b>		
<b>Services</b>		
<b>Parameters</b>		Ext_OPC (1 bytes) Extended opcode,
<b>Conditions</b>		
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j

### 3.3 OPCODES with 2 additional bytes

#### 3.3.1 [40] RLOC - Request Engine Session

<b>Name</b>		RLOC
<b>Value</b>	<b>Decimal</b>	64
	<b>Hex</b>	40
<b>Priority</b>		Normal
<b>Description</b>		Request engine session
<b>Comment</b>		This command is typically sent by a cab to the command station following a change of the controlled decoder address. RLOC is exactly equivalent to <a href="#">GLOC</a> with all flag bits set to zero, but command stations must continue to support RLOC for backwards compatibility. 7 bit addresses have (AddrH=0). 14 bit addresses have bits 6,7 of AddrH set to 1.
<b>Direction</b>		Cab to command station
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		DCC_CAB or DCC_CMD
<b>Parameters</b>		Dat1 (1 bytes) AddrH of the decoder, Dat2 (1 bytes) AddrL of the decoder
<b>Conditions</b>		If the module is not a DCC command station then the message is ignored. If the command station does not have an available session slot an <a href="#">ERR</a> (Loco stack full) message is sent. If the loco is currently assigned to another session then an <a href="#">ERR</a> (Loco address Taken) is sent.
<b>Result</b>		If conditions are met then associate loco address to the specified session and send a <a href="#">PLOC</a> message.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.3.2 [41] QCON - Query Consist

<b>Name</b>		QCON
<b>Value</b>	<b>Decimal</b>	65
	<b>Hex</b>	41
<b>Priority</b>		Normal
<b>Description</b>		Query Consist
<b>Comment</b>		Allows enumeration of a consist. Command station responds with <a href="#">PLOC</a> if an engine exists at the specified index, otherwise responds with <a href="#">ERR</a> : no more engines
<b>Direction</b>		To command station
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		DCC_CAB or DCC_CMD
<b>Parameters</b>		ConID (1 byte) Consist ID Index (1 byte)
<b>Conditions</b>		If the module is not a DCC command station then the message is ignored. If an engine does not exist at the specified index then send an <a href="#">ERR</a> (No session) message.
<b>Result</b>		If conditions are met then send a <a href="#">PLOC</a> message.
<b>History</b>		No change from CBUS revision 4 ver 8j



## 3.3.3 [42] SNN - Set Node Number

<b>Name</b>		SNN
<b>Value</b>	<b>Decimal</b>	66
	<b>Hex</b>	42
<b>Priority</b>		Low
<b>Description</b>		Set Node Number
<b>Comment</b>		Sent by a configuration tool to assign a node number to a requesting node in response to a <a href="#">RQNN</a> message. The target node must be in 'setup' mode.
<b>Direction</b>		To module
<b>States/Modes</b>		Setup
<b>Services</b>		MNS
<b>Parameters</b>		NN (2 bytes) the new node number
<b>Conditions</b>		Module must be in setup mode otherwise the SNN message is ignored.
<b>Result</b>		If conditions are met then the specified node number is saved in persistent storage for use in future communications. The module shall send a <a href="#">NNACK</a> message in response.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.3.4 [43] ALOC - Allocate Loco to Activity

<b>Name</b>		ALOC
<b>Value</b>	<b>Decimal</b>	67
	<b>Hex</b>	43
<b>Priority</b>		Normal
<b>Description</b>		Allocate loco to activity.
<b>Comment</b>		
<b>Direction</b>		To command station
<b>States/Modes</b>		Normal
<b>Services</b>		DCC_CAB or DCC_CMD
<b>Parameters</b>		Session ID (1 byte) the Session ID. Allocation code (1 byte) application specific allocation code.
<b>Conditions</b>		If the module is not a DCC command station then ignore the request. If the module does not have an active session with the specified session identifier then send an <a href="#">ERR</a> (No session) message.
<b>Result</b>		If conditions are met then assign the activity code to the session otherwise.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.3.5 [44] STMOD - Set Cab Session Mode

<b>Name</b>		STMOD
<b>Value</b>	<b>Decimal</b>	68
	<b>Hex</b>	44
<b>Priority</b>		Normal
<b>Description</b>		Set CAB session mode
<b>Comment</b>		Bits 0 –1: speed mode 00 =128 speed steps, 01 =14 speed steps, 10 =28 speed steps with interleave steps, 11 =28 speed steps Bit 2: service mode Bit 3:sound control mode
<b>Direction</b>		Cab to command station
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		DCC_CAB or DCC_CMD
<b>Parameters</b>		Session (1 bytes), mode (1 bytes)
<b>Conditions</b>		If the module is not a DCC command station then ignore the request. If the module does not have an active session with the specified session identifier then send an <a href="#">ERR</a> (No session) message.
<b>Result</b>		If conditions are met then update the session information for number of speed steps, service mode and sound control mode.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.3.6 [45] PCON - Consist Engine

<b>Name</b>		PCON
<b>Value</b>	<b>Decimal</b>	69
	<b>Hex</b>	45
<b>Priority</b>		Normal
<b>Description</b>		Consist Engine
<b>Comment</b>		Adds a decoder specified by Session to a consist. Consist# has bit 7 set if consist direction is reversed.
<b>Direction</b>		Cab to command station
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		DCC_CAB or DCC_CMD
<b>Parameters</b>		Session (1 bytes), Consist# (1 bytes)
<b>Conditions</b>		If the module is not a DCC command station then ignore the request. If the module does not have an active session with id Session then send <a href="#">ERR</a> (No session).
<b>Result</b>		If the module does not already have a consist with the specified id then the consist is created. The session is added to the specified consist.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.3.7 [46] KCON - Remove Loco from Consist

<b>Name</b>		KCON
<b>Value</b>	<b>Decimal</b>	70
	<b>Hex</b>	46
<b>Priority</b>		Normal
<b>Description</b>		Removes a loco from a consist.
<b>Comment</b>		
<b>Direction</b>		To module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		DCC_CAB or DCC_CMD
<b>Parameters</b>		Session (1 bytes), Consist# (1 bytes)
<b>Conditions</b>		If the module is not a DCC command station then ignore the message. If the module does not have a session with the specified Session id then send <a href="#">ERR</a> (No session). If the module does not have a consist with the specified Consist# id then ignore the message.
<b>Result</b>		If conditions are met then remove the specified session from the specified consist.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.3.8 [47] DSPD - Set Engine Speed/Dir

<b>Name</b>		DSPD
<b>Value</b>	<b>Decimal</b>	71
	<b>Hex</b>	47
<b>Priority</b>		Normal
<b>Description</b>		Set Engine Speed/Dir
<b>Comment</b>		Speed/dir value, where the most significant bit is direction and the 7ls bits are the unsigned speed value. Sent by a CAB or equivalent to request an engine speed/dir change.
<b>Direction</b>		Cab to command station
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		DCC_CAB or DCC_CMD
<b>Parameters</b>		Session (1 bytes), Speed/Dir (1 bytes)
<b>Conditions</b>		If the module is not a DCC command station then ignore the message. If the module does not have an active session with the specified session identifier then send <a href="#">ERR</a> (No session).
<b>Result</b>		If conditions are met then set the speed and direction of the loco specified by the session.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.3.9 [48] DFLG - Set Engine Flags

<b>Name</b>		DFLG
<b>Value</b>	<b>Decimal</b>	72
	<b>Hex</b>	48
<b>Priority</b>		Normal
<b>Description</b>		Set Engine Flags
<b>Comment</b>		<p>Bits 0-1: Speed Mode (00 =128 speed steps, 01 =14 speed steps, 10 =28 speed steps with interleave steps, 11 =28 speed steps)</p> <p>Bit 2: Lights On/OFF</p> <p>Bit 3: Engine relative direction</p> <p>Bits 4-5: Engine state (active =0 , consisted =1, consist master=2, inactive=3)</p> <p>Bits 6-7: Reserved.</p> <p>Sent by a cab to notify the command station of a change in engine flags.</p>
<b>Direction</b>		Cab to command station
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		DCC_CAB or DCC_CMD
<b>Parameters</b>		Session (1 bytes), SpeedMode (1 bytes)
<b>Conditions</b>		<p>If the module is not a DCC command station then ignore the message.</p> <p>If the module does not have an active session with the specified session identifier then send an ERR (No session) message.</p>
<b>Result</b>		If conditions are met then set the specified session flags.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.3.10 [49] DFNON - Set Engine Function ON

<b>Name</b>		DFNON
<b>Value</b>	<b>Decimal</b>	73
	<b>Hex</b>	49
<b>Priority</b>		Normal
<b>Description</b>		Set Engine function on
<b>Comment</b>		Sent by a cab to turn on a specific loco function. This provides an alternative method to <a href="#">DFUN</a> for controlling loco functions. A command station must implement both methods.
<b>Direction</b>		To module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		DCC_CAB or DCC_CMD
<b>Parameters</b>		Session (1 bytes), Fnum (1 bytes)
<b>Conditions</b>		If the module is not a DCC command station then ignore the message. If the module does not have an active session with the specified session identifier then send an <a href="#">ERR</a> (No session) message.
<b>Result</b>		If conditions are met then turn on the loco function on the specified session.
<b>History</b>		No change from CBUS revision 4 ver 8j



## 3.3.11 [4A] DFNOF - Set Engine Function OFF

<b>Name</b>		DFNOF
<b>Value</b>	<b>Decimal</b>	74
	<b>Hex</b>	4A
<b>Priority</b>		Normal
<b>Description</b>		Set Engine function off
<b>Comment</b>		Sent by a cab to turn off a specific loco function. This provides an alternative method to <a href="#">DFUN</a> for controlling loco functions. A command station must implement both methods.
<b>Direction</b>		To module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		DCC_CAB or DCC_CMD
<b>Parameters</b>		Session (1 bytes), Fnum (1 bytes)
<b>Conditions</b>		If the module is not a DCC command station then ignore the message. If the module does not have an active session with the specified session identifier then send an <a href="#">ERR</a> (No session) message.
<b>Result</b>		If conditions are met then turn off the loco function on the specified session.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.3.12 [4C] SSTAT - Service Mode Status

<b>Name</b>		SSTAT
<b>Value</b>	<b>Decimal</b>	76
	<b>Hex</b>	4C
<b>Priority</b>		Low
<b>Description</b>		Service mode status
<b>Comment</b>		Status returned by command station/programmer at the end of a programming operation that does not return data. Response to <a href="#">QCVS</a> to indicate no data.
<b>Direction</b>		From command station
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		DCC_CAB or DCC_CMD
<b>Parameters</b>		Session (1 bytes), Status (1 bytes)
<b>Conditions</b>		Response to <a href="#">QCVS</a> when no data was available.
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.3.13 [4F] NNRSM - Reset to Manufacturer Settings

<b>Name</b>		NNRSM
<b>Value</b>	<b>Decimal</b>	79
	<b>Hex</b>	4F
<b>Priority</b>		Low
<b>Description</b>		Reset to manufacturer settings
<b>Comment</b>		Reset a module back to manufacturer settings
<b>Direction</b>		To module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		MNS
<b>Parameters</b>		NN (2 bytes) Node number
<b>Conditions</b>		If the NN does not match the module's node number then ignore the message.
<b>Result</b>		If conditions are met then the module shall respond with <a href="#">GRSP</a> OK and then clear all configuration and revert to a state at time of initial programming, including <i>Uninitialised</i> mode i.e. NN=0, <u>manufacturer's default NVs and default Events.</u> (CANID will be enumerated on the first CAN message send.)
<b>History</b>		CBUS specifies preservation of NN and returns to FLiM. VLCB reverts the module to NN=0 and enters Uninitialised mode.

## 3.3.14 [50] RQNN - Request Node Number

<b>Name</b>		RQNN
<b>Value</b>	<b>Decimal</b>	80
	<b>Hex</b>	50
<b>Priority</b>		low
<b>Description</b>		Request node number
<b>Comment</b>		<p>The module is requesting that it is provided with a new node number.</p> <p>A configuration tool should respond with <a href="#">SNN</a> to provide the requesting module with an allocated node number.</p> <p>The NN within the message is the current node number of the module.</p>
<b>Direction</b>		From module
<b>States/Modes</b>		Setup
<b>Services</b>		MNS
<b>Parameters</b>		NN (2 bytes) Existing Node number
<b>Conditions</b>		<p>Module has been instructed to request a new node number. This may be done in a variety of ways such as holding down a push button on the module for a number of seconds.</p> <p>Module will not send RQNN until instructed to obtain new NN.</p>
<b>Result</b>		<p>The module enters setup mode.</p> <p>If the module does not receive a <a href="#">SNN</a> within 30 seconds, the module will return to its previous mode and reclaim its previous NN by issuing a NNACK.</p>
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.3.15 [51] NNREL - Node Number Release

<b>Name</b>		NNREL
<b>Value</b>	<b>Decimal</b>	81
	<b>Hex</b>	51
<b>Priority</b>		Low
<b>Description</b>		Node number release
<b>Comment</b>		A node signals that it no longer requires a node number by sending NNREL. The module will do this upon moving from normal mode to setup mode.
<b>Direction</b>		From module
<b>States/Modes</b>		Setup
<b>Services</b>		MNS
<b>Parameters</b>		NN (2 bytes) Node number
<b>Conditions</b>		Module is in the process of changing to Setup mode.
<b>Result</b>		Module no longer has a node number. The node number is replaced with 0 indicating 'no node number'.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.3.16 [52] NNACK - Node Number Acknowledge

<b>Name</b>		NNACK
<b>Value</b>	<b>Decimal</b>	82
	<b>Hex</b>	52
<b>Priority</b>		Low
<b>Description</b>		Node number acknowledge
<b>Comment</b>		This message is sent in response to <a href="#">SNN</a> . A node signals that it will now use the node number specified in the <a href="#">SNN</a> message.
<b>Direction</b>		From module
<b>States/Modes</b>		Setup
<b>Services</b>		MNS
<b>Parameters</b>		NN (2 bytes) the new node number to be used.
<b>Conditions</b>		Module will be transitioning from Setup mode to Normal mode.
<b>Result</b>		Module will be in Normal mode with the new node number assigned.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.3.17 [53] NNLRN - Set Node to Learn Mode

<b>Name</b>		NNLRN
<b>Value</b>	<b>Decimal</b>	83
	<b>Hex</b>	53
<b>Priority</b>		Low
<b>Description</b>		Set node into learn mode
<b>Comment</b>		Sent by a configuration tool to put a specific node into learn mode. Deprecated and replaced by <a href="#">MODE</a> .
<b>Direction</b>		To module
<b>States/Modes</b>		Normal
<b>Services</b>		Teach
<b>Parameters</b>		NN (2 bytes) Node number
<b>Conditions</b>		<p>if the NN does NOT match the node number of the module and the module is in Learn mode then it must revert to Normal mode.</p> <p>If the NN does NOT match the node number of the module and the module is not in Learn mode then the message is ignored.</p> <p>If the NN matches the module's node number and the module supports event teaching then the module enters Learn mode.</p> <p>If the NN matches the module's node number and the module does not support event teaching then the message is ignored.</p>
<b>Result</b>		If conditions are met then the module enters Learn mode.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.3.18 [54] NNULN - Node Out of Learn Mode

<b>Name</b>		NNULN
<b>Value</b>	<b>Decimal</b>	84
	<b>Hex</b>	54
<b>Priority</b>		Low
<b>Description</b>		Release node from learn mode
<b>Comment</b>		Sent by a configuration tool to take the module out of learn mode and revert to normal operation. Deprecated and replaced by <a href="#">MODE</a> .
<b>Direction</b>		To module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		Teach
<b>Parameters</b>		NN (2 bytes) Node number
<b>Conditions</b>		If the NN does not match the module's node number then the message is ignored. If the module does not support event teaching then the message is ignored. If the NN matches the module's node number and the module is in Learn mode then the module exits Learn mode and returns to Normal mode.
<b>Result</b>		If the conditions are met the module exits Learn mode and enters Normal mode.
<b>History</b>		No change from CBUS revision 4 ver 8j



## 3.3.19 [55] NNCLR - Clear All Events

<b>Name</b>		NNCLR
<b>Value</b>	<b>Decimal</b>	85
	<b>Hex</b>	55
<b>Priority</b>		Low
<b>Description</b>		Clear all events from a node
<b>Comment</b>		Sent by a configuration tool to clear all events from a specific node. Must be in learn mode first to safeguard against accidental erasure of all events
<b>Direction</b>		To module
<b>States/Modes</b>		Learn
<b>Services</b>		Teach
<b>Parameters</b>		NN (2 bytes) Node number
<b>Conditions</b>		<p>If the NN does not match the module's node number then the message is ignored.</p> <p>If the module is not in learn mode then a CMDERR(Not Learn Mode) message and a GRSP(Not in Learn Mode) is returned.</p> <p>If the module does not support event teaching then the message is ignored.</p>
<b>Result</b>		If conditions are met then remove all stored events and send a <a href="#">WRACK</a> message.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.3.20 [56] NNEVN - Number of Events Available

<b>Name</b>		NNEVN
<b>Value</b>	<b>Decimal</b>	86
	<b>Hex</b>	56
<b>Priority</b>		Low
<b>Description</b>		Read the number of event slots available in a node
<b>Comment</b>		Sent by a configuration tool to read the number of available event slots in a node.
<b>Direction</b>		To module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		Teach
<b>Parameters</b>		NN (2 bytes) Node number
<b>Conditions</b>		If the NN does not match the module's node number then ignore the message.
<b>Result</b>		If conditions are met then send <a href="#">EVNLF</a> message with number of available slots in event table.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.3.21 [57] NERD - Read All Events

<b>Name</b>		NERD
<b>Value</b>	<b>Decimal</b>	87
	<b>Hex</b>	57
<b>Priority</b>		Low
<b>Description</b>		Read back all stored events in a node. There MUST be no hidden events.
<b>Comment</b>		Sent by a configuration tool to read all the stored events in a node.
<b>Direction</b>		To module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, <a href="#">ENACK</a>
<b>Services</b>		Teach
<b>Parameters</b>		NN (2 bytes) Node number
<b>Conditions</b>		If the NN does not match the module's node number then ignore the message.
<b>Result</b>		If conditions are met then send a <a href="#">ENRSP</a> message for each configured event.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.3.22 [58] RQEVN - Read number of Stored Events

<b>Name</b>		RQEVN
<b>Value</b>	<b>Decimal</b>	88
	<b>Hex</b>	58
<b>Priority</b>		Low
<b>Description</b>		Request to read number of stored events
<b>Comment</b>		Sent by a configuration tool to read the number of stored events in a node.
<b>Direction</b>		To module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		Teach
<b>Parameters</b>		NN (2 bytes) Node number
<b>Conditions</b>		If the NN does not match the module's node number then ignore the message.
<b>Result</b>		If conditions are met then send a <a href="#">NUMEV</a> message to indicate the number of stored events.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.3.23 [59] WRACK - Write Acknowledge

<b>Name</b>		WRACK
<b>Value</b>	<b>Decimal</b>	89
	<b>Hex</b>	59
<b>Priority</b>		Low
<b>Description</b>		Write acknowledge
<b>Comment</b>		Sent by a node to indicate the completion of a write to memory operation. All nodes must issue WRACK when a write operation to node variables, events or event variables has completed. This allows for teaching nodes where the processing time may be slow. Deprecated and replaced by <a href="#">GRSP</a> .
<b>Direction</b>		From module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		Teach, NV
<b>Parameters</b>		NN (2 bytes) Node number
<b>Conditions</b>		The module has completed writing to non-volatile memory and is ready to accept more commands.
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.3.24 [5A] RQDAT - Request Data Event

<b>Name</b>		RQDAT
<b>Value</b>	<b>Decimal</b>	90
	<b>Hex</b>	5A
<b>Priority</b>		Low
<b>Description</b>		Request node data event
<b>Comment</b>		Sent by one node to read the data event from another node.(eg: RFID data).
<b>Direction</b>		Both
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		
<b>Parameters</b>		NN (2 bytes) Node number
<b>Conditions</b>		If the NN does not match the module's node number then ignore the message. If the module does not support RQDAT then ignore the message.
<b>Result</b>		If conditions are met then send an <a href="#">ARDAT</a> message containing the application specific data.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.3.25 [5B] RQDDS - Request Device Data - short mode

<b>Name</b>		RQDDS
<b>Value</b>	<b>Decimal</b>	91
	<b>Hex</b>	5B
<b>Priority</b>		Low
<b>Description</b>		Request device data –short mode
<b>Comment</b>		To request a ‘data set’ from a device using the short event method where DN is the device number.
<b>Direction</b>		To module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		
<b>Parameters</b>		DN (2 bytes) Device number
<b>Conditions</b>		If DN is not recognised by the module then ignore the message.
<b>Result</b>		If conditions are met then send a <a href="#">DDRS</a> message response.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.3.26 [5C] BOOTM - Enter Bootloader Mode

<b>Name</b>		BOOTM
<b>Value</b>	<b>Decimal</b>	92
	<b>Hex</b>	5C
<b>Priority</b>		Low
<b>Description</b>		Put node into bootloading mode
<b>Comment</b>		For modules with no NN then the NN of the command must be zero. For nodes in Normal mode the command must contain the NN of the target node. Sent by a configuration tool to prepare for loading a new program.
<b>Direction</b>		To module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		Boot
<b>Parameters</b>		NN (2 bytes) Node number
<b>Conditions</b>		If NN does not match the module's node number then ignore the message.
<b>Result</b>		If conditions are met then enter BOOT mode. If using the standard PIC bootloader then write a 0x01 to the top EEPROM location and reset the processor. The module's PIC bootloader will be activated before the application code. Once the bootloading is complete it will pass control by to the application at the Load Address in the parameter block.
<b>History</b>		No change from CBUS revision 4 ver 8j



## 3.3.27 [5D] ENUM - Force Self Enumeration of CANID

<b>Name</b>		ENUM
<b>Value</b>	<b>Decimal</b>	93
	<b>Hex</b>	5D
<b>Priority</b>		Low
<b>Description</b>		Force a self enumeration cycle for use with CAN. <b>Deprecated. Replaced with automatic self enumeration after duplicate CANID detection</b>
<b>Comment</b>		For nodes in Normal mode using CAN as a transport.. This message will force a self-enumeration cycle for the specified node. A new CAN_ID will be allocated if needed.
<b>Direction</b>		To module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		CAN
<b>Parameters</b>		NN (2 bytes) Node number
<b>Conditions</b>		If the NN does not match the module's node number then the message will be ignored.
<b>Result</b>		If conditions are met then start to perform self enumeration. A RTR CAN frame is sent. The module must wait 100ms for other modules to respond with a zero length data frame containing their CANID. After 100ms the module shall select an unused CANID in the range 1..127. If no CANIDs are available then send <a href="#">CMDERR(7)</a> . After the enum process is complete and if a CANID has been assigned then send <a href="#">NNACK</a> .
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.3.28 [5E] NNRST - Node Reset

<b>Name</b>		NNRST
<b>Value</b>	<b>Decimal</b>	94
	<b>Hex</b>	5E
<b>Priority</b>		Low
<b>Description</b>		Reset
<b>Comment</b>		Reset a module's microprocessor.
<b>Direction</b>		To module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		
<b>Parameters</b>		NN (2 bytes) Node number
<b>Conditions</b>		If the NN does not match the module's node number then ignore the request.
<b>Result</b>		If conditions are met then perform a reset of the microprocessor.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.3.29 [5F] EXTC1 - Extended Opcode with 1 Additional Bytes

<b>Name</b>		EXTC1
<b>Value</b>	<b>Decimal</b>	95
	<b>Hex</b>	5F
<b>Priority</b>		Low
<b>Description</b>		Extended opcode with 1 additional bytes
<b>Comment</b>		Reserved to allow the 1 additional bytes range to be extended by a further 256 opcodes.
<b>Direction</b>		
<b>States/Modes</b>		
<b>Services</b>		
<b>Parameters</b>		Ext_OPC (1 bytes) Extended opcode, Data1 (1 bytes)
<b>Conditions</b>		
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.4 OPCODES with 3 additional bytes

### 3.4.1 [60] DFUN - Set Engine Functions

<b>Name</b>		DFUN
<b>Value</b>	<b>Decimal</b>	96
	<b>Hex</b>	60
<b>Priority</b>		Normal
<b>Description</b>		Set Engine functions
<b>Comment</b>		<p>&lt;Fn1&gt;is the function range  1 is F0(FL) to F4,  2 is F5 to F8,  3 is F9 to F12,  4 is F13 to F20,  5 is F21to F28)  &lt;Fn2&gt; is the NMRA DCC format function byte for that range in corresponding bits. A bit set to 1 turns function “on” and a cleared bit sets function “off”.</p> <p>Sent by a CAB or equivalent to request an engine Fn state change.</p>
<b>Direction</b>		Cab to command station
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		DCC_CAB or DCC_CMD
<b>Parameters</b>		Session (1 bytes), Fn1 (1 bytes), Fn2 (1 bytes)
<b>Conditions</b>		<p>If the module is not a DCC command station then ignore the message.  If the module does not have an active session with the specified session identifier then send an <a href="#">ERR</a> (No session) message.</p>
<b>Result</b>		If conditions are met then set the functions in the range given to the requested state.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.4.2 [61] GLOC - Get Engine Session

<b>Name</b>		GLOC
<b>Value</b>	<b>Decimal</b>	97
	<b>Hex</b>	61
<b>Priority</b>		Normal
<b>Description</b>		Get engine session
<b>Comment</b>		<p>&lt;Flags&gt; contains flag bits as follows:            Bit 0: Set for "Steal" mode            Bit 1: Set for "Share" mode.            Both bits set to 0 is exactly equivalent to an <a href="#">RLOC</a> request but command stations must continue to support <a href="#">RLOC</a> for backwards compatibility.</p>
<b>Direction</b>		Cab to command station
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		DCC_CAB or DCC_CMD
<b>Parameters</b>		Addr (2 bytes), Flags (1 bytes)
<b>Conditions</b>		<p>If the module is not a DCC command station then ignore the message.            If the least significant two bits of Flags are both set then send an <a href="#">ERR</a> (Invalid Request) message.            If the loco with the specified address is taken and steal/share is disabled then send an <a href="#">ERR</a> (Loco taken) message.            If there is no available session slot for the steal then send an <a href="#">ERR</a> (Stack full) message.            If there is no current session for a share then send an <a href="#">ERR</a> (No session) message.</p>
<b>Result</b>		Perform the share/steal and send a <a href="#">PLOC</a> message.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.4.3 [63] ERR - Command Station Error

<b>Name</b>		ERR
<b>Value</b>	<b>Decimal</b>	99
	<b>Hex</b>	63
<b>Priority</b>		Normal
<b>Description</b>		Command Station Error report
<b>Comment</b>		Sent in response to an error situation by a command station. See <a href="#">Appendix A - DCC ERR error codes</a> for a list of error codes.
<b>Direction</b>		From command station to cab
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		DCC_CAB or DCC_CMD
<b>Parameters</b>		AddrH (1 bytes), AddrL (1 bytes), ErrorCode (1 bytes)
<b>Conditions</b>		Sent by a command station in response to a DCC command to report an error.
<b>Result</b>		See table below for the use of the Data fields.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.4.4 [6F] CMDERR - Configuration Error

<b>Name</b>		CMDERR
<b>Value</b>	<b>Decimal</b>	111
	<b>Hex</b>	6F
<b>Priority</b>		Low
<b>Description</b>		Error messages from nodes during configuration
<b>Comment</b>		<p>Sent by node if there is an error when a configuration command is sent. See <a href="#">Appendix C - CMDERR error codes</a> for the list of supported codes. Deprecated and replaced by GRSP.</p> <p>Modules should continue to support CMDERR as possible responses to CBUS compatible requests in order to maintain backwards compatibility to CBUS. In these cases a VLCB GRSP should also be reported. VLCB requests that are not in CBUS should report errors only with GRSP.</p>
<b>Direction</b>		From module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		MNS, Teach, NV
<b>Parameters</b>		<p>NN (2 bytes) Node number,  Error (1 bytes) Error number, see CMDERR list in Appendix C</p>
<b>Conditions</b>		Sent by a module to indicate an error response to a command.
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.4.5 [70] EVNLF - Number of Event Spaces Remaining

<b>Name</b>		EVNLF
<b>Value</b>	<b>Decimal</b>	112
	<b>Hex</b>	70
<b>Priority</b>		Low
<b>Description</b>		Event space left reply from node
<b>Comment</b>		Spaces is a one byte value giving the number of available event spaces left in the node's event table This is the maximum number of additional events that can be stored by the module..
<b>Direction</b>		From module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		Teach
<b>Parameters</b>		NN (2 bytes) Node number, Spaces(1 bytes)
<b>Conditions</b>		Sent in response to a <a href="#">NNEVN</a> request.
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j



## 3.4.6 [71] NVRD - Node Variable Read

<b>Name</b>		NVRD
<b>Value</b>	<b>Decimal</b>	113
	<b>Hex</b>	71
<b>Priority</b>		Low
<b>Description</b>		Request read of a node variable
<b>Comment</b>		NV# is the index for the node variable value requested. Response is <a href="#">NVANS</a> . Reading NV#0 shall first return a <a href="#">NVANS</a> with the number of NVs followed by a <a href="#">NVANS</a> for each NV.
<b>Direction</b>		To module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		NV
<b>Parameters</b>		NN (2 bytes) Node number, NV# (1 bytes) Node variable index
<b>Conditions</b>		If NN does not match the module's node number then the message is ignored. If message is short so that it does not include the NV# then a <a href="#">GRSP</a> (Invalid Command) message is returned. If NV# is not between 0 and the supported number of NVs then <a href="#">CMDERR</a> (Invalid Node Variable Index) message is returned and a <a href="#">GRSP</a> (Invalid Node Variable Index) message is returned.
<b>Result</b>		If conditions are met and NV# is 0 then send a NVANS response for NV#0 and value of the number of NVs followed by a NVANS for each NV. If conditions are met and NV# is greater than 0 then send a single <a href="#">NVANS</a> response containing the value of the requested NV. If NV# is not between 1 and the supported number of NVs then <a href="#">CMDERR</a> (Invalid Node Variable Index) message is returned and a <a href="#">GRSP</a> (Invalid Node Variable Index) message is returned.
<b>History</b>		Modified from CBUS revision 4 ver 8j to also return GRSP and support for NV#0.

## 3.4.7 [72] NENRD - Read Event by Index

<b>Name</b>		NENRD
<b>Value</b>	<b>Decimal</b>	114
	<b>Hex</b>	72
<b>Priority</b>		Low
<b>Description</b>		Request read of stored event by event index <b>Deprecated</b>
<b>Comment</b>		EN# is the index for the stored event requested.
<b>Direction</b>		To module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		Teach
<b>Parameters</b>		NN (2 bytes) Node number, EN# (1 bytes) Event index
<b>Conditions</b>		NN matches module's node number. EN# is a valid event index
<b>Result</b>		If condition 'NN matches module's node number' is not met then ignore request. If condition 'EN# is a valid event index' is met then send <a href="#">ENRSP</a> response message otherwise send <a href="#">CMDERR</a> (Invalid Event).
<b>History</b>		In CBUS revision 4 ver 8j, deprecated for VLCB.

## 3.4.8 [73] RQNPN - Read Node Parameter By Index

<b>Name</b>		RQNPN
<b>Value</b>	<b>Decimal</b>	115
	<b>Hex</b>	73
<b>Priority</b>		Low
<b>Description</b>		Request read of a node parameter by index
<b>Comment</b>		Para# is the index for the parameter requested. Reading Index 0 first returns a <a href="#">PARAN</a> with the number of available parameters followed by a <a href="#">PARAN</a> for each of those parameters. See <a href="#">Appendix B - Module parameters</a> for the list of available parameters and their meaning.
<b>Direction</b>		To module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		MNS
<b>Parameters</b>		NN (2 bytes) Node number, Para# (1 bytes)
<b>Conditions</b>		If NN does not match the module's node number then ignore the message. If message is short so that it does not include the Para# then a <a href="#">GRSP</a> (Invalid Command) message is returned. If Para# is greater than the number of supported parameters the send message <a href="#">CMDERR</a> (Invalid Parameter Index) and message <a href="#">GRSP</a> (Invalid Parameter Index)
<b>Result</b>		If conditions are met then If Para# is 0 then send a <a href="#">PARAN</a> message with the number of available parameters as the value for parameter 0 followed by a <a href="#">PARAN</a> message for each of the parameters else send a single <a href="#">PARAN</a> message containing the requested parameter value.
<b>History</b>		Modified from CBUS revision 4 ver 8j so that Para# 0 returns a PARAN for each parameter.

## 3.4.9 [74] NUMEV - Number of Events

<b>Name</b>		NUMEV
<b>Value</b>	<b>Decimal</b>	116
	<b>Hex</b>	74
<b>Priority</b>		Low
<b>Description</b>		Number of events stored in node
<b>Comment</b>		Response to request <a href="#">RQEVN</a>
<b>Direction</b>		From module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		Teach
<b>Parameters</b>		NN (2 bytes) Node number, No. of events (1 bytes) Number of events
<b>Conditions</b>		Sent in response to a <a href="#">RQEVN</a> request.
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.4.10 [75] CANID - Set CANID

<b>Name</b>		CANID
<b>Value</b>	<b>Decimal</b>	117
	<b>Hex</b>	75
<b>Priority</b>		Low
<b>Description</b>		Set a CAN_ID in existing node. <b>Deprecated. Replaced with Self-enumeration.</b>
<b>Comment</b>		Used to force a specified CAN_ID into a node. Value range is from 1 to 0x63 (99 decimal). This OPC must be used with care as duplicate CAN_IDs are not allowed.
<b>Direction</b>		To module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		CAN
<b>Parameters</b>		NN (2 bytes) Node number, CAN_ID (1 bytes) CAN identifier
<b>Conditions</b>		If NN does not match the module's node number then ignore the message. If message is short so that it does not include the CAN_ID then a <a href="#">GRSP</a> (Invalid Command) message is returned. If CANID is not between 1 (inclusive) and 99 (inclusive) then send message <a href="#">CMDERR</a> (Invalid Event) and message <a href="#">GRSP</a> (Invalid command parameter)
<b>Result</b>		If conditions are met then store the CAN_ID to be used in subsequent CAN message transmission. Send message <a href="#">WRACK</a> and <a href="#">GRSP</a> (ok).
<b>History</b>		Modified from CBUS revision 4 ver 8j to include GRSP responses.

## 3.4.11 [76] MODE - Set Operating Mode

<b>Name</b>		MODE
<b>Value</b>	<b>Decimal</b>	118
	<b>Hex</b>	76
<b>Priority</b>		Low
<b>Description</b>		Set module operating mode
<b>Comment</b>		<p>Request to change the operational mode of the module.</p> <ul style="list-style-type: none"> <li>• Mode 0xFF is Uninitialised mode</li> <li>• Mode 0 is Setup mode</li> <li>• Mode 1 is Normal mode</li> <li>• Mode 2 is Learn mode</li> </ul> <p>Other modes may be defined by additional Services. E.g. The Bootloader service might introduce BOOT mode.</p>
<b>Direction</b>		To module
<b>States/Modes</b>		Setup, Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		MNS
<b>Parameters</b>		NN (2 bytes) Node number, Mode (1 bytes) Requested Mode
<b>Conditions</b>		<p>If the module has a non zero node number and NN does not match the module's node number then ignore the message. Note that if the module is in Setup mode or Uninitialised mode then the module's NN should be zero.</p> <p>If the message is short so that it does not include the Mode then a <a href="#">GRSP</a> (Invalid Command) message is returned.</p> <p>If the module is in Setup or Uninitialised modes and the message NN is non zero then ignore the message.</p> <p>If the module is in Uninitialised state and the requested mode is not Setup mode then send <a href="#">GRSP</a>(invalid mode)</p> <p>If the module is in Setup mode then send a <a href="#">GRSP</a>(invalid mode) message.</p> <p>If the module is in Learn mode and the requested mode is Setup then send a <a href="#">GRSP</a>(invalid mode) message.</p>

<b>Result</b>	<p>If requested mode is Setup</p> <ul style="list-style-type: none"> <li>• If the module's current NN != 0 send <a href="#">NNREL</a> for current node number</li> <li>• Send <a href="#">RQNN</a></li> <li>• Set mode to Setup, start timer for timeout</li> <li>• Send <a href="#">GRSP</a>(ok). In this case the original NN is included rather than the new NN of 0.</li> <li>• Set node number to 0</li> </ul> <p>If requested mode is Normal</p> <ul style="list-style-type: none"> <li>• Set mode to Normal</li> <li>• Send <a href="#">GRSP</a>(ok)</li> </ul> <p>If requested mode is Learn</p> <ul style="list-style-type: none"> <li>• Set mode to Learn</li> <li>• Send <a href="#">GRSP</a>(ok)</li> </ul>
<b>History</b>	New for VLCB

## 3.4.12 [78] RQSD - Request Service Discovery

<b>Name</b>		RQSD
<b>Value</b>	<b>Decimal</b>	120
	<b>Hex</b>	78
<b>Priority</b>		Low
<b>Description</b>		Request service discovery
<b>Comment</b>		<p>Request service data from a module.            If the ServiceIndex is zero then the module responds with a <a href="#">SD</a> response for each service supported. If ServiceIndex is non zero then the module will respond with a single <a href="#">ESD</a> message.</p> <p>Similar to other requests for data with an index of 0 (e.g. NVRD and REQEV) the first response shall return the number of responses followed by a response for each data item. The first response will have a ServiceIndex=0, ServiceType=0 and Version field to contain the number of services.</p>
<b>Direction</b>		To module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		MNS
<b>Parameters</b>		NN (2 bytes) Node number, ServiceIndex (1 bytes) Index into the list of services.
<b>Conditions</b>		<p>If NN does not match the module's node number then ignore the message.</p> <p>If the message is short so that it does not include the ServiceType then a <a href="#">GRSP</a> (Invalid Command) message is returned.</p> <p>If ServiceType is greater than the number of supported services send a <a href="#">GRSP</a>(Invalid service) message.</p>
<b>Result</b>		If ServiceIndex is zero a <a href="#">SD</a> (0,0, number of services) message is sent followed by a SD message for each implemented service, otherwise send an <a href="#">ESD</a> message for the specified service.
<b>History</b>		New for VLCB



## 3.4.13 [7F] EXTC2 - Extended Opcode with 2 Additional Bytes

<b>Name</b>		EXTC2
<b>Value</b>	<b>Decimal</b>	127
	<b>Hex</b>	7F
<b>Priority</b>		Low
<b>Description</b>		Extended opcode with 2 additional bytes
<b>Comment</b>		Reserved to allow the 2 additional bytes range to be extended by a further 256 opcodes.
<b>Direction</b>		
<b>States/Modes</b>		
<b>Services</b>		
<b>Parameters</b>		Ext OPC (1 bytes) Extended opcode, Data1 (1 bytes) Data2 (1 bytes)
<b>Conditions</b>		
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.5 OPCODES with 4 additional bytes

### 3.5.1 [80] RDCC3 - Request 3 bytes DCC Packet

<b>Name</b>		RDCC3
<b>Value</b>	<b>Decimal</b>	128
	<b>Hex</b>	80
<b>Priority</b>		Normal
<b>Description</b>		Request 3-byte DCC Packet
<b>Comment</b>		Allows a CAB or equivalent to request a 3 byte DCC packet to be sent to the track. The packet is sent <REP> times and is not refreshed on a regular basis. Note: a 3 byte DCC packet is the minimum allowed.
<b>Direction</b>		Cab to common station
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		DCC_CAB or DCC_CMD
<b>Parameters</b>		Rep (1 bytes), Byte1 (1 bytes), Byte2 (1 bytes), Byte3 (1 bytes)
<b>Conditions</b>		If the module is not a command station then ignore the message.
<b>Result</b>		If conditions are met then the DCC command stations shall send the requested DCC packet <REP> times.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.5.2 [82] WCVO - Write CV byte in OPS mode

<b>Name</b>		WCVO
<b>Value</b>	<b>Decimal</b>	130
	<b>Hex</b>	82
<b>Priority</b>		Normal
<b>Description</b>		Write CV (byte) in OPS mode
<b>Comment</b>		Sent to the command station to write a DCC CV byte in OPS mode to a specific loco (on the main).
<b>Direction</b>		To command station
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		DCC_CAB or DCC_CMD
<b>Parameters</b>		Session (1 bytes), CV (2 bytes), Value (1 bytes)
<b>Conditions</b>		If the module is not a DCC command station then ignore the message. If the command station does not have an active session with the specified session identifier then send a message <a href="#">ERR</a> (No session).
<b>Result</b>		If conditions are met then the DCC command stations shall write the specified value to the specified CV.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.5.3 [83] WCVB - Write CV Bit in OPS Mode

<b>Name</b>		WCVB
<b>Value</b>	<b>Decimal</b>	131
	<b>Hex</b>	83
<b>Priority</b>		Normal
<b>Description</b>		Write CV (bit) in OPS mode
<b>Comment</b>		<p>Sent to the command station to write a DCC CV in OPS mode to specific loco (on the main).</p> <p>The format for Value is that specified in RP 9.2.1 for OTM bit manipulation in a DCC packet. This is '111CDBBB' where C is here is always 1 as only 'writes' are possible OTM (unless some loco ACK scheme like RailCom is used). D is the bit value, either 0 or 1 and BBB is the bit position in the CV byte. 000 to 111 for bits 0 to 7.</p>
<b>Direction</b>		To command station
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		DCC_CAB or DCC_CMD
<b>Parameters</b>		Session (1 bytes), CV (2 bytes), Value (1 bytes)
<b>Conditions</b>		If the module is not a DCC command station then ignore the message. If the command station does not have an active session with the specified session identifier then send a message <a href="#">ERR</a> (No session).
<b>Result</b>		If conditions are met then the DCC command stations shall write the specified value to the specified CV in bit mode.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.5.4 [84] QCVS - Read CV

<b>Name</b>		QCVS
<b>Value</b>	<b>Decimal</b>	132
	<b>Hex</b>	84
<b>Priority</b>		Normal
<b>Description</b>		Read CV
<b>Comment</b>		This command is used exclusively with service mode. Sent by the cab to the command station in order to read a CV value.
<b>Direction</b>		Cab to command station
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		DCC_CAB or DCC_CMD
<b>Parameters</b>		Session (1 bytes), CV (2 bytes), Mode (1 bytes)
<b>Conditions</b>		If the module is not a DCC command station then ignore the message. If the command station does not have an active session with the specified session identifier then send a message <a href="#">ERR</a> (No session). If the CV value cannot be read then send a <a href="#">SSTAT</a> message with the reason for failure.
<b>Result</b>		If conditions are met then send a <a href="#">PVCS</a> message with CV value.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.5.5 [85] PCVS - Report CV

<b>Name</b>		PCVS
<b>Value</b>	<b>Decimal</b>	133
	<b>Hex</b>	85
<b>Priority</b>		Normal
<b>Description</b>		Report CV
<b>Comment</b>		This command is used exclusively with service mode. Sent by the command station to report a read CV in response to <a href="#">QCVS</a> .
<b>Direction</b>		From command station
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		DCC_CAB or DCC_CMD
<b>Parameters</b>		Session (1 bytes), CV (2 bytes), Value (1 bytes)
<b>Conditions</b>		
<b>Result</b>		Response to <a href="#">QCVS</a> to report the CV value.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.5.6 [87] RDGN - Request Diagnostic Data

<b>Name</b>		RDGN
<b>Value</b>	<b>Decimal</b>	135
	<b>Hex</b>	87
<b>Priority</b>		Low
<b>Description</b>		Request diagnostic data
<b>Comment</b>		Request diagnostic data from a module. If the requested diagnostic data is zero then a response for all diagnostic data is returned.
<b>Direction</b>		To module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		MNS
<b>Parameters</b>		NN (2 bytes) Node number, ServiceIndex (1 bytes) Index into the list of services, DiagnosticCode (1 bytes) Diagnostic data code
<b>Conditions</b>		<p>If NN does not match the module's node number then ignore the message.</p> <p>If the message is short so that it does not include the specified parameters then a <a href="#">GRSP</a> (Invalid Command) message is returned.</p> <p>If ServiceIndex references an unsupported service then send a GRSP(Invalid service) message.</p> <p>If ServiceIndex references a valid service and DiagnosticCode is zero but the service does not support diagnostics then GRSP (INVALID_DIAGNOSTIC) should be returned.</p> <p>If DiagnosticCode references an invalid or unsupported diagnostic number then send a <a href="#">GRSP</a>(Invalid diagnostic) message.</p>
<b>Result</b>		<p>If ServiceIndex is zero then for each service send a <a href="#">DGN</a> message indicating the number of DiagnosticCodes for that service followed by a <a href="#">DGN</a> message for each diagnostic code. Note that DiagnosticCode in the RDGN request is ignored in this scenario.</p>

## VLCB Opcode specification

	<p>If ServiceIndex is non zero and references a valid service and DiagnosticCode is zero then send a <a href="#">DGN</a> message with DiagnosticCode of zero with the DiagnosticVal field containing the number of other DiagnosticCodes.</p> <p>Otherwise send a <a href="#">DGN</a> response containing the requested diagnostic data for the service specified.</p>
<b>History</b>	New for VLCB



## 3.5.8 [8E] NVSETRD - Set NV with Read

<b>Name</b>		NVSETRD
<b>Value</b>	<b>Decimal</b>	144
	<b>Hex</b>	8E
<b>Priority</b>		Low
<b>Description</b>		Set a NV value with read back
<b>Comment</b>		Sets a NV value and additionally responds with the new value. The new value may not be the value which was requested to be written.
<b>Direction</b>		To module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		NV
<b>Parameters</b>		NN (2 bytes) Node number, NV# (1 bytes) Node variable index NVvalue (1 byte) Node variable value
<b>Conditions</b>		If the NN does not match the module's node number then ignore the message. If the message is short so that it does not include the specified parameters then a <a href="#">GRSP</a> (Invalid Command) message is returned. If the NV# is zero or greater than the number of NVs available then send message <a href="#">GRSP</a> (Invalid node variable index).
<b>Result</b>		Update the value of the NV, taking into account any module specific limitations and constraints on NV value. Send a single <a href="#">NVANS</a> message containing the NV value.
<b>History</b>		New for VLCB

## 3.5.9 [90] ACON - Accessory ON Event

<b>Name</b>		ACON
<b>Value</b>	<b>Decimal</b>	144
	<b>Hex</b>	90
<b>Priority</b>		Low
<b>Description</b>		Accessory ON long event.
<b>Comment</b>		Indicates an 'ON' event using the full event number of 4 bytes (long event). An event is sent by a module when it detects a change of state. Modules may consume the event and perform actions.
<b>Direction</b>		
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		Producer or Consumer
<b>Parameters</b>		NN (2 bytes) Node number, EN (2 bytes) Event number
<b>Conditions</b>		If the module has not been taught the event nor has the event by default then the event message is ignored.
<b>Result</b>		If the module has the event configured to be sent when there is a change of state and that object changes to state ON then send this event. If the module has been configured to consume the event then perform the actions associated with the ON event.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.5.10 [91] ACOF - Accessory OFF Event

<b>Name</b>		ACOF
<b>Value</b>	<b>Decimal</b>	145
	<b>Hex</b>	91
<b>Priority</b>		Low
<b>Description</b>		Accessory OFF long event
<b>Comment</b>		Indicates an 'OFF' event using the full event number of 4 bytes (long event). An event is sent by a module when it detects a change of state. Modules may consume the event and perform actions.
<b>Direction</b>		
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		Producer or Consumer
<b>Parameters</b>		NN (2 bytes) Node number, EN (2 bytes) Event number
<b>Conditions</b>		If the module has not been taught the event nor has the event by default then the event message is ignored.
<b>Result</b>		If the module has the event configured to be sent when there is a change of state and that object changes to state ON then send this event. If the module has been configured to consume the event then perform the actions associated with the OFF event.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.5.11 [92] AREQ - Accessory Request Event

<b>Name</b>		AREQ
<b>Value</b>	<b>Decimal</b>	146
	<b>Hex</b>	92
<b>Priority</b>		Low
<b>Description</b>		Accessory Request Event
<b>Comment</b>		Indicates a 'request' event using the full event number of 4 bytes (long event). A request event is used to elicit a status response from a producer when it is required to know the 'state' of the producer without producing an ON or OFF event.
<b>Direction</b>		To module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		Producer
<b>Parameters</b>		NN (2 bytes) Node number, EN (2 bytes) Event number
<b>Conditions</b>		<del>If the message is short so that it does not include the specified parameters then a <a href="#">GRSP</a> (Invalid Command) message is returned.</del> <del>If the NN does not match the module's node number then ignore the message.</del> If the module does not have the event provisioned then ignore the message.
<b>Result</b>		If conditions are met and the 'Current status is ON' then send an <a href="#">ARON</a> message otherwise send an <a href="#">AROF</a> message.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.5.12 [93] ARON - Accessory Response ON Event

<b>Name</b>		ARON
<b>Value</b>	<b>Decimal</b>	147
	<b>Hex</b>	93
<b>Priority</b>		Low
<b>Description</b>		Accessory Response Event
<b>Comment</b>		Indicates an 'ON' response. A response is a reply to a status request ( <a href="#">AREQ</a> ) without producing an ON or OFF event.
<b>Direction</b>		From module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		Producer
<b>Parameters</b>		NN (2 bytes) Node number, EN (2 bytes) Event number
<b>Conditions</b>		The module has the event defined and the current state of the event is ON.
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.5.13 [94] AROF - Accessory Response OFF Event

<b>Name</b>		AROF
<b>Value</b>	<b>Decimal</b>	148
	<b>Hex</b>	94
<b>Priority</b>		Low
<b>Description</b>		Accessory Response Event (AROF)
<b>Comment</b>		Indicates an 'OFF' response. A response is a reply to a status request ( <a href="#">AREQ</a> ) without producing an ON or OFF event.
<b>Direction</b>		From module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		Producer
<b>Parameters</b>		NN (2 bytes) Node number, EN (2 bytes) Event number
<b>Conditions</b>		The module has the event defined and the current state of the event is OFF.
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.5.14 [95] EVULN - Event Unlearn

<b>Name</b>		EVULN
<b>Value</b>	<b>Decimal</b>	149
	<b>Hex</b>	95
<b>Priority</b>		Low
<b>Description</b>		Unlearn an event in learn mode
<b>Comment</b>		Sent by a configuration tool to remove an event from a node.
<b>Direction</b>		To module
<b>States/Modes</b>		Learn
<b>Services</b>		Teach
<b>Parameters</b>		NN (2 bytes) Node number, EN (2 bytes) Event number
<b>Conditions</b>		If the message is short so that it does not include the specified parameters then a <a href="#">GRSP</a> (Invalid Command) message is returned. If the module does not currently have the event configured then send a <a href="#">CMDERR</a> (Invalid Event) message and a <a href="#">GRSP</a> (Invalid Event) message.
<b>Result</b>		If conditions are met then remove the event matching the specified event from the configuration and send <a href="#">WRACK</a> .
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.5.15 [96] NVSET - NV Set

<b>Name</b>		NVSET
<b>Value</b>	<b>Decimal</b>	150
	<b>Hex</b>	96
<b>Priority</b>		Low
<b>Description</b>		Set a node variable
<b>Comment</b>		Sent by a configuration tool to set a node variable. NV# is the NV index number. <b>Deprecated and replaced by NVSETRD.</b>
<b>Direction</b>		To module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		NV
<b>Parameters</b>		NN (2 bytes) Node number, NV# (1 bytes) Node variable index, NV val (1 bytes) Node variable value
<b>Conditions</b>		If NN does not match the module's node number then ignore the request. If the message is short so that it does not include the specified parameters then a <a href="#">GRSP</a> (Invalid Command) message is returned. If NV# is not between 1 (inclusive) and the number of NVs (inclusive) then send a <a href="#">CMDERR</a> (Invalid Node Variable Index) message. If the NVval is not valid for the type of module then send a <a href="#">CMDERR</a> (Invalid Node Variable Value) message.
<b>Result</b>		If conditions are met then store NV value and send <a href="#">WRACK</a> .
<b>History</b>		No change from CBUS revision 4 ver 8j



## 3.5.16 [97] NVANS - NV Value Response

<b>Name</b>		NVANS
<b>Value</b>	<b>Decimal</b>	151
	<b>Hex</b>	97
<b>Priority</b>		Low
<b>Description</b>		Response to a request for a node variable value
<b>Comment</b>		Sent by node in response to request <a href="#">NVRD</a> or <a href="#">NVSETRD</a> .
<b>Direction</b>		From module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		NV
<b>Parameters</b>		NN (2 bytes) Node number, NV# (1 bytes) Node variable index, NV val (1 bytes) Node variable value
<b>Conditions</b>		If the module Module has accepted a <a href="#">NVRD</a> or <a href="#">NVSETRD</a> request then NVANS is returned in response.
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.5.17 [98] ASON - Accessory ON Short Event

<b>Name</b>		ASON
<b>Value</b>	<b>Decimal</b>	152
	<b>Hex</b>	98
<b>Priority</b>		Low
<b>Description</b>		Accessory Short ON
<b>Comment</b>		Indicates an 'ON' event using the short event number of 2 LS bytes. An event is sent by a module when it detects a change of state. Modules may consume the event and perform actions. The NN is not used to match events, the NN normally indicates the source of the event.
<b>Direction</b>		
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		Producer or Consumer
<b>Parameters</b>		NN (2 bytes) Node number, EN (2 bytes) Event number
<b>Conditions</b>		If the module has not been taught the event nor has the event by default then the event message is ignored.
<b>Result</b>		If the module has the event configured to be sent when there is a change of state and that object changes to state ON then send this event. If the module has been configured to consume the event (ignoring the NN) then perform the actions associated with the ON event.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.5.18 [99] ASOF - Accessory OFF Short Event

<b>Name</b>		ASOF
<b>Value</b>	<b>Decimal</b>	153
	<b>Hex</b>	99
<b>Priority</b>		Low
<b>Description</b>		Accessory Short OFF
<b>Comment</b>		Indicates an 'OFF' event using the short event number of 2 LS bytes. An event is sent by a module when it detects a change of state. Modules may consume the event and perform actions. The NN is not used to match events, the NN normally indicates the source of the event.
<b>Direction</b>		
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		Producer or Consumer
<b>Parameters</b>		NN (2 bytes) Node number, EN (2 bytes) Event number
<b>Conditions</b>		If the module has not been taught the event nor has the event by default then the event message is ignored.
<b>Result</b>		If the module has the event configured to be sent when there is a change of state and that object changes to state OFF then send this event. If the module has been configured to consume the event (ignoring the NN) then perform the actions associated with the OFF event.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.5.19 [9A] ASRQ - Accessory Request Short Event

<b>Name</b>		ASRQ
<b>Value</b>	<b>Decimal</b>	154
	<b>Hex</b>	9A
<b>Priority</b>		Low
<b>Description</b>		Accessory Short Request Event
<b>Comment</b>		Indicates a 'request' event using the short event number of 2 LS bytes. A request event is used to elicit a status response from a producer when it is required to know the 'state' of the producer without producing an ON or OFF event.
<b>Direction</b>		To module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		Producer
<b>Parameters</b>		NN (2 bytes) Node number, EN (2 bytes) Event number
<b>Conditions</b>		If NN==0, then every module that produces this short-event should respond. If the NN does not match the module's node number and is non zero then ignore the message. If the module does not have the event provisioned then ignore the message.
<b>Result</b>		If conditions are met and the 'Current status is ON' then send an <a href="#">ARSON</a> message otherwise send an <a href="#">ARSOE</a> message.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.5.20 [9B] PARAN - Node Parameter Response

<b>Name</b>		PARAN
<b>Value</b>	<b>Decimal</b>	155
	<b>Hex</b>	9B
<b>Priority</b>		Low
<b>Description</b>		Response to request for individual node parameter <a href="#">RQNPN</a>
<b>Comment</b>		<p>NN is the node number of the sending node. Para# is the index of the parameter and Para val is the parameter value.</p> <p>Returns a parameter value.</p> <p>Parameter index is the parameter number and matches that in the <a href="#">RQNPN</a> request.</p> <p>See <a href="#">Appendix B - Module parameters</a> for a list of available parameters.</p>
<b>Direction</b>		From module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		MNS
<b>Parameters</b>		NN (2 bytes) Node number, Para# (1 bytes) Parameter index, Para val (1 bytes) Parameter value
<b>Conditions</b>		Response to RQNPN request
<b>Result</b>		The PARAN message contains the requested parameter value.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.5.21 [9C] REVAL - Request EV Read

<b>Name</b>		REVAL
<b>Value</b>	<b>Decimal</b>	156
	<b>Hex</b>	9C
<b>Priority</b>		Low
<b>Description</b>		Request for read of an event variable
<b>Comment</b>		<p>This request differs from B2 (<a href="#">REQEV</a>) as it doesn't need to be in learn mode but does require the knowledge of the event index to which the EV request is directed.</p> <p>Deprecated use <a href="#">REQEV</a> instead.</p>
<b>Direction</b>		To module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		Teach
<b>Parameters</b>		NN (2 bytes) Node number, EN# (1 bytes) Event index, EV# (1 bytes) Event variable index
<b>Conditions</b>		<p>If the NN does not match the module's node number then ignore the message.</p> <p>If the message is short so that it does not include the specified parameters then a <a href="#">GRSP</a> (Invalid Command) message is returned.</p> <p>If the module does not have an event for the event index then send a message <a href="#">CMDERR</a>(Invalid Event).</p> <p>If the EV# is greater than the number of EVs per event then send a message <a href="#">CMDERR</a>(No EV).</p> <p>If the event does not have an EV with the specified EV# then send a message <a href="#">CMDERR</a>(Invalid Event Variable Index).</p>
<b>Result</b>		If conditions are met then send a <a href="#">NEVAL</a> message containing the EV value.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.5.22 [9D] ARSON - Accessory Response ON Short Event

<b>Name</b>		ARSON
<b>Value</b>	<b>Decimal</b>	157
	<b>Hex</b>	9D
<b>Priority</b>		Low
<b>Description</b>		Accessory Short Response Event
<b>Comment</b>		Indicates an 'ON' response. A response is a reply to a status request ( <a href="#">ASRQ</a> ) without producing an ON or OFF event.
<b>Direction</b>		From module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		Producer
<b>Parameters</b>		NN (2 bytes) Node number, EN (2 bytes) Event number
<b>Conditions</b>		The module has the event defined and the current state of the event is ON.
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.5.23 [9E] ARSOF - Accessory Response OFF Short Event

<b>Name</b>		ARSOF
<b>Value</b>	<b>Decimal</b>	158
	<b>Hex</b>	9E
<b>Priority</b>		Low
<b>Description</b>		Accessory Short Response Event
<b>Comment</b>		Indicates an 'OFF' response. A response is a reply to a status request ( <a href="#">ASRQ</a> ) without producing an ON or OFF event.
<b>Direction</b>		From module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		Producer
<b>Parameters</b>		NN (2 bytes) Node number, EN (2 bytes) Event number
<b>Conditions</b>		The module has the event defined and the current state of the event is OFF.
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j



## 3.5.24 [9F] EXTC3 - Extended Opcode with 3 Additional Bytes

<b>Name</b>		EXTC3
<b>Value</b>	<b>Decimal</b>	159
	<b>Hex</b>	9F
<b>Priority</b>		Low
<b>Description</b>		Extended opcode with 3 additional bytes
<b>Comment</b>		Reserved to allow the 3 additional bytes range to be extended by a further 256 opcodes.
<b>Direction</b>		
<b>States/Modes</b>		
<b>Services</b>		
<b>Parameters</b>		Ext_OPC (1 bytes) Extended opcode, Data1 (1 bytes) Data2 (1 bytes) Data3 (1 bytes)
<b>Conditions</b>		
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.6 OPCODES with 5 additional bytes

### 3.6.1 [A0] RDCC4 - Request 4 Byte DCC Packet

<b>Name</b>		RDCC4
<b>Value</b>	<b>Decimal</b>	160
	<b>Hex</b>	A0
<b>Priority</b>		Normal
<b>Description</b>		Request 4-byte DCC Packet
<b>Comment</b>		Allows a CAB or equivalent to request a 4 byte DCC packet to be sent to the track. The packet is sent <REP> times and is not refreshed on a regular basis.
<b>Direction</b>		To command station
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		DCC_CAB or DCC_CMD
<b>Parameters</b>		REP (1 bytes), Byte0 (1 bytes), Byte1 (1 bytes), Byte2 (1 bytes), Byte3 (1 bytes)
<b>Conditions</b>		If the NN does not match the node number of the module then ignore the message. If the module is not a DCC command station then ignore the message.
<b>Result</b>		If conditions are met then the requested DCC packet is sent <REP> times.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.6.2 [A2] WCVS - Write CV in Service Mode

<b>Name</b>		WCVS
<b>Value</b>	<b>Decimal</b>	162
	<b>Hex</b>	A2
<b>Priority</b>		Normal
<b>Description</b>		Write CV in Service mode
<b>Comment</b>		Sent to the command station to write a DCC CV in service mode.
<b>Direction</b>		To module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		DCC_CAB or DCC_CMD
<b>Parameters</b>		Session (1 bytes), CV (2 bytes), Mode (1 bytes), Value (1 bytes)
<b>Conditions</b>		If the NN does not match the module's node number then ignore the message. If the module is not a DCC command station then ignore the request. If the command station does not have an active session with id <Session> then send a <a href="#">ERR</a> (No session) message.
<b>Result</b>		If conditions are met then the DCC command station shall write the specified CV.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.6.3 [AB] HEARTB - Module Heartbeat

<b>Name</b>		HEARTB
<b>Value</b>	<b>Decimal</b>	171
	<b>Hex</b>	AB
<b>Priority</b>		Low
<b>Description</b>		Heartbeat from module
<b>Comment</b>		<p>Heartbeat message from module indicating that the module is alive and communicating on the bus.</p> <p>Sent every 5 seconds by a module to confirm it is alive and connected to the network along with an indication of module status.</p> <p>Sequence is a count from 0 incrementing on each message transmitted and wrapping around to zero, It facilitates detection of missing frames.</p> <p>Status: This is a binary representation of the module's diagnostic status as outlined in MNS Specification Section 8.3. 0x00 Shall always represent "normal" operation.</p> <p>StatusBits: Reserved for future expansion, set to 0x00</p>
<b>Direction</b>		From module
<b>States/Modes</b>		Normal, Learn, ENACK
<b>Services</b>		MNS
<b>Parameters</b>		NN (2 bytes) Source Node number, Sequence (1 bytes) The message sequence number Status (1 bytes) Diagnostic status, StatusBits (1 bytes) Reserved,
<b>Conditions</b>		
<b>Result</b>		
<b>History</b>		New for VLCB

## 3.5.7 [AC] SD - Service Discovery Response

<b>Name</b>		SD
<b>Value</b>	<b>Decimal</b>	172
	<b>Hex</b>	AC
<b>Priority</b>		Low
<b>Description</b>		Service discovery response
<b>Comment</b>		<p>The version of a service supported by a module.</p> <p>Sent in response to <a href="#">RQSD</a> with ServiceIndex = 0. A number of SD messages are sent by a module. The first SD response indicates the number of services with ServiceIndex=0, and the number in the Version field. Then one SD response for each of the services supported by the module.</p> <p>Indicates that the originating module, defined by NN supports the service defined by Service# with the specified version</p> <p>Also see <a href="#">ESD</a>.</p>
<b>Direction</b>		From module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		MNS
<b>Parameters</b>		NN (2 bytes) Node number, ServiceIndex (1 bytes) Index into the list of services ServiceType (1 bytes) Service Type, Version (1 bytes) Version of the service definition, not the version of its implementation.
<b>Conditions</b>		
<b>Result</b>		Sent in response to <a href="#">RQSD</a> . Contains the version of a service supported by the module.
<b>History</b>		New for VLCB

## 3.6.4 [AF] GRSP - Generic Response

<b>Name</b>		GRSP
<b>Value</b>	<b>Decimal</b>	175
	<b>Hex</b>	AF
<b>Priority</b>		Low
<b>Description</b>		Generic Response
<b>Comment</b>		Generic response for a configuration change request. Result byte indicates ok for success or an error code in case of failure. See the service specific documentation for the list of codes. Indicates the module is ready for further configuration.
<b>Direction</b>		From module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		MNS
<b>Parameters</b>		NN (2 bytes) Node number, opcode (1 bytes) Request opcode, ServiceType (1 bytes) Service Type, Result (1 bytes) Result
<b>Conditions</b>		
<b>Result</b>		Sent to indicate the result of a configuration change request. Module is ready for further configuration.
<b>History</b>		New for VLCB

## 3.6.5 [B0] ACON1 - Accessory ON Event with 1 Data Byte

<b>Name</b>		ACON1
<b>Value</b>	<b>Decimal</b>	176
	<b>Hex</b>	B0
<b>Priority</b>		Low
<b>Description</b>		Accessory ON
<b>Comment</b>		<p>Indicates an 'ON' event using the full event number of 4 bytes with one additional data byte.</p> <p>An event is sent by a module when it detects a change of state.</p> <p>Modules may consume the event and perform actions.</p> <p>The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.</p>
<b>Direction</b>		
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		Producer or Consumer
<b>Parameters</b>		NN (2 bytes) Node number, EN (2 bytes) Event number, data (1 bytes) Event data 1
<b>Conditions</b>		If the module has not been taught the event nor has the event by default then the event message is ignored.
<b>Result</b>		<p>If the module has the event configured to be sent when there is a change of state and that object changes to state ON then send this event.</p> <p>If the module has been configured to consume the event then perform the actions associated with the ON event.</p>
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.6.6 [B1] ACOF1 - Accessory OFF Event with 1 Data Byte

<b>Name</b>		ACOF1
<b>Value</b>	<b>Decimal</b>	177
	<b>Hex</b>	B1
<b>Priority</b>		Low
<b>Description</b>		Accessory OFF
<b>Comment</b>		<p>Indicates an 'OFF' event using the full event number of 4 bytes with one additional databyte.</p> <p>An event is sent by a module when it detects a change of state.</p> <p>Modules may consume the event and perform actions.</p> <p>The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.</p>
<b>Direction</b>		
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		Producer or Consumer
<b>Parameters</b>		NN (2 bytes) Node number, EN (2 bytes) Event number, data (1 bytes) Event data 1
<b>Conditions</b>		If the module has not been taught the event nor has the event by default then the event message is ignored.
<b>Result</b>		<p>If the module has the event configured to be sent when there is a change of state and that object changes to state OFF then send this event.</p> <p>If the module has been configured to consume the event then perform the actions associated with the OFF event.</p>
<b>History</b>		No change from CBUS revision 4 ver 8j



## 3.6.7 [B2] REQEV - Read Event Variable

<b>Name</b>		REQEV
<b>Value</b>	<b>Decimal</b>	178
	<b>Hex</b>	B2
<b>Priority</b>		Low
<b>Description</b>		Read event variable in learn mode
<b>Comment</b>		<p>Allows a configuration tool to read stored event variables from a node. EV# is the EV variable index.</p> <p>NN and EN identify the event and not the module.</p> <p>Reading EV#0 shall first return the number of EVs followed by a series of EVANS with the value for each EV.</p>
<b>Direction</b>		To module
<b>States/Modes</b>		Learn
<b>Services</b>		Teach
<b>Parameters</b>		NN (2 bytes) Node number of event, EN (2 bytes) Event number, EV# (1 bytes) Event variable index
<b>Conditions</b>		<p>If the message is short so that it does not include the specified parameters then a <a href="#">GRSP</a> (Invalid Command) message is returned.</p> <p>If the module does not have an event for the specified NN:EN then send a message <a href="#">CMDERR</a>(Invalid Event) and <a href="#">GRSP</a>(Invalid Event).</p> <p>If the EV# is greater than the number of EVs per event then send a message <a href="#">CMDERR</a>(Invalid event variable index) and <a href="#">GRSP</a>(Invalid event variable index).</p> <p>If the event does not have an EV with the specified EV# then send a message <a href="#">CMDERR</a>(Invalid Event Variable Index) and <a href="#">GRSP</a>(Invalid Event Variable Index).</p>
<b>Result</b>		If conditions are met then send an <a href="#">EVANS</a> message with the EV value.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.6.8 [B3] ARON1 - Accessory ON Response Event with 1 Data Byte

<b>Name</b>		ARON1
<b>Value</b>	<b>Decimal</b>	179
	<b>Hex</b>	B3
<b>Priority</b>		Low
<b>Description</b>		Accessory Response Event
<b>Comment</b>		<p>Indicates an 'ON' response with one additional data byte. A response is a reply to a status request (<a href="#">AREQ</a>) without producing an ON or OFF event.</p> <p>The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.</p>
<b>Direction</b>		From module
<b>States/Modes</b>		Normal
<b>Services</b>		Producer
<b>Parameters</b>		NN (2 bytes) Node number, EN (2 bytes) Event number, data (1 bytes) Event data 1
<b>Conditions</b>		The module has the event defined and the current state of the event is ON.
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.6.9 [B4] AROF1 - Accessory OFF Response Event with 1 Data Byte

<b>Name</b>		AROF1
<b>Value</b>	<b>Decimal</b>	180
	<b>Hex</b>	B4
<b>Priority</b>		Low
<b>Description</b>		Accessory Response Event
<b>Comment</b>		<p>Indicates an 'OFF' response with one additional data byte. A response is a reply to a status request (<a href="#">AREQ</a>) without producing an ON or OFF event.</p> <p>The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.</p>
<b>Direction</b>		From module
<b>States/Modes</b>		Normal
<b>Services</b>		Producer
<b>Parameters</b>		NN (2 bytes) Node number, EN (2 bytes) Event number, data (1 bytes) Event data 1
<b>Conditions</b>		The module has the event defined and the current state of the event is OFF.
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.6.10 [B5] NEVAL - Response to Read EV

<b>Name</b>		NEVAL
<b>Value</b>	<b>Decimal</b>	181
	<b>Hex</b>	B5
<b>Priority</b>		Low
<b>Description</b>		Response to request for read of EV value
<b>Comment</b>		This is the response to the request to read an EV - <a href="#">REVAL</a> .
<b>Direction</b>		From module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		Teach
<b>Parameters</b>		NN (2 bytes) Node number, EN# (1 bytes) Event index, EV# (1 bytes) Event variable index, EVval (1 bytes) Event variable value
<b>Conditions</b>		
<b>Result</b>		The EV value is returned in the message.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.6.11 [B6] PNN - Presence of Node

<b>Name</b>		PNN
<b>Value</b>	<b>Decimal</b>	182
	<b>Hex</b>	B6
<b>Priority</b>		Low
<b>Description</b>		Response to Query Node - <a href="#">QNN</a>
<b>Comment</b>		<p>Sent in response to a <a href="#">QNN</a> request.</p> <p>The Flags byte contains bit flags as follows:</p> <ul style="list-style-type: none"> <li>• Bit 0: Set to 1 for consumer node,</li> <li>• Bit 1: Set to 1 for producer node,</li> <li>• Bit 2: Set to 1 for FLiM mode (normal mode),</li> <li>• Bit 3: Set to 1 for Bootloader compatible,</li> <li>• Bit 4: Set if able to consume its own produced events</li> <li>• Bit 5: Set to 1 if module is in Learn mode</li> <li>• Bit 6: Set to 1 if module supports service discovery</li> </ul> <p>If a module is both a producer and a consumer then it is referred to as a “combi” node and both flags will be set.</p> <p>The Manufacturer Id and Module Id together make a 16bit module type identification (ManufacturerId in the upper byte).</p> <p>VLCB modules shall use a dedicated set of Manufacturer Ids, currently a Manufacturer Id of 250 has been assigned. When developing a new module a new identifier can be obtained with a pull request of the VLCB module Id list in Github..</p>
<b>Direction</b>		From module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		MNS
<b>Parameters</b>		NN (2 bytes) Node number, Manufacturer Id (1 bytes) Manufacturer identifier, Module Id (1 bytes) Module identifier, Flags (1 bytes) Module flags
<b>Conditions</b>		
<b>Result</b>		Returned in response to QNN. The message contains important information about the module.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.6.12 [B8] ASON1 - Accessory ON Event with 1 Data Byte

<b>Name</b>		ASON1
<b>Value</b>	<b>Decimal</b>	184
	<b>Hex</b>	B8
<b>Priority</b>		Low
<b>Description</b>		Accessory Short ON
<b>Comment</b>		<p>Indicates an 'ON' event using the short event number of 2 LS bytes with one added data byte.</p> <p>An event is sent by a module when it detects a change of state. Modules may consume the event and perform actions.</p> <p>The NN is not used to match events, the NN normally indicates the source of the event.</p> <p>The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.</p>
<b>Direction</b>		
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		Producer or Consumer
<b>Parameters</b>		NN (2 bytes) Node number, EN (2 bytes) Event number, data (1 bytes) Event data 1
<b>Conditions</b>		If the module has not been taught the event nor has the event by default then the event message is ignored.
<b>Result</b>		<p>If the module has the event configured to be sent when there is a change of state and that object changes to state ON then send this event.</p> <p>If the module has been configured to consume the event (ignoring the NN) then perform the actions associated with the ON event.</p>
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.6.13 [B9] ASOF1 - Accessory OFF Event with 1 Data Byte

<b>Name</b>		ASOF1
<b>Value</b>	<b>Decimal</b>	185
	<b>Hex</b>	B9
<b>Priority</b>		Low
<b>Description</b>		Accessory Short OFF
<b>Comment</b>		<p>Indicates an 'OFF' event using the short event number of 2 LS bytes with one added data byte.</p> <p>An event is sent by a module when it detects a change of state. Modules may consume the event and perform actions.</p> <p>The NN is not used to match events, the NN normally indicates the source of the event.</p> <p>The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.</p>
<b>Direction</b>		
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		Producer or Consumer
<b>Parameters</b>		NN (2 bytes) Node number, EN (2 bytes) Event number, data (1 bytes) Event data 1
<b>Conditions</b>		If the module has not been taught the event nor has the event by default then the event message is ignored.
<b>Result</b>		<p>If the module has the event configured to be sent when there is a change of state and that object changes to state OFF then send this event.</p> <p>If the module has been configured to consume the event (ignoring the NN) then perform the actions associated with the OFF event.</p>
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.6.14 [BD] ARSON1 - Accessory ON Response Event with 1 Data

<b>Name</b>		ARSON1
<b>Value</b>	<b>Decimal</b>	189
	<b>Hex</b>	BD
<b>Priority</b>		Low
<b>Description</b>		Accessory Short Response Event
<b>Comment</b>		<p>Indicates an 'ON' response with one added data byte. A response is a reply to a status request (<a href="#">ASRQ</a>) without producing an ON or OFF event.</p> <p>The NN is not used to match events, the NN normally indicates the source of the event.</p> <p>The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.</p>
<b>Direction</b>		From module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		Producer
<b>Parameters</b>		NN (2 bytes) Node number, EN (2 bytes) Event number, data (1 bytes) Event data 1
<b>Conditions</b>		The module has the event defined and the current state of the event is ON.
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j



## 3.6.15 [BE] ARSOF1 - Accessory OFF Response Event with 1 Data

<b>Name</b>		ARSOF1
<b>Value</b>	<b>Decimal</b>	190
	<b>Hex</b>	BE
<b>Priority</b>		Low
<b>Description</b>		Accessory Short Response Event with one data byte.
<b>Comment</b>		<p>Indicates an 'OFF' response with one added data byte. A response is a reply to a status request (ASRQ) without producing an ON or OFF event.</p> <p>A response event is a reply to a status request (<a href="#">ASRQ</a>) without producing an ON or OFF event.</p> <p>The NN is not used to match events, the NN normally indicates the source of the event.</p> <p>The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.</p>
<b>Direction</b>		From module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		Producer
<b>Parameters</b>		NN (2 bytes) Node number, EN (2 bytes) Event number, data (1 bytes) Event data 1
<b>Conditions</b>		The module has the event defined and the current state of the event is OFF.
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.6.16 [BF] EXTC4 - Extended Opcode with 4 Additional Bytes

<b>Name</b>		EXTC4
<b>Value</b>	<b>Decimal</b>	191
	<b>Hex</b>	BF
<b>Priority</b>		Low
<b>Description</b>		Extended opcode with 4 additional bytes
<b>Comment</b>		Reserved to allow the 4 additional bytes range to be extended by a further 256 opcodes.
<b>Direction</b>		
<b>States/Modes</b>		
<b>Services</b>		
<b>Parameters</b>		Ext_OPC (1 bytes) Extended opcode, Data1 (1 bytes) Data2 (1 bytes) Data3 (1 bytes) Data4 (1 bytes)
<b>Conditions</b>		
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.7 OPCODES with 6 additional bytes

### 3.7.1 [C0] RDCC5 - Request 5 Byte DCC Packet

<b>Name</b>		RDCC5
<b>Value</b>	<b>Decimal</b>	192
	<b>Hex</b>	C0
<b>Priority</b>		Normal
<b>Description</b>		Request 5-byte DCC Packet
<b>Comment</b>		Allows a CAB or equivalent to request a 5 byte DCC packet to be sent to the track. The packet is sent <REP> times and is not refreshed on a regular basis.
<b>Direction</b>		To module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		DCC_CAB or DCC_CMD
<b>Parameters</b>		REP (1 bytes), Byte 0 (1 bytes), Byte1 (1 bytes), Byte2 (1 bytes), Byte3 (1 bytes), Byte4 (1 bytes)
<b>Conditions</b>		If the NN does not match the node number of the module then ignore the message. If the module is not a DCC command station then ignore the message.
<b>Result</b>		If conditions are met then the requested DCC packet is sent <REP> times.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.7.2 [C1] WCVOA - Write CV in OPS Mode by Address

<b>Name</b>		WCVOA
<b>Value</b>	<b>Decimal</b>	193
	<b>Hex</b>	C1
<b>Priority</b>		Normal
<b>Description</b>		Write CV (byte) in OPS mode by address
<b>Comment</b>		Sent to the command station to write a DCC CV byte in OPS mode to specific loco (on the main). Used by computer based ops mode programmer that does not have a valid throttle handle.
<b>Direction</b>		To command station
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		DCC_CAB or DCC_CMD
<b>Parameters</b>		Addr (2 bytes), CV (2 bytes), Mode (1 bytes), Value (1 bytes)
<b>Conditions</b>		If the NN does not match the module's node number then ignore the message. If the module is not a DCC command station then ignore the request.
<b>Result</b>		If conditions are met then the DCC command station shall write the specified CV.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.7.3 [C2] CABDAT - Send data to CAB

<b>Name</b>		CABDAT
<b>Value</b>	<b>Decimal</b>	194
	<b>Hex</b>	C2
<b>Priority</b>		Normal
<b>Description</b>		Send data to the DCC CAB which is controlling a particular loco
<b>Comment</b>		<p>addrH and addrL are the loco address in the same format as RLOC and GLOC 7 bit addresses have (addrH=0). 14 bit addresses have bits 6,7 of addrH set to 1.</p> <p>dataCode defines the meaning of the remaining 3 bytes. The following values for dataCod have currently been defined:</p> <ul style="list-style-type: none"> <li>01 - CABSIG - Transmitted by a layout control system to send signal aspects to be displayed on a cab handset as cab signalling. Parameter data1 is used for aspect1 Parameter data2 is used for aspect2 Parameter data3 is used for speed</li> </ul> <p>aspect1 is signalling system independent, and is defined as follows (colours in brackets correspond to UK colour light signalling, the given aspect names may be displayed differently in other signalling systems):</p> <p>Bits 0-1 - 2 bit aspect code 00=danger (red), 01=caution (yellow), 10=preliminary caution (double yellow), 11=proceed (green) Bit 2 - set 1 for calling on or shunt aspect (bits 0-1 would be set to 00 for danger when calling on) Bit 3 - Set 0 to indicate upper nibble is feather location, set 1 for upper nibble is theatre type route indicator Bits 4-7 - 0 - no route indicated, 1 to 6 = feather position or 1 to 16 for theatre route indication aspect1 should be set to 0xFF if no signal information is available. This can be used, for example, to indicate leaving a cab signalling area. A cab should extinguish any currently showing aspect on receipt of this code. Note that because bits 0 and 1 should be set to zero when bit 2 is set, the code 0xFF is not otherwise a valid aspect. &lt;aspect2&gt; may be used as required for specific signalling systems. The meaning will vary for each signalling system. For the UK 2003 rulebook, bit 0 set indicates a flashing aspect, applicable to caution, preliminary caution or proceed. For UK semaphore signalling, where there are multiple arms for</p>

	<p>different routes on a mast, these bits indicate which arm has been pulled off, which is equivalent to a feather on colour light signalling.</p> <p>speed is a speed limit indication that a cab may optionally display to the driver. If speed is not implemented by a layout control system, or whenever speed limit information is not available, this byte should be set to 0xFF (255).</p> <p>How this value is derived from the layout blocks, signals etc, and the range and meaning of the values in this byte, are implementation dependent, except for the requirement that the value of 0xFF must not be a valid speed.</p>
<b>Direction</b>	To DCC CAB
<b>States/Modes</b>	Normal, Learn, NOHEARTB, ENACK
<b>Services</b>	DCC-CAB
<b>Parameters</b>	addrH (1 bytes) addrL (1 bytes) dataCode (1 bytes) data1 (1 bytes) data2 (1 bytes) data3 (1 bytes)
<b>Conditions</b>	
<b>Result</b>	
<b>History</b>	Defined in RFC0005

## 3.7.4 [C7] DGN - Diagnostic Data Response

<b>Name</b>		DGN
<b>Value</b>	<b>Decimal</b>	199
	<b>Hex</b>	C7
<b>Priority</b>		Low
<b>Description</b>		Diagnostic data response
<b>Comment</b>		Diagnostic data value from a module. Sent in response to <a href="#">RDGN</a> .
<b>Direction</b>		From module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		MNS
<b>Parameters</b>		NN (2 bytes) Node number, ServiceIndex (1 bytes) Index into the list of services, DiagnosticCode (1 bytes) Diagnostic data code, DiagnosticVal (2 bytes) Diagnostic data value
<b>Conditions</b>		
<b>Result</b>		A response to <a href="#">RDGN</a> and contains diagnostic information for the requested diagnostic of the specified service.
<b>History</b>		New for VLCB

## 3.7.5 [CF] FCLK - Fast Clock

<b>Name</b>		FCLK
<b>Value</b>	<b>Decimal</b>	207
	<b>Hex</b>	CF
<b>Priority</b>		Normal
<b>Description</b>		Fast Clock
<b>Comment</b>		Used to implement a fast clock for the layout.
<b>Direction</b>		
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		
<b>Parameters</b>		mins (1 bytes) Minutes 0-59, hrs (1 bytes) Hours 0-23, wdmon (1 bytes) Bits 0-3 define day of week (1=Sun ..7=Sat). Bits 4-7 define month (1=Jan .. 12=Dec), div (1 bytes) Divider. 0=freeze, mday (1 bytes) Day of month 1-31, temp (1 bytes) Temperature. Two's complement -127 to +127
<b>Conditions</b>		All the value of any parameter is out of range then send a <a href="#">CMDERR</a> (Invalid Event) message.
<b>Result</b>		If conditions are met then update a fast clock with the specified settings.
<b>History</b>		No change from CBUS revision 4 ver 8j



## 3.7.6 [D0] ACON2 - Accessory ON Event with 2 Data Bytes

<b>Name</b>		ACON2
<b>Value</b>	<b>Decimal</b>	208
	<b>Hex</b>	D0
<b>Priority</b>		Low
<b>Description</b>		Accessory ON
<b>Comment</b>		<p>Indicates an 'ON' event using the full event number of 4 bytes with two additional data bytes.</p> <p>An event is sent by a module when it detects a change of state.</p> <p>Modules may consume the event and perform actions.</p> <p>The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.</p>
<b>Direction</b>		
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		Producer or Consumer
<b>Parameters</b>		NN (2 bytes) Node number, EN (2 bytes) Event number, data1 (1 bytes) Event data 1, data2 (1 bytes) Event data 2
<b>Conditions</b>		If the module has not been taught the event nor has the event by default then the event message is ignored.
<b>Result</b>		<p>If the module has the event configured to be sent when there is a change of state and that object changes to state ON then send this event.</p> <p>If the module has been configured to consume the event then perform the actions associated with the ON event.</p>
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.7.7 [D1] ACOF2 - Accessory OFF Event with 2 Data Bytes

<b>Name</b>		ACOF2
<b>Value</b>	<b>Decimal</b>	209
	<b>Hex</b>	D1
<b>Priority</b>		Low
<b>Description</b>		Accessory OFF
<b>Comment</b>		<p>Indicates an 'OFF' event using the full event number of 4 bytes with two additional data bytes.</p> <p>An event is sent by a module when it detects a change of state.</p> <p>Modules may consume the event and perform actions.</p> <p>The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.</p>
<b>Direction</b>		Both
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		Producer or Consumer
<b>Parameters</b>		NN (2 bytes) Node number, EN (2 bytes) Event number, data1 (1 bytes) Event data 1, data2 (1 bytes) Event data 2
<b>Conditions</b>		If the module has not been taught the event nor has the event by default then the event message is ignored.
<b>Result</b>		<p>If the module has the event configured to be sent when there is a change of state and that object changes to state OFF then send this event.</p> <p>If the module has been configured to consume the event then perform the actions associated with the OFF event.</p>
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.7.8 [D2] EVLRN - Teach an EV

<b>Name</b>		EVLRN
<b>Value</b>	<b>Decimal</b>	210
	<b>Hex</b>	D2
<b>Priority</b>		Low
<b>Description</b>		Teach an event in learn mode
<b>Comment</b>		Sent by a configuration tool to a node in learn mode to teach it an event variable. Also teaches it the associated event. This command is repeated for each EV required.
<b>Direction</b>		To module
<b>States/Modes</b>		Learn
<b>Services</b>		Event/Teach
<b>Parameters</b>		NN (2 bytes) Event Node number, EN (2 bytes) Event number, EV# (1 bytes) Event variable index, (1-n) EV val (1 bytes) Event variable value
<b>Conditions</b>		If the message is short so that it does not include the specified parameters then a <a href="#">GRSP</a> (Invalid Command) message is returned. If the module does not have space available for the event to be created then send a message a <a href="#">CMDERR</a> (Too many events) message and a <a href="#">GRSP</a> (Too many events) message. If the event variable index is zero or greater than the number of EVs per event parameter then send a <a href="#">CMDERR</a> (Invalid Event Variable Index) message and a <a href="#">GRSP</a> (Invalid Event Variable Index) message.
<b>Result</b>		If conditions are met then Save the EV and send a <a href="#">WRACK</a> message. If the NN is zero then the taught event will be considered to be a Short event. If the NN is non zero then the event will be considered to be a Long event.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.7.9 [D3] EVANS - EV Read Response

<b>Name</b>		EVANS
<b>Value</b>	<b>Decimal</b>	211
	<b>Hex</b>	D3
<b>Priority</b>		Low
<b>Description</b>		Response to a request for an EV value in a node in learn mode
<b>Comment</b>		A node response to a request from a configuration tool for the EVs associated with an event ( <a href="#">REQEV</a> ). For multiple EVs, there will be one response per request.
<b>Direction</b>		From module
<b>States/Modes</b>		Learn
<b>Services</b>		Teach
<b>Parameters</b>		NN (2 bytes) event's Node number, EN (2 bytes) Event number, EV# (1 bytes) Event variable index, EV val (1 bytes) Event variable value
<b>Conditions</b>		Sent in response to <a href="#">REQEV</a> . If the original request was for EV# of zero then multiple EVANS will be sent, The first for EV#0 with EV val set to the number of EVs and subsequent EVANS one for each EV containing the EV value.
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.7.10 [D4] ARON2 - Accessory Response ON Event with 2 Bytes

<b>Name</b>		ARON2
<b>Value</b>	<b>Decimal</b>	212
	<b>Hex</b>	D4
<b>Priority</b>		Low
<b>Description</b>		Accessory Response Event
<b>Comment</b>		<p>Indicates an 'ON' response event with two added data bytes. A response is a reply to a status request (<a href="#">AREQ</a>) without producing an ON or OFF event.</p> <p>The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.</p>
<b>Direction</b>		From module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		Producer
<b>Parameters</b>		NN (2 bytes) Node number, EN (2 bytes) Event number, data1 (1 bytes) Event data 1, data2 (1 bytes) Event data 2
<b>Conditions</b>		The module has the event defined and the current state of the event is ON.
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.7.11 [D5] AROF2 - Accessory Response OFF Event with 2 Bytes

<b>Name</b>		AROF2
<b>Value</b>	<b>Decimal</b>	213
	<b>Hex</b>	D5
<b>Priority</b>		Low
<b>Description</b>		Accessory Response Event
<b>Comment</b>		<p>Indicates an 'OFF' response event with two added data bytes. A response is a reply to a status request (<a href="#">AREQ</a>) without producing an ON or OFF event.</p> <p>The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.</p>
<b>Direction</b>		From module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		Producer
<b>Parameters</b>		NN (2 bytes) Node number, EN (2 bytes) Event number, data1 (1 bytes) Event data 1, data2 (1 bytes) Event data 2
<b>Conditions</b>		The module has the event defined and the current state of the event is OFF.
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.7.12 [D8] ASON2 - Accessory Short ON Event with 2 Bytes

<b>Name</b>		ASON2
<b>Value</b>	<b>Decimal</b>	216
	<b>Hex</b>	D8
<b>Priority</b>		Low
<b>Description</b>		Accessory Short ON
<b>Comment</b>		<p>Indicates an 'ON' event using the short event number of 2 LS bytes with two added data bytes.</p> <p>An event is sent by a module when it detects a change of state.</p> <p>Modules may consume the event and perform actions.</p> <p>The NN is not used to match events, the NN normally indicates the source of the event.</p> <p>The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.</p>
<b>Direction</b>		
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		Producer or Consumer
<b>Parameters</b>		NN (2 bytes) Node number, EN (2 bytes) Event number, data1 (1 bytes) Event data 1, data2 (1 bytes) Event data 2
<b>Conditions</b>		If the module has not been taught the event nor has the event by default then the event message is ignored.
<b>Result</b>		<p>If the module has the event configured to be sent when there is a change of state and that object changes to state ON then send this event.</p> <p>If the module has been configured to consume the event (ignoring the NN) then perform the actions associated with the ON event.</p>
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.7.13 [D9] ASOF2 - Accessory Short OFF Event with 2 Bytes

<b>Name</b>		ASOF2
<b>Value</b>	<b>Decimal</b>	217
	<b>Hex</b>	D9
<b>Priority</b>		Low
<b>Description</b>		Accessory Short OFF
<b>Comment</b>		<p>Indicates an 'OFF' event using the short event number of 2 LS bytes with two added data bytes.</p> <p>An event is sent by a module when it detects a change of state. Modules may consume the event and perform actions.</p> <p>The NN is not used to match events, the NN normally indicates the source of the event.</p> <p>The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.</p>
<b>Direction</b>		
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		Producer or Consumer
<b>Parameters</b>		NN (2 bytes) Node number, EN (2 bytes) Event number, data1 (1 bytes) Event data 1, data2 (1 bytes) Event data 2
<b>Conditions</b>		If the module has not been taught the event nor has the event by default then the event message is ignored.
<b>Result</b>		<p>If the module has the event configured to be sent when there is a change of state and that object changes to state OFF then send this event.</p> <p>If the module has been configured to consume the event (ignoring the NN) then perform the actions associated with the OFF event.</p>
<b>History</b>		No change from CBUS revision 4 ver 8j



## 3.7.14 [DD] ARSON2 - Accessory Response ON Event with 2 Bytes

<b>Name</b>		ARSON2
<b>Value</b>	<b>Decimal</b>	221
	<b>Hex</b>	DD
<b>Priority</b>		Low
<b>Description</b>		Accessory Short Response Event ON with two data bytes.
<b>Comment</b>		<p>Indicates an 'ON' response event with two added data bytes. A response is a reply to a status request (<a href="#">ASRQ</a>) without producing an ON or OFF event.</p> <p>The NN is not used to match events, the NN normally indicates the source of the event.</p> <p>The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.</p>
<b>Direction</b>		From module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		Producer
<b>Parameters</b>		NN (2 bytes) Node number, EN (2 bytes) Event number, data1 (1 bytes) Event data 1, data2 (1 bytes) Event data 2
<b>Conditions</b>		The module has the event defined and the current state of the event is ON.
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.7.15 [DE] ARSOF2 - Accessory Response OFF Event with 2 Bytes

<b>Name</b>		ARSOF2
<b>Value</b>	<b>Decimal</b>	222
	<b>Hex</b>	DE
<b>Priority</b>		Low
<b>Description</b>		Accessory Short Response Event OFF with two data bytes
<b>Comment</b>		<p>Indicates an 'OFF' response event with two added data bytes. A response is a reply to a status request (<a href="#">ASRQ</a>) without producing an ON or OFF event.</p> <p>A response event is a reply to a status request (<a href="#">ASRQ</a>) without producing an ON or OFF event.</p> <p>The NN is not used to match events, the NN normally indicates the source of the event.</p> <p>The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.</p>
<b>Direction</b>		From module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		Producer
<b>Parameters</b>		NN (2 bytes) Node number, EN (2 bytes) Event number, data1 (1 bytes) Event data 1, data2 (1 bytes) Event data 2
<b>Conditions</b>		The module has the event defined and the current state of the event is OFF.
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.7.16 [DF] EXTC5 - Extended Opcode with 5 Additional Bytes

<b>Name</b>		EXTC5
<b>Value</b>	<b>Decimal</b>	223
	<b>Hex</b>	DF
<b>Priority</b>		Low
<b>Description</b>		Extended opcode with 5 additional bytes
<b>Comment</b>		Reserved to allow the 5 additional bytes range to be extended by a further 256 opcodes.
<b>Direction</b>		
<b>States/Modes</b>		
<b>Services</b>		
<b>Parameters</b>		Ext_OPC (1 bytes) Extended opcode, Data1 (1 bytes) Data2 (1 bytes) Data3 (1 bytes) Data4 (1 bytes) Data5 (1 bytes)
<b>Conditions</b>		
<b>Result</b>		
<b>History</b>		

## 3.8 OPCODES with 7 additional bytes

### 3.8.1 [E0] RDCC6 - Request 6 bytes DCC Packet

<b>Name</b>		RDCC6
<b>Value</b>	<b>Decimal</b>	224
	<b>Hex</b>	E0
<b>Priority</b>		Normal
<b>Description</b>		Request 6-byte DCC Packet
<b>Comment</b>		Allows a CAB or equivalent to request a 6 byte DCC packet to be sent to the track. The packet is sent <REP> times and is not refreshed on a regular basis.
<b>Direction</b>		To module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		DCC_CAB or DCC_CMD
<b>Parameters</b>		REP (1 bytes), Byte0 (1 bytes), Byte1 (1 bytes), Byte2 (1 bytes), Byte3 (1 bytes), Byte4 (1 bytes), Byte5 (1 bytes)
<b>Conditions</b>		If the NN does not match the node number of the module then ignore the message. If the module is not a DCC command station then ignore the message.
<b>Result</b>		If conditions are met then the requested DCC packet is sent <REP> times.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.8.2 [E1] PLOC - Engine Report

<b>Name</b>		PLOC
<b>Value</b>	<b>Decimal</b>	225
	<b>Hex</b>	E1
<b>Priority</b>		Normal
<b>Description</b>		Engine report
<b>Comment</b>		A report of an engine entry sent by the command station. Sent in response to <a href="#">QLOC</a> or as an acknowledgement of acquiring an engine requested by a cab ( <a href="#">RLOC</a> or <a href="#">GLOC</a> ).
<b>Direction</b>		From command station
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		DCC_CAB or DCC_CMD
<b>Parameters</b>		Session (1 bytes), Addr (2 bytes), Speed/Dir (1 bytes), Fn1 (1 bytes) Function byte F0-F4, Fn2 (1 bytes) Function byte F5-F8, Fn3 (1 bytes) Function byte F9-F12
<b>Conditions</b>		Sent in response to <a href="#">QLOC</a> , <a href="#">RLOC</a> or <a href="#">GLOC</a> .
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j

## x3.8.3 [E2] NAME - Request for Name Response

<b>Name</b>		NAME
<b>Value</b>	<b>Decimal</b>	226
	<b>Hex</b>	E2
<b>Priority</b>		Low
<b>Description</b>		Response to request for node name string
<b>Comment</b>		<p>Returns the type name for the module in response to <a href="#">RQMN</a>. Any leading “CAN” or “ETH” is not included in the response. The type is post-padded to 7 characters with spaces (0x20).</p> <p>The requester can subsequently add the “CAN” or “ETH” using the protocol indicated in parameter 10.</p>
<b>Direction</b>		From module
<b>States/Modes</b>		Setup
<b>Services</b>		MNS
<b>Parameters</b>		NAME (7 bytes) Module type name in ASCII and padded on right with spaces (0x20).
<b>Conditions</b>		Sent in response to a <a href="#">RQMN</a> message.
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.8.4 [E3] STAT - Command Station Status Report

<b>Name</b>		STAT
<b>Value</b>	<b>Decimal</b>	227
	<b>Hex</b>	E3
<b>Priority</b>		Normal
<b>Description</b>		Command Station status report
<b>Comment</b>		<p>Sent by the command station in response to <a href="#">RSTAT</a>.          &lt;flags&gt; is status defined by the bits below:          0 -Hardware Error (self test),          1 -Track Error          2 -Track On/ Off,          3 -Bus On/ Halted,          4 -EM. Stop all performed,          5 -Reset done,          6 -Service mode (programming) On/ Off,          7 –reserved.</p>
<b>Direction</b>		From command station
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		DCC_CAB or DCC_CMD
<b>Parameters</b>		NN (2 bytes) Node number, CNum (1 byte) For future expansion -set to zero at present, Flags (1 byte), Major rev (1 bytes) Major revision number, Minor rev (1 bytes) Minor revision letter, Build no (1 bytes) Build number.
<b>Conditions</b>		Sent in response to a <a href="#">RSTAT</a> message.
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.8.5 [E6] ENACK - Event Acknowledge

<b>Name</b>		ENACK
<b>Value</b>	<b>Decimal</b>	230
	<b>Hex</b>	E6
<b>Priority</b>		Low
<b>Description</b>		Event Acknowledge
<b>Comment</b>		Sent by a module to acknowledge the consumption of an event. Used for diagnostic purposes.
<b>Direction</b>		From module
<b>States/Modes</b>		ENACK
<b>Services</b>		ENACK and Consumer
<b>Parameters</b>		NN (2 bytes) Module's Node Number, opcode (1 bytes), The opcode of the event being acknowledged, EventNNh (1 bytes), The high byte of the event's NN, EventNNl (1 bytes), The low byte of the event's NN, EventENh (1 bytes), The high byte of the event's EN, EventENl (1 bytes), The low byte of the event's EN
<b>Conditions</b>		Module must be in event acknowledge mode. Module must have the specified defined as a consumed event. Sent in response to an event.
<b>Result</b>		
<b>History</b>		New for VLCB



## 3.8.6 [E7] ESD - Extended Service Discovery Response

<b>Name</b>		ESD
<b>Value</b>	<b>Decimal</b>	231
	<b>Hex</b>	E7
<b>Priority</b>		Low
<b>Description</b>		Extended service discovery response
<b>Comment</b>		<p>Detailed information about a service supported by a module. The data supplied is service specific.</p> <p>Sent in response to <a href="#">RQSD</a> with ServiceIndex is not zero. A single ESD response message is sent by a module for the specified service.</p> <p>The data parameters are service specific and reference should be made to the relevant service specification.</p> <p>Also see <a href="#">SD</a>.</p>
<b>Direction</b>		From module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		MNS
<b>Parameters</b>		NN (2 bytes) Node number, ServiceIndex (1 bytes) Index into the list of services ServiceType (1 bytes) Service Type, Data1 (1 bytes) Service specific data, Data2 (1 bytes) Service specific data, Data3 (1 bytes) Service specific data,
<b>Conditions</b>		Sent in response to <a href="#">RQSD</a> when the requested Service Type is not zero.
<b>Result</b>		
<b>History</b>		New for VLCB

## 3.8.7 [E9] DTXC- Streaming protocol

<b>Name</b>		DTXC
<b>Value</b>	<b>Decimal</b>	233
	<b>Hex</b>	E9
<b>Priority</b>		Low
<b>Description</b>		Streaming protocol (RFC0005)
<b>Comment</b>		<p>Used to transport a relatively large block of data.</p> <p>StreamID is a unique layout wide identifier of a particular message stream. It is the responsibility of the layout installer/module installer to ensure that any StreamIDs are unique across the installation. StreamIDs 0~20 are reserved as CBUS system wide IDs. Users would not allocate these IDs to private streams.</p> <p>SequenceNum is a 0x00 to 0xFF identification of the frame sequence . 0x00 is used to denote a header frame , any number != 0x00 indicates a continuation frame.</p> <p>MessageLen is a 16 bit size in bytes of the transmitted message , However as only 254 continuation frames are possible the Message Len is limited to a count of 1275. However private protocols may be deployed to send larger messages and the full extent of these fields can be used. A Message length of Zero is supported, albeit rather pointless.</p> <p>CRC16 is a standard implementation of CRC, ie <math>P(x) = x^{16} + x^{15} + x^2 + 1</math>. CRC fields are optional and set to 0x00 if not implemented.</p> <p>Continuation frames merely contain the StreamID and SequenceNum and 5 bytes of message data</p> <p>It is recommended that continuation frames are throttled at 1 over 20ms.</p>
<b>Direction</b>		
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		

<b>Parameters</b>	<p>For sequenceNum != 0</p> <p>StreamID (1 bytes) Stream identifier</p> <p>SequenceNum (1 bytes) Sequence Number</p> <p>Data1 (1 bytes) Stream data</p> <p>Data2 (1 bytes) Stream data</p> <p>Data3 (1 bytes) Stream data</p> <p>Data4 (1 bytes) Stream data</p> <p>Data5 (1 bytes) Stream data</p> <p>For sequenceNum = 0</p> <p>StreamID (1 bytes) Stream identifier</p> <p>0x00 (1 bytes) Sequence Number</p> <p>MessageLen (2 bytes) Message Length</p> <p>CRC16 (2 bytes) Checksum</p> <p>Flags (1 bytes) flags - reserved for future use</p>
<b>Conditions</b>	
<b>Result</b>	
<b>History</b>	Defined in RFC0005

## 3.8.8 [EF] PARAMS - Response for Node Parameters

<b>Name</b>		PARAMS
<b>Value</b>	<b>Decimal</b>	239
	<b>Hex</b>	EF
<b>Priority</b>		Low
<b>Description</b>		Response to request for node parameters
<b>Comment</b>		<p>Returns the first 7 parameters for the module in response to <a href="#">RQNP</a>.</p> <p>See <a href="#">Appendix B - Module parameters</a> for a list of available parameters.</p>
<b>Direction</b>		From module
<b>States/Modes</b>		Setup
<b>Services</b>		MNS
<b>Parameters</b>		PARA 1 (1 bytes) Parameter 1, PARA 2 (1 bytes) Parameter 2, PARA 3 (1 bytes) Parameter 3, PARA 4 (1 bytes) Parameter 4, PARA 5 (1 bytes) Parameter 5, PARA 6 (1 bytes) Parameter 6, PARA 7 (1 bytes) Parameter 7
<b>Conditions</b>		Sent in response to <a href="#">RQNP</a> .
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.8.9 [F0] ACON3 - Accessory ON Event with 3 Data Bytes

<b>Name</b>		ACON3
<b>Value</b>	<b>Decimal</b>	240
	<b>Hex</b>	F0
<b>Priority</b>		Low
<b>Description</b>		Accessory ON
<b>Comment</b>		<p>Indicates an 'ON' event using the full event number of 4 bytes with three additional data bytes.</p> <p>An event is sent by a module when it detects a change of state.</p> <p>Modules may consume the event and perform actions.</p> <p>The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.</p>
<b>Direction</b>		
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		Producer or Consumer
<b>Parameters</b>		NN (2 bytes) Node number, EN (2 bytes) Event number, data1 (1 bytes) Event data 1, data2 (1 bytes) Event data 2, data3 (1 bytes) Event data 3
<b>Conditions</b>		If the module has not been taught the event nor has the event by default then the event message is ignored.
<b>Result</b>		<p>If the module has the event configured to be sent when there is a change of state and that object changes to state ON then send this event.</p> <p>If the module has been configured to consume the event then perform the actions associated with the ON event.</p>
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.8.10 [F1] ACOF3 - Accessory OFF Event with 3 Data Bytes

<b>Name</b>		ACOF3
<b>Value</b>	<b>Decimal</b>	241
	<b>Hex</b>	F1
<b>Priority</b>		Low
<b>Description</b>		Accessory OFF
<b>Comment</b>		<p>Indicates an 'OFF' event using the full event number of 4 bytes with three additional data bytes.</p> <p>An event is sent by a module when it detects a change of state.</p> <p>Modules may consume the event and perform actions.</p> <p>The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.</p>
<b>Direction</b>		
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		Producer or Consumer
<b>Parameters</b>		NN (2 bytes) Node number, EN (2 bytes) Event number, data1 (1 bytes) Event data 1, data2 (1 bytes) Event data 2, data3 (1 bytes) Event data 3
<b>Conditions</b>		If the module has not been taught the event nor has the event by default then the event message is ignored.
<b>Result</b>		<p>If the module has the event configured to be sent when there is a change of state and that object changes to state OFF then send this event.</p> <p>If the module has been configured to consume the event then perform the actions associated with the OFF event.</p>
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.8.11 [F2] ENRSP - Read Event Response

<b>Name</b>		ENRSP
<b>Value</b>	<b>Decimal</b>	242
	<b>Hex</b>	F2
<b>Priority</b>		Low
<b>Description</b>		Response to request to read node events
<b>Comment</b>		This is a response to either <a href="#">NERD</a> or <a href="#">NENRD</a> .
<b>Direction</b>		From module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		Teach
<b>Parameters</b>		NN (2 bytes) Node number, EN3 (1 bytes) Event Node number hi, EN2 (1 bytes) Event Node number lo, EN1 (1 bytes) Event number hi, EN0 (1 bytes) Event number lo, EN# (1 bytes) Event index. The Event index is deprecated and may be returned as a fixed value of 0.
<b>Conditions</b>		Sent in response to a request to read events.
<b>Result</b>		
<b>History</b>		Changed from CBUS revision 4 ver 8j

## 3.8.12 [F3] ARON3 - Accessory Response ON Event with 3 Data

<b>Name</b>		ARON3
<b>Value</b>	<b>Decimal</b>	243
	<b>Hex</b>	F3
<b>Priority</b>		Low
<b>Description</b>		Accessory Response Event
<b>Comment</b>		<p>Indicates an 'ON' response event with three added data bytes. A response is a reply to a status request (<a href="#">AREQ</a>) without producing an ON or OFF event.</p> <p>The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.</p>
<b>Direction</b>		From module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		Producer or Consumer
<b>Parameters</b>		NN (2 bytes) Node number, EN (2 bytes) Event number, data1 (1 bytes) Event data 1, data2 (1 bytes) Event data 2, data3 (1 bytes) Event data 3
<b>Conditions</b>		The module has the event defined and the current state of the event is ON.
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j



## 3.8.13 [F4] AROF3 - Accessory Response OFF Event with 3 Bytes

<b>Name</b>		AROF3
<b>Value</b>	<b>Decimal</b>	244
	<b>Hex</b>	F4
<b>Priority</b>		Low
<b>Description</b>		Accessory Response Event
<b>Comment</b>		Indicates an 'OFF' response event with three added data bytes. A response is a reply to a status request ( <a href="#">AREQ</a> ) without producing an ON or OFF event. The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.
<b>Direction</b>		From module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		Producer or Consumer
<b>Parameters</b>		NN (2 bytes) Node number, EN (2 bytes) Event number, data1 (1 bytes) Event data 1, data2 (1 bytes) Event data 2, data3 (1 bytes) Event data 3
<b>Conditions</b>		The module has the event defined and the current state of the event is OFF.
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.8.14 [F5] EVLRNI - Teach an EV using Event Indexing

<b>Name</b>		EVLRNI
<b>Value</b>	<b>Decimal</b>	245
	<b>Hex</b>	F5
<b>Priority</b>		Low
<b>Description</b>		Teach an event in learn mode using event indexing
<b>Comment</b>		<p>Sent by a configuration tool to a node in learn mode to teach it an event. The event index must be known. Also teaches it the associated event variables (EVs). This command is repeated for each EV required.</p> <p>Parameter EN# is ignored and this request is similar to <a href="#">EVLRN</a>.</p> <p><b>Deprecated.</b></p>
<b>Direction</b>		To module
<b>States/Modes</b>		Learn
<b>Services</b>		Teach
<b>Parameters</b>		NN (2 bytes) Event Node number, EN (2 bytes) Event number, EN# (1 bytes) Event index, EV# (1 bytes) Event variable index, EV val (1 bytes) Event variable value
<b>Conditions</b>		<p>If the message is short so that it does not include the specified parameters then a <a href="#">GRSP</a> (Invalid Command) message is returned.</p> <p>If the module does not have space available for the event to be created then send a message a <a href="#">CMDERR</a>(Invalid Event) message.</p> <p>If the event variable index is zero or greater than the number of EVs per event parameter then send a <a href="#">CMDERR</a>(Invalid Event Variable Index) message.</p>
<b>Result</b>		If conditions are met then Save the EV and send a <a href="#">WRACK</a> message.
<b>History</b>		Deprecated in VLCB

## 3.8.15 [F6] ACDAT - Accessory Data Event

<b>Name</b>		ACDAT
<b>Value</b>	<b>Decimal</b>	246
	<b>Hex</b>	F6
<b>Priority</b>		Low
<b>Description</b>		Accessory node data event
<b>Comment</b>		Indicates an event from this node with 5 bytes of data. For example, this can be used to send the 40 bits of an RFID tag. There is no event number in order to allow space for 5 bytes of data in the packet, so there can only be one data event per node. The meaning of the event is therefore dependent upon the type and use of the module.
<b>Direction</b>		From module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		
<b>Parameters</b>		NN (2 bytes) Node number, data 1 (1 bytes), data 2 (1 bytes), data 3 (1 bytes), data 4 (1 bytes), data 5 (1 bytes)
<b>Conditions</b>		Sent to indicate an accessory event for this module.
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.8.16 [F7] ARDAT - Accessory Data Response

<b>Name</b>		ARDAT
<b>Value</b>	<b>Decimal</b>	247
	<b>Hex</b>	F7
<b>Priority</b>		Low
<b>Description</b>		Accessory node data Response
<b>Comment</b>		<p>Indicates a node data response. A response event is a reply to a status request (<a href="#">RQDAT</a>) without producing a new data event.</p> <p>There is no event number in order to allow space for 5 bytes of data in the packet, so there can only be one data event per node. The meaning of the response is therefore dependent upon the type and use of the module.</p>
<b>Direction</b>		From module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		
<b>Parameters</b>		NN (2 bytes) Node number, data 1 (1 bytes), data 2 (1 bytes), data 3 (1 bytes), data 4 (1 bytes), data 5 (1 bytes)
<b>Conditions</b>		
<b>Result</b>		Sent in response to a RQDAT message.
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.8.17 [F8] ASON3 - Accessory Short ON Event with 3 Bytes

<b>Name</b>		ASON3
<b>Value</b>	<b>Decimal</b>	248
	<b>Hex</b>	F8
<b>Priority</b>		Low
<b>Description</b>		Accessory Short ON
<b>Comment</b>		<p>Indicates an 'ON' event using the short event number of 2 LS bytes with three added data bytes.</p> <p>An event is sent by a module when it detects a change of state.</p> <p>Modules may consume the event and perform actions.</p> <p>The NN is not used to match events, the NN normally indicates the source of the event.</p> <p>The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.</p>
<b>Direction</b>		
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		Producer or Consumer
<b>Parameters</b>		NN (2 bytes) Node number, EN (2 bytes) Event number, data1 (1 bytes) Event data 1, data2 (1 bytes) Event data 2, data3 (1 bytes) Event data 3
<b>Conditions</b>		If the module has not been taught the event nor has the event by default then the event message is ignored.
<b>Result</b>		<p>If the module has the event configured to be sent when there is a change of state and that object changes to state ON then send this event.</p> <p>If the module has been configured to consume the event (ignoring the NN) then perform the actions associated with the ON event.</p>
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.8.18 [F9] ASOF3 - Accessory Short OFF Event with 3 Bytes

<b>Name</b>		ASOF3
<b>Value</b>	<b>Decimal</b>	249
	<b>Hex</b>	F9
<b>Priority</b>		Low
<b>Description</b>		Accessory Short OFF
<b>Comment</b>		<p>Indicates an 'OFF' event using the short event number of 2 LS bytes with three added data bytes.</p> <p>An event is sent by a module when it detects a change of state. Modules may consume the event and perform actions.</p> <p>The NN is not used to match events, the NN normally indicates the source of the event.</p> <p>The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.</p>
<b>Direction</b>		
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		Producer or Consumer
<b>Parameters</b>		NN (2 bytes) Node number, EN (2 bytes) Event number, data1 (1 bytes) Event data 1, data2 (1 bytes) Event data 2, data3 (1 bytes) Event data 3
<b>Conditions</b>		If the module has not been taught the event nor has the event by default then the event message is ignored.
<b>Result</b>		<p>If the module has the event configured to be sent when there is a change of state and that object changes to state OFF then send this event.</p> <p>If the module has been configured to consume the event (ignoring the NN) then perform the actions associated with the OFF event.</p>
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.8.19 [FA] DDES - Device Data Event (short mode)

<b>Name</b>		DDES
<b>Value</b>	<b>Decimal</b>	250
	<b>Hex</b>	FA
<b>Priority</b>		Low
<b>Description</b>		Device data event (short mode)
<b>Comment</b>		<p>Function is the same as <a href="#">ACDAT</a> but uses device addressing so it can relate data to a device attached to a node. e.g. one of several RFID readers attached to a single node.</p> <p>The meaning of the event and the data is dependent upon the type and use of the module.</p>
<b>Direction</b>		From module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		
<b>Parameters</b>		DN (2 bytes) Device number, data 1 (1 bytes), data 2 (1 bytes), data 3 (1 bytes), data 4 (1 bytes), data 5 (1 bytes)
<b>Conditions</b>		Sent to indicate a device event for this module.
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.8.20 [FB] DDRS - Device Data Response (short mode)

<b>Name</b>		DDRS
<b>Value</b>	<b>Decimal</b>	251
	<b>Hex</b>	FB
<b>Priority</b>		Low
<b>Description</b>		Device data response (short mode)
<b>Comment</b>		The response to a <a href="#">RQDDS</a> request for data from a device. The meaning of the event and the data is dependent upon the type and use of the module.
<b>Direction</b>		From module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		
<b>Parameters</b>		DN (2 bytes) Device number, data 1 (1 bytes), data 2 (1 bytes), data 3 (1 bytes), data 4 (1 bytes), data 5 (1 bytes)
<b>Conditions</b>		Sent in response to a RQDDS request.
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j



## 3.8.21 [FC] DDWS - Device Data Write

<b>Name</b>		DDWS
<b>Value</b>	<b>Decimal</b>	252
	<b>Hex</b>	FC
<b>Priority</b>		Low
<b>Description</b>		Write data
<b>Comment</b>		Used to write data to a device such as a RFID tag. data1 ~ data5 is data to be written to the device. RC522 devices should have data1 set to 0
<b>Direction</b>		To module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		
<b>Parameters</b>		DN (2 bytes) Device number, data 1 (1 bytes) data to be written to device, data 2 (1 bytes) data to be written to device, data 3 (1 bytes) data to be written to device, data 4 (1 bytes) data to be written to device, data 5 (1 bytes) data to be written to device
<b>Conditions</b>		
<b>Result</b>		
<b>History</b>		?

## 3.8.22 [FD] ARSON3 - Accessory Response ON Event with 3 Bytes

<b>Name</b>		ARSON3
<b>Value</b>	<b>Decimal</b>	253
	<b>Hex</b>	FD
<b>Priority</b>		Low
<b>Description</b>		Accessory Short Response Event
<b>Comment</b>		<p>Indicates an 'ON' response event with three added data bytes. A response is a reply to a status request (<a href="#">ASRQ</a>) without producing an ON or OFF event.</p> <p>The NN is not used to match events, the NN normally indicates the source of the event.</p> <p>The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.</p>
<b>Direction</b>		From module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		Producer or Consumer
<b>Parameters</b>		NN (2 bytes) Node number, EN (2 bytes) Event number, data1 (1 bytes) Event data 1, data2 (1 bytes) Event data 2, data3 (1 bytes) Event data 3
<b>Conditions</b>		The module has the event defined and the current state of the event is ON.
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.8.23 [FE] ASROF3 - Accessory Response OFF Event with 3 Bytes

<b>Name</b>		ARSOF3
<b>Value</b>	<b>Decimal</b>	254
	<b>Hex</b>	FE
<b>Priority</b>		Low
<b>Description</b>		Accessory Short Response Event
<b>Comment</b>		<p>Indicates an 'OFF' response event with three added data bytes. A response is a reply to a status request (<a href="#">ASRQ</a>) without producing an ON or OFF event.</p> <p>A response event is a reply to a status request (<a href="#">ASRQ</a>) without producing an ON or OFF event.</p> <p>The NN is not used to match events, the NN normally indicates the source of the event.</p> <p>The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.</p>
<b>Direction</b>		From module
<b>States/Modes</b>		Normal, Learn, NOHEARTB, ENACK
<b>Services</b>		Producer or Consumer
<b>Parameters</b>		NN (2 bytes) Node number, EN (2 bytes) Event number, data1 (1 bytes) Event data 1, data2 (1 bytes) Event data 2, data3 (1 bytes) Event data 3
<b>Conditions</b>		The module has the event defined and the current state of the event is OFF.
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j

## 3.8.24 [FF] EXTC6 - Extended Opcode with 6 Additional Bytes

<b>Name</b>		EXTC6
<b>Value</b>	<b>Decimal</b>	255
	<b>Hex</b>	FF
<b>Priority</b>		Low
<b>Description</b>		Extended opcode with 6 additional bytes
<b>Comment</b>		Reserved to allow the 6 additional bytes range to be extended by a further 256 opcodes.
<b>Direction</b>		
<b>States/Modes</b>		
<b>Services</b>		
<b>Parameters</b>		Ext_OPC (1 bytes) Extended opcode, Data1 (1 bytes) Data2 (1 bytes) Data3 (1 bytes) Data4 (1 bytes) Data5 (1 bytes) Data6 (1 bytes)
<b>Conditions</b>		
<b>Result</b>		
<b>History</b>		No change from CBUS revision 4 ver 8j

## 4 Appendix A - DCC ERR error codes

Code	Error	Comment
1	Loco stack full	The first two bytes are the loco address, the third byte is the error number.
2	Loco address taken	The first two bytes are the loco address, the third byte is the error number.
3	Session not present	The first byte is the session id, the second byte is zero, the third byte is the error number.
4	Consist empty	The first byte is the consist id, the second byte is zero, the third byte is the error number.
5	Loco not found	The first byte is the session id, the second byte is zero, the third byte is the error number.
6	CAN bus error	The firstTwo data bytes are set to zero (not used), the third is the error number. This would be sent out in the unlikely event that the command station buffers overflow.
7	Invalid request	The first two bytes are the loco address, the third byte is an error number. Indicates an invalid or inconsistent request. For example, a GLOC request with both steal and share flags set.
8	Session canceled	The first byte is the session id, the second byte is zero, the third byte is the error number. Sent to a cab to cancel the session when another cab is stealing that session.

## 5 Appendix B - Module Parameters

Code	Use	VLCB use															
0	Number of parameters																
1	Manufacturer's Id.	Used in combination with ModulerId to create an unique 16bit module identifier. This is the high byte.  See the Cbusdefs document for existing values															
2	Minor Version (a character) e.g. 0x62 = 'b'																
3	Module Type Id. See the Cbusdefs document for values	Used in combination with ManufacturerId to create an unique 16bit module identifier. This is the low byte.  See the Cbusdefs document for existing values															
4	No. of events supported by module																
5	No of Event Variables per event																
6	No of Node Variables																
7	Major version (integer) e.g. 0x01 = 1																
8	Flags indicating module support: <table><tr><th>Bit number</th><th>Bit value</th><th colspan="2">Use</th></tr><tr><td>0</td><td>1</td><td>Event consumer</td><td rowspan="2">Set to 3 for a Combi module</td></tr><tr><td>1</td><td>2</td><td>Event producer</td></tr><tr><td>2</td><td>4</td><td colspan="2">Normal mode</td></tr></table>	Bit number	Bit value	Use		0	1	Event consumer	Set to 3 for a Combi module	1	2	Event producer	2	4	Normal mode		Bit 3 used for Normal mode
Bit number	Bit value	Use															
0	1	Event consumer	Set to 3 for a Combi module														
1	2	Event producer															
2	4	Normal mode															

	3	8	Bootable using the FCU/JMRI boot loader protocol	
	4	16	Able to consume own events	
	5	32	Learn mode	
	6	64	Service discovery support	
9	Processor Id -defines the processor, e.g. 2480, 25K80 the firmware was built for. Set to zero for non-PIC processors. See Cbusdefs for values.			Refer to bootloader service.
10	Interface protocol -the network type that the module uses, currently either CAN or Ethernet. See Cbusdefs for values.			
11-14	The load address for the new code, this is a 4 byte little endian address, this can vary depending on the module being loaded,the normal address for all PIC processor is 0x800 except for the CANCAB language modules which are loaded above the code area. Currently only used by PIC processors, other processors should set these parameters to zero.			Refer to bootloader service.
15-18	Manufacturers processor code –this is a four byte field, only the first two bytes are used for the PIC18F processor family, this must be read directly from the hardware when requested. Currently only used by PIC processors, if implemented. If not used, the parameters must be set to zero.			Refer to bootloader service.
19	Manufacturer code –this parameter identifies the manufacturer. See Cbusdefs for values.			Refer to bootloader service.
20	Beta release code –a non-zero value specifies the beta release version, zero indicates a normal release			Used for Patch number.
21-24	Reserved for future use			

## 6 Appendix C - CMDERR and GRSP error codes

Code	Error	Used for CMDERR	GRSP service
0	OK		Any
1	Invalid command, command Not Supported.	✓	Any
2	Not In Learn Mode.	✓	Teach
3	Not in Setup Mode.	✓	MNS
4	Too Many Events.	✓	Teach
5	No Event.	✓	Teach
6	Invalid Event variable index.	✓	Teach
7	Invalid Event.	✓	Teach
8	Reserved.		
9	Invalid Parameter Index.	✓	MNS
10	Invalid Node Variable Index.	✓	Teach
11	Invalid Event Variable Value.	✓	Teach
12	Invalid Node Variable Value.	✓	Teach
13	Other in Learn mode	✓	
250	Invalid mode		An
251	Invalid command parameter		Any
252	Invalid service		Any
253	Invalid diagnostic		Any
254	Unknown NVM type		Any
255	Reserved		