CAN Communications

Revision 5	corrections to New Velocity Response format	7/18/09	C. Zeigler
Revision 4	Updates to add error response documentation	6/15/09	C. Zeigler
Revision 3	Updates for 50016801 new firmware CAN 2.0B	2/11/09	C. Zeigler
Revision 2	Updates for 50016800 new firmware sine on halls	1/12/09	C. Zeigler
Revision 1	Updates from Automotion IAV meeting	3/10/03	Ed Wilhelm

CAN Addresses:

This program supports both CAN 2.0A with an eleven bit address and CAN 2.0B with a twenty nine bit address. The base address for receiving messages is set by the CN.RA parameter. The base address for transmitting messages is set by the CN.TA parameter. The default CAN address are 300h for receiving and 400h for transmitting.

CAN Messages:

Each message type will have a different address.

CAN Adr	Description	From	Data	LENGTH
Base CN.RA	New Velocity Information	Master	Two bytes torque feed forward (+/- 0-1023), two bytes velocity command in RPM, one or two bytes of control information.	6
Base CN.RA +1	Write Parameter	Master	Two Byte parameter address followed by two bytes of data.	4
Base CN.RA +2	Read Parameter	Master	Two byte parameter or variable address.	2
Base CN.TA	Error Response	Drive	Two byte message address, First five bytes of data, one byte error number.	8
Base CN.TA +1	Read Parameter Response	Drive	Two byte parameter address followed by two or four bytes of data.	4 Or 6
Base CN.TA +2	New Velocity Response	Drive	Two bytes computed velocity in RPM, Two bytes computed torque, two bytes motor voltage, two bytes fault and status bits.	8

CAN Baud Rate and other setup:

The speed of the CAN bus will be 250 Kbit by default. It can be changed by using the CN.BR. When in RUN mode, and the CN.FE is set in the fault enable mode new velocity messages will is needed every CN.CT milliseconds or the no new command status bit will be set.

CAN Error response Transmit Base Address:

The error response is sent any time a CAN message with an ID of 300 to 303 is received and the message cannot be understood or the action specified cannot be taken. Examples: a message has an improper variable identifier; an attempt is made to write a variable with a value out of range.

Data word 0 contains the CAN ID from the message causing the error. In words 1, 2, and the upper byte of word 3 contain the first 5 data bytes from the message causing the error. In the lower byte of word 3, the error message number.

Error name:	Value:	Meaning:
Invalid Variable invalid	2	Parameter identifier
InvalidCAN_ID (not valid CAN ID)	3	Message ID base CN.RA +3 received,
InvalidWrite	4	Attempt to write a read only parameter
InvalidWrite	5	Attempt to write a parameter with a value out of range
InvalidEEPROM	6	Error when writing variable into EEPROM
InvalidInCAN	7	Parameter accessible through serial port only

Drive Status Bits Defined:

Bit No.	Description	Action	Recovery Method
MSB 0	Boot Phase	▪ Drive is initializing.	▪ Wait for initialization sequence to complete. ▪ Drive will clear this bit when complete.
1	Standby	▪ Drive is initialized and ready for commands / communications.	▪ This is a normal mode of operation when the drive is not running the motor.
2	HVIC Interrupted	▪ A break in the HVIL has been detected. ▪ Drive will start auto-discharge sequence. ▪ Drive will send HVIL messages until discharged.	▪ Check electrical connections that contain HVIL conductors.
3	EEPROM Write Cycle	▪ Bit is set while the drive is saving information to internal EEPROM memory.	▪ Drive will clear this bit when the EEPROM write cycle is complete.
4	Motor Over Temp	▪ Drive detected a motor over temperature condition. ▪ Drive will pass this information to the system controller and not take any other action.	▪ The system controller will decide how to handle a motor over temperature condition.
5	Drive Over Temp	▪ Drive detected an over temperature condition. ▪ Drive will stop spinning the motor and transition into STANDBY.	▪ Wait for the drive to cool down. ▪ Issue a Clear Faults command.
6	Drive Over Current	▪ Drive detected an over current condition. ▪ Drive will stop spinning the motor and transition into STANDBY.	▪ Look for shorted or miss-wired cables. ▪ Possible problem with motor or drive. ▪ Possible mechanical problem with motor/blower assembly. ▪ Issue a Clear Faults command.
7	Drive Over Voltage	▪ Drive detected an over voltage condition (voltage > 400V). ▪ Drive will stop spinning the motor and transition into STANDBY.	▪ Correct problem with incoming power source. ▪ Possible internal shunt problem. ▪ Issue a Clear Faults command.
8	Drive Under Voltage	▪ Drive detected an under voltage condition (160 < voltage < 180V) ▪ Drive will continue to operate although performance may be affected. ▪ If voltage < 160V, drive may stop operation.	▪ Correct problem with incoming power source. ▪ Possible internal discharge problem. ▪ Issue a Clear Faults command.

9	Drive Hall Fault	▪ Drive will stop sourcing power to motor and transition into STANDBY. ▪ If a noise condition, may not interrupt operation of drive.	▪ Possible noise problem. ▪ Possible wiring problem. ▪ Issue a Clear Faults command.
10	Drive EEPROM Fault	▪ Drive is unable to save / retrieve data from internal EEPROM memory.	▪ Possible problem with internal EEPROM device. ▪ Issue a Clear Faults command. ▪ Issue a Write to EEPROM command. ▪ May be overridden by system controller by setting each parameter after each reset.
11	Drive Logic Power Supply Fault	▪ Drive will stop spinning the motor and transition into STANDBY.	▪ Possible problem with internal logic power supplies. ▪ Possible Drive Under Voltage condition. ▪ Issue a Clear Faults command.
12	Drive Locked Rotor Fault	▪ Drive will stop spinning the motor and transition into STANDBY.	▪ Possible noise problem. ▪ Possible wiring problem. ▪ Possible problem with motor or drive. ▪ Possible mechanical problem with motor/blower assembly. ▪ Issue a Clear Faults command.
13	No new command	▪ Drive checks the setting of CN.FE shuts down if the shutdown is enabled.	▪
14	Not defined	▪	▪
LSB 15	Not defined	▪	▪

System Controller Command Bits Defined:

Bit No.	Description	Action
0 MSB	Clear Faults	▪ Drive to clear status bits and re-check for persistent fault conditions.
1	Standby	▪ Drive to go into STANDBY.
2	Run	▪ Drive to go into RUN. ▪ Drive will spin motor only when velocity command is > zero.
3	Write to EEPROM	▪ Drive will save parameters from internal RAM to EEPROM memory.
4	Restore from EEPROM	▪ Drive will read parameters from EEPROM and store into internal RAM.
5	Not defined	▪
6	Not defined	▪
7	Not defined	▪
8	Not defined	▪
9	Not defined	▪
10	Not defined	▪
11	Not defined	▪
12	Not defined	▪
13	Not defined	▪
14	Not defined	▪
15	Not defined	▪
16 lsb	Not defined	▪

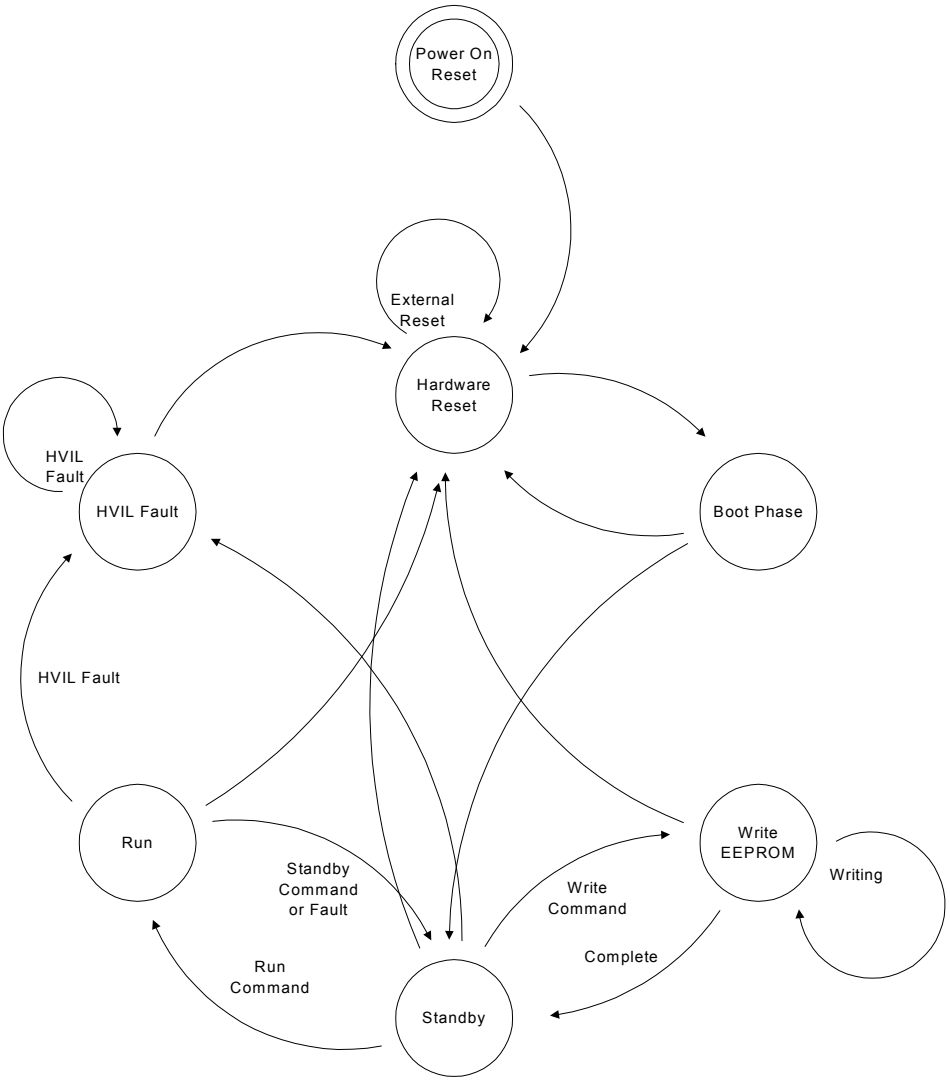
Adr In Hex	Sym bol	Description	Comments	CMD PARM	RO R/W	# of Bytes	New
0		Reserved					*
1	UO	Phase U Current A/D Offset	Factory use only Should not be changed by user	PROT PARM	R/W	2	*
2	VO	Phase V Current A/D Offset	Factory use only Should not be changed by user	PROT PARM	R/W	2	*
3	WO	Phase W Current A/D Offset	Factory use only Should not be changed by user	PROT PARM	R/W	2	*
4	UR	Phase U Current A/D Scale	Factory use only Should not be changed by user	PROT PARM	R/W	2	*
5	VR	Phase V Current A/D Scale	Factory use only Should not be changed by user	PROT PARM	R/W	2	*
6	WR	Phase W Current A/D Scale	Factory use only Should not be changed by user	PROT PARM	R/W	2	*
7	IR	Global Current A/D Scale	Factory use only Should not be changed by user	PROT PARM	R/W	2	*
8		Reserved					*
9	VT	Measured Velocity Filter	0 (no filter) to 65535	PARM	R/W	2	*
A	CV	Program Version	RS232 ONLY	Status	RO	2	
B	LR	Disable/Enable Low Rail	0 = Disable, 1 = Enable	Status	RO	2	
C	HC	Half Chop PWM modulation	RESERVED	Status	RO	2	
D	DU	Phase U Current	measured Phase U current	Status	RO	2	
E	DV	Phase V Current	measured Phase V current	Status	RO	2	
F	DW	Phase W Current	measured Phase w current	Status	RO	2	
10	CF	Display faults	RS232 ONLY	Status	RO	x	
11	CH	Halls State	Motor hall state	Status	RO	2	
12	CO	Recalculate U, V, W Offsets	Must be in Standby	CMD	R/W	2	
14	DA	display modulation command	DSP ACTR register	Status	RO	2	
15	DI	Feedback current	calculated feedback current	Status	RO	2	
16	OR	Velocity Loop Rate	Number of PWM Cycles	PARM	R/W	2	
17	RC	Locked rotor current	0 to 1025	PARM	R/W	2	
18	RT	Locked rotor time	in [ms]	PARM	R/W	2	
19	DP	Display power voltages	RS232 ONLY	Status		x	
1A	MP	Motor Phase	Current rotor position	Status	RO	2	
1B	SY	Not Used			RO	2	
1C	SR	Enable drive	RS232 run command	CMD	R/W	x	
1D	SB	Enable Dynamic Brake	RS232 Brake command	CMD	R/W	x	
1E	SC	Set current command	Needs to be in torque mode	CMD	R/W	x	
1F	SS	Display status	RS232 ONLY	Status	R/W	x	
20	HP	Advance Motor Phase		PARM	R/W	2	
21	TC	TEST CURRENT	Automotion use only	CMD	R/W	2	
22	TV	TEST VOLTAGE	Automotion use only	CMD	R/W	2	
23	TT	NUMBER OF TEST CURRENT LOOPS	Automotion use only	CMD	R/W	2	
24	IO	Slow down rs232 comm.	Automotion use only	PARM	R/W	2	
25	MT	Motor Over temp Control feedback	Value used item 26	Status	RO	2	
26	TE	Motor Over temp Control		PARM	R/W	2	

NOTE: PROT PARM are calibration parameters or informational data that are factory set.

100	CL.KP	Current Loop Proportional Gain		PARM	R/W	2	
101	CL.KI	Current Loop Integral Gain		PARM	R/W	2	
102	LC	Current Limit	Current Limit 1023= rated current	PARM	R/W	2	
103	LS	Commanded Current Limit	Limit current setpoint	PARM	R/W	2	
104	CL.PR	PWM Period	Units of 50 Nanoseconds	PARM	R/W	2	
105	CC	Commanded Current 0 to +/-1023	Velocity mode[2] CL.CG (116h)	Status	RO	2	
105	CC	Commanded Current o to +/-1023	Torque mode[2] CL.CG (116h)	CMD	R/W	2	
106	CL.DO	current loop modulation output command	modulation output command	Status	RO	2	
107	CL.DS	integer summation portion of output command	Units of 50 Nanoseconds	Status	RO	2	
108	MN	minimum value of output command	Units of 50 Nanoseconds	Status	RO	2	
109	MX	maximum value of output command	Units of 50 Nanoseconds	Status	RO	2	
10A	FD	current loop feedback	+/-1023 = rated current	Status	RO	2	
10B	ER	current loop error	+/-1023 = rated current	Status	RO	2	
10C	CL.IN	current loop integral summation		Status	RO	4	
10D	CL.IH	High order of 10Ch		Status	RO	2	
10E	CL.YK	Proportional Gain portion of output command	Units of 50 Nanoseconds	Status	RO	2	
10F	CL.FS	portion of output command used to boost the response to a motor hall state change	Units of 50 Nanoseconds	Status	RO	2	
110	CL.LF	Commanded Current Limit flag	set to 1 if feedback current > LC	Status	RO	2	
111	CL.PC	Number of modulation periods in present motor phase		Status	RO	2	
112	CL.PL	Number of Motor Poles		PARM	R/W	2	
113	CL.EC	Encoder Counts per Rev	4 times # of encoder lines	PARM	R/W	2	
114	CL.AP	Encoder Advance	1024= 360 elect deg	PARM	R/W	2	
115	CL.SH	Current Loop Gain Scale factor		PARM	R/W	2	
116	CL.CG	Drive Configuration		PARM	R/W	2	
117	CL.ID	Flux Current (non torque producing)		Status	RO	2	
118	CL.DV	FLUX Voltage	Used to reduce “ID” to zero	Status	RO	2	
119	CL.EA	Electrical Angle	Sine Modulation Phase	Status	RO[1]	2	
11A	CL.SC	Min. absolute velocity for Sine modulation		PARM	R/W	2	
11B	CL.TA	Sine modulation time adjustment		PARM	R/W	2	
11C	CL.HT	Hall table number		PARM	R/W	2	
11D	CL.EX	Output modulation max limit (voltage)	Reduces “MX” Item 109	PARM	R/W	2	
11E	CL.EN	Output modulation min limit (voltage)	Reduces “MN” Item 108	PARM	R/W	2	
11F	RD	Command to Read Parameters from EEPROM		CMD	R/W	2	
120	CK	DSP Flash memory CHECK SUM	RS232 ONLY	Status	RO	x	
121	CL.ZC	Dead band compensation		PARM	R/W	x	
122	N/A	RESERVED				x	
123	CN.CT	CAN heartbeat timer	Uses new command response CAN address = (RA BASE +2)	PARM	R/W	2	
124	CN.BR	CAN Baud rate code	Default = 3 (250khz)	PARM	R/W	2	
125	CN.RA	CAN Receive Address	Default 768 (300 hex)	PARM	R/W	4	*
126	CN.RH	CAN Receive Address high order	High order of 125	PARM	R/W	2	*
127	CN.TA	CAN Transmit Address	Default 1024 (400 hex)	PARM	R/W	4	*
128	CN.TH	CAN Transmit Address high order	High order of 127	PARM	R/W	2	*

129	CN.FE	CAN No New command fault enable ALSO enables Can communications	0 = CAN not enabled 1= Can enabled; no new cmd. msg.fault enabled 2 = CAN enabled; no new cmd. Msg. fault disabled 3= Can enabled; no new cmd. msg.fault enabled		R/W	2	*
12A	CN.EA	CAN Extended 29 bit Address enable	Default 0 0 = CAN 2.0A; 1 = CAN 2.0B	PARM	R/W	2	*
12B	CN.DA	CAN Heartbeat Data A Address	Default 300H; VL.AC	PARM	R/W	2	*
12C	CN.DB	CAN Heartbeat Data B Address	Default 10AH; CL.FD	PARM	R/W	2	*
12D	CN.DC	CAN Heartbeat Data C Address	Default 209H; FL.BV	PARM	R/W	2	*
12E	CN.DD	CAN Heartbeat Data D Address	Default 01fH; SS	PARM	R/W	2	*
12F	CN.CA	CAN Command A Address	Default 30eH; VL.FF	PARM	R/W	2	*
130	CN.CB	CAN Command B Address	Default 302H; VL.CM	PARM	R/W	2	*
200	VF.FL	Velocity command filter	0(no filter) to 65535	PARM	R/W	2	
201	VF.GN	Velocity command gain	Vel = (Cmd + Offset)* gain / 256	PARM	R/W	2	
202	VF.OF	Velocity command offset	Vel = (Cmd + Offset)* gain / 256	PARM	R/W	2	
203	VL.VD	Velocity Command	Filtered command	Status	RO	4	
204	VL.VA	Velocity command high order	High order of 203	Status	RO	2	
205	VF.AC	Velocity Acceleration limit		PARM	R/W	2	
206	VF.JK	Velocity Jerk limit		PARM	R/W	2	
207	VF.IP	Invert PWM command signal	not used in EBC drives	PARM	R/W	2	
208	N/A	RESERVED				2	
209	FL.BV	Buss Voltage		Status	RO	2	
20A	FL.CV	Voltage		Status	RO	2	
300	VL.AC	Filtered actual velocity	In RPM	Status	RO	4	
301	VL.AH	Filtered actual velocity high order	High order of 300	Status	RO	2	
302	VL.CM	Command velocity	In RPM Posit loop enabled	Status	RO	4	
303	VL.CH	Command velocity high order	MSB of 302 Posit loop enabled	Status	RO	2	
302	VL.CM	Command velocity	Velocity mode	CMD	R/W	4	
303	VL.CH	Command velocity high order	Velocity mode	CMD	R/W	2	
304	VL.ER	Velocity error		Status	RO	2	
305	VL.KP	Velocity proportional gain		PARM	R/W	2	
306	VL.KD	Velocity derivative gain		PARM	R/W	2	
307	VL.DD	Last velocity derivative		Status	RO	4	
308	VL.DE	Last velocity derivative	High order of 307	Status	RO	2	
309	VL.DF	Velocity derivative filter	0(no filter) to 65535	PARM	R/W	2	
30A	VL.KI	Velocity integral gain		PARM	R/W	2	
30B	VL.IN	Velocity integral		Status	RO	4	
30C	VL.IH	Velocity integral high order	High order of 30B	Status	RO	2	
30D	VL.IL	Velocity integral limit	0 to 1023	PARM	R/W	2	
30E	VL.FF	Velocity feed forward			RO	2	
30F	VL.MX	Velocity maximum output	0 to 1023 (??? not 1024?)	PARM	R/W	2	
310	VL.SH	Velocity Gain Scale Factor		PARM	R/W	2	
311	VL.MN	Velocity Minimum out	-1023 to 0, default –1023	PARM	R/W	2	
312	VL.FM	Velocity max out		Status	RO	2	
400-40C	DG.xx	Reserved for graph function		Cmd's			

Drive State Diagram



CAN COMMUNICATION MESSAGE FORMAT
With Default CAN base address data length and data fields

Send Command data to the drive VF.FF and VL.CM data length 6

CAN Adr	Msb Data VL.FF	Lsb Data VL.FF	Msb Data VL.CM	Lsb Data VL.CM	Msb Data CMD BITS	Lsb Data CMD BITS
300					Bits 0-7	Bits 8-15

Send Write parameter command to the drive data length 4

CAN Adr	Msb Data Adr	Lsb Data Adr	Msb Data Byte 1	Lsb Data Byte 0
301				

Send "Read parameter" command to the drive data length 2

CAN Adr	Msb Data Adr	Lsb Data Adr
302		

Error response from the drive data length 6. The error code are described on page 2.

CAN Adr	Byte 0	Byte 1	Byte 2	Byte 3	Byte4	Byte 5 Error code
400						

Drive response to command "Read parameter" command for Two Byte Data
Data length 4

CAN Adr	Msb Data Adr	Lsb Data Adr	Msb Data Data byte 1	Lsb Data Data byte 0
401				

Drive response to "Read parameter" command for Four Byte Data
Data length 6

CAN Adr	Msb Data Adr	Lsb Data Adr	Byte 1	Lsb Data Byte 0	Msb Data Byte 3	Byte 2
401						

Heartbeat Response with new velocity data
Data length 6

Lsb Can Adr	Msb	Lsb	Msb	Lsb	Msb Voltage	Lsb Voltage	Msb Error status	Lsb Error status
402	Data a	Data a	Data b	Data b	Data c	Data c	Data d Bit 0-7	Data d Bit 8-15

Note 1: CAN ID's 300h,301h &302h base address of 300 h can be changed using the CN.RA command
and CAN ID's 400h,401h &402h base address of 400 h can be changed using the CN.TA command

CAN COMMUNICATION MESSAGE FORMAT

With configurable CAN base address data length and data fields

Send Command data to the drive CMD_A to CMD_B data length 6

Can Adr	Msb Data CMD_A	Lsb Data CMD_A	Msb Data CMD_B	Lsb Data CMD_B	Msb Data CMD BITS	Lsb Data CMD BITS
Base CN.RA+0					Bits 0-7	Bits 8-15

Send Write parameter command to the drive data length 4

CAN Adr	Msb Data Adr	Lsb Data Adr	Msb Data Byte 1	Lsb Data Byte0
Base CN.RA+1				

Send "Read Parameter" command to the drive data length 2

CAN Adr	Msb Data Adr	Lsb Data Adr
Base CN.RA+2		

Error response from the drive data length 6. The error code are described on page 2.

CAN Adr	Byte 0	Byte 1	Byte 2	Byte 3	Byte4	Byte 5 Error code
Base CN.TA						

Drive response to the CN.RA+2 command for Two Byte Data, Data length 4

Can Adr	Msb Data Adr	Lsb Data Adr	Msb Data Data byte 1	Lsb Data Data byte 0
Base CN.TA + 1				

Drive response to the CN.RA+2 command for Four Byte Data, Data length 6

Can Adr	Msb Data Adr	Lsb Data Adr	Data Byte 1	Lsb Data Byte0	Msb Data Byte 3	Data Byte 2
Base CN.TA + 1						

Heartbeat Response with selectable data timed using CN.CT, Data length 8

Can Adr	Msb Data_A	Lsb Data_A	Msb Data_B	Lsb Data_B	Msb Data_C	Lsb Data_C	Msb Data_D	Lsb Data_D
Base CN.TA + 2								