MGL Avionics

N16 Aviation band Navigation Radio

ICD V1

Table of Contents

MGL Avionics N16 transceiver communications protocols

Version

This document contains preliminary information on the binary communications protocol used by MGL Avionics VHF airband navigation radio N16.

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General

Communications takes place via RS232 or via CAN bus or both

RS232 settings
9600 Baud
8 Data bits
1 Stop bit
No parity

CAN bus settings
11 bit identifiers
250KBaud

The transceiver transmits regular status messages containing sufficient information to build a typical display image. The status message is transmitted every 100mS. During special conditions the status message is sent every 200mS inter spaced with a setup information or

technical information message every 200mS (so the overall message rate remains at 100mS).

Messages to the transceiver consist of commands. Most commands result in transmission of an acknowledgment when the command has been received with a matching checksum.

Command messages containing frequency request that are not within the permitted navigation band or illegal channel frequencies are ignored and not acknowledged.

The N16 provides two RS232 ports and one CAN bus. Only RS232 port 1 supports this protocol. RS232 port 2 is reserved for special functions.

Frequencies

Frequencies are transmitted as 4 byte unsigned integer values in the RS232 protocol and 3 byte integer values in the CAN bus protocol,

Frequency values consist of MHZ and 100's of Khz plus a channel number within the 100Khz band.

Frequencies are transmitted in Khz Example:

110.150MHZ = 110150

Note all navigation channels are on a 50Khz channel spacing starting at 108.000Mhz and ending at 117.950 Mhz.

For ILS frequencies the localizer frequency is set. The corresponding glide slope receiver frequency is automatically set based on the chosen localizer frequency.

RS232 protocol

General message format:

02	STX
05	DLE
CC	Command
D0	1 to n bytes of data
...	
Dn	
CKS	Checksum

Checksum is a linear XOR of the message contents from Command to the last data byte.
The result of this is XOR'ed with the value of $55.
This form of checksum is also known as longitudinal checksum or 8 bit parity.

Note: This protocol is based on the protocol used by the MGL Avionics V6 and V10 transceivers. Note that the commands and status messages are not all identical.

Example RS232 message to set standby frequency (values are in HEX)

02 05 01 18 F0 01 00 E8

The value E8 is the checksum and the frequency requested is 127.000 MHZ (0x1F018).

Note: The status message sent by the N16 has a deviation in the calculation. The status message excludes the command byte. All other messages include the command as shown above.

Commands:

00+$80	Set active frequency
n0	Frequency, binary, LSB first
....	
n3	to new value when TX ends.

Note: Frequency must be a valid frequency. Invalid frequencies will be ignored and no acknowledge will be sent for the message.

Sends acknowledge when message received OK

01+$80	Set standby frequency
n0	Frequency, binary, LSB first
....	
n3	

Note: Frequency must be a valid frequency. Invalid frequencies will be ignored and no acknowledge will be sent for the message.

Sends acknowledge when message received OK

02+$80	Increase RX volume (3dB),
00	Don't care data value (recommend to set to zero)

Sends acknowledge when message received OK

03+$80	Decrease RX volume (3dB),
00	Don't care data value (recommend to set to zero)

Sends acknowledge when message received OK

04+$80	Set RX volume
00	Volume value 0-31 (lowest to highest)

Sends acknowledge when message received OK

05+$80 Increase squelch
00 Don't care data value (recommend to set to zero)

Sends acknowledge when message received OK

06+$80 Decrease squelch
00 Don't care data value (recommend to set to zero)

Sends acknowledge when message received OK

07+$80 Set squelch
00 Squelch value 0-31 (lowest to highest)

Sends acknowledge when message received OK

08+$80 Set scanning on/off
00 0 = scanning off
1 = scanning on

Sends acknowledge when message received OK

09+$80 Flip back course flag
00 Don't care data value (recommend to set to zero)

Backcourse, when set, reverses localizer CDI

Sends acknowledge when message received OK

10+$80 set back course flag
n0 00 or 01 – set or reset back course flag

Backcourse, when set, reverses localizer CDI

Sends acknowledge when message received OK

11+$80 Set OBS
n0 OBS LSB
n1 OBS MSB

The OBS (Omnidirectional Bearing Select) received here is passed via the CAN bus to a connected head. It has no function in the N16. The value is in whole degrees from 0 to 359 sent as two bytes.

Sends acknowledge when message received OK

13+$80	Receiver test
00	Don't care (recommend to set to zero)

Opens receiver squelch for two seconds

Sends acknowledge when message received OK

14+$80	Flip active and standby frequencies
00	Don't care (recommend to set to zero)

Sends acknowledge when message received OK

19+$80	Causes a short “beep” on the audio output
00	Don't care (recommend to set to zero)

Used mostly as user interface acknowledge sound

Sends acknowledge when message received OK

20+$80	Setup menu control
nn	0: Setup de-activate (power on state) 1: Setup activate 2: Menu up (previous item) – wraps to end of menu. 3: Menu down (next item) = wraps to start of menu. 4: Change value of current menu item UP, ON, YES or flip state 5: Change value of current menu item DOWN, OFF, NO or flip state 6: Technical setup de-activate (power on state) 7: Technical setup activate

If the N16 is placed in setup menu mode it will automatically cancel this mode if no activity within 60 seconds related to the Menu.

If the menu is active the Setup menu message will be sent every 200mS interspaced with the normal status message. The Setup message contains information on the nature of the current setup item and an ascii text message suitable for display on a control head or EFIS. The control head does not require any specific knowledge of the attached device. It simply activates the menu and displays the text to the user. The user navigates the menu and changes values using the above commands.

Technical setup should never be entered without detailed knowledge and required special equipment. The Technical menu includes a number of calibration items that should never be changed during the life of the N16 unless certain repairs have been carried out. DO NOT CHANGE ANY OF THESE ITEMS unless you have the required equipment and knowledge of the procedures required.

No acknowledge is sent in response to these commands

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21 Audio switches
n0 0 = ID and Voice off
1 = ID on, Voice off
2 = ID off, Voice on
3 = ID on, Voice on

This command switches the 1.02Khz ID audio pass filter and 1.02Khz ID suppression filter. Note: The voice band is not fully suppressed, only attenuated by 20db if in “off” state. This complies with certification requirements.

Sends acknowledge when message received OK

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32 Request technical information
n0 Item number requested.

Note: This message is not documented here. It is used during manufacture of the device to obtain transmission of a selection of technical information used to verify device operation.

Sends acknowledge when message received OK

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33 Diagnostics
n0 Diagnostic switch value

This selects audio output of parts of the nav decoder. This function is used for diagnostics only.

0 Normal operation
1 VOR1 after 9960Hz filter
2 VOR1 9960 raw FM demodulated
3 VOR1 signal from 30Hz filter
4 VOR1 signal from FM demodulator after 30 Hz filter
5 VOR2 after 9960Hz filter
6 VOR2 9960 raw FM demodulated
7 VOR2 signal from 30Hz filter
8 VOR2 signal from FM demodulator after 30 Hz filter
9 Localizer signal after 90Hz filter
10 Localizer signal after 150Hz filter
11 Glide slope after 90Hz filter
12 Glide slope after 150Hz filter
13 RAW audio – entire pass band after I/Q demodulator

Sends acknowledge when message received OK

Format of Acknowledge message (sent by transceiver)

$02 $05 $06 $53 (full message including checksum)

Format of status message (sent by transceiver every 100mS unless setup menu is active)

02	STX
05	DLE
05	Message type
nn	Flags Bit 0 – 1 = VOR 1 unflagged Bit 1 – 1 = VOR 2 unflagged Bit 2 – 1 = Localizer unflagged Bit 3 – 1 = Glide Slope unflagged Bit 4 – 1 = Scanning active Bit 5 – 1 = Audio ID ON Bit 6 – 1 = Audio Voice ON Bit 7 – 1 = Backcourse active
nn	Status Bit 0 – 1 = Fault detected
nn	RX signal level on main frequency in dBm relative to -140dbm.
nn	RX signal level on secondary frequency in dBm relative to -140dbm. Note: Only valid is scanning is active.
nn	Supply voltage in 10^{th} of a volt relative to +5.0 volts.
n0	Main frequency (4 bytes, LSB first)
....	
n3	
n0	Secondary frequency (4 bytes, LSB first)
....	
n3	
nn	Internal temperature at in degrees C relative to -50 degrees. Note: this value is not implemented, ignore.
nn	Current RX volume 0-31
nn	Current squelch 0-31
nn	Glide slope RX signal level on main frequency in dBm relative to -140dbm.
n0	VOR 1 radial in tenth's of a degree 0-3599, LSB first
n1	
n0	VOR 2 radial in tenth's of a degree 0-3599, LSB first
n1	
n0	Localizer DDM in tenths of a % 0..-999,999..0 LSB first
n1	
n0	Glideslope DDM in tenths of a % 0..-999,999..0 LSB first
n1	
n0	Station ID (4 ASCII characters) from morse decoder
…	
n3	
CKS	Checksum

Format of the Setup menu message (sent every 200mS if setup menu active)

02	STX
05	DLE
07	Message type
nn	Length of this message
nn	Setup type
nn	Minimum permitted value
nn	Maximum permitted value
nn	Current value
xx	String of ascii characters preceeded by a byte containing number of ascii characters in string.
CKS	Checksum

Setup types:
- 0 Setup has no value to change. For example, “set to factory default”. In this case you could send Menu command “menu item UP” to activate the function.
- 1 The most common. Minimum and maximum values are valid and you can change the value using the Up and Down commands.
- 2 This is not currently used. Treat as reserved value.
- 3 Menu item flips between two states. Use either UP or Down to select the desired state.

Length of this message field – This field contains the number of bytes in the message excluding the STX, DLE, Message type, length of message and checksum. It works out to the number of ASCII characters in the string + 5. It is used by the receiver to count the number of bytes until end of message.
Note that the string itself contains as first byte the number of characters in the string (Pascal “Shortstring” format).

Note: The status message checksum deviates from the checksum calculation mentioned in this document.
Checksum does not include the Message type (04). The checksum calculation starts with “Flags”.

Technical string

This message is sent on condition to convey further information. It is only used during technical work using dedicated diagnostics equipment.

02	STX
05	DLE
03	Message type
nn	Number of ASCII characters in string
xx	ASCII characters of string
CKS	Checksum

CAN bus protocol

The CAN bus protocol is a duplication of the information on the RS232 protocol packaged into suitable CAN message packets. Each packet may contain up to 8 bytes of data.

CAN packets are identified by address in a CAN network. The address scheme used conforms to the 11 bit message ID standard CAN protocol as well as to the scheme used with MGL Avionics CAN bus equipment.

The ID takes the value 0x46n where “n” can be a value from 0 to 15 depending on message type.

The MGL addressing scheme uses the upper 7 bits of the ID as device identifier and the lower 4 bits to identify specific functions or message types local to that device.

Messages from the N16

Status message

The status message is split over 5 packets send in order every 100mS or 200mS if the menu is active.

For a description on each item please refer to the text in the RS232 protocol related to the status message.

ID 0x460	Status packet 1, length 8 bytes
Byte 0	Message type = 0
Byte 1	Flags
Byte 2-4	Main frequency, three bytes, LSB first
Byte 5-7	Secondary frequency, three bytes, LSB first

ID 0x460	Status packet 2, length 8 bytes
Byte 0	Message type = 1
Byte 1	Status
Byte 2-3	VOR1 Radial
Byte 4-5	VOR2 Radial
Byte 6-7	Localizer DDM

ID 0x460	Status packet 3, length 8 bytes
Byte 0	Message type = 2
Byte 1	RX Volume
Byte 2	RX Level 1
Byte 3	RX Level 2
Byte 4	Voltage

Byte 5	Temperature
Byte 6-7	Glide slope DDM

ID 0x460	Status packet 4, length 3 bytes
Byte 0	Message type = 3
Byte 1	RX Squelch
Byte 2	RX Level Glide slope

ID 0x460	Status packet 5, length 5 bytes
Byte 0	Message type = 4
Byte 1-4	Station ID

Menu item message

The menu item message is sent every 200mS as a block of packets in order alternating with the status messages.

The menu message is sent only if the menu is active. For details please see the description in the RS232 protocol related to the menu system.

ID 0x461	Menu packet 1, length 8 bytes
Byte 0	Message type = 0
Byte 1	Setup type
Byte 2	Minimum value
Byte 3	Maximum value
Byte 4	Current value
Byte 5	Length of ascii string in bytes
Byte 6	1st character of string
Byte 7	2nd character of string

ID 0x461	Subsequent menu packet(s), length 2 to 8 bytes
Byte 0	Message type – 1,2,3,4,5 (maximum 31 characters in string, 7 per packet)
Byte 1-7	Remaining characters of string to a maximum of 7 characters.

Technical string

This message is sent on condition to convey further information. It is only used during technical work using dedicated diagnostics equipment and activated by command 32.

ID 0x462	Subsequent menu packet(s), length 2 to 8 bytes
Byte 0	Message type – 0
Byte 1	Length of string in bytes
Byte 2-7	Up to 6 characters of string

ID 0x462	Subsequent technical text packet(s), length 2 to 8 bytes
Byte 0	Message type – 1-9 (maximum 63 characters in string, 7 per packet)
Byte 1-7	Remaining characters of string to a maximum of 7 characters.

Messages to the N16

N16 controllers use the assigned CAN ID 0x49n where “n” is a message type identifier. Multiple control heads will use the SAME ID.

ID 0x490	Length variable (minimum 1 byte)
Byte 0	Command ID
Byte 1-7	Optional data for command

Note: the N16 checks the length of a received CAN packet and will only accept packets that have the correct length for a given command. Do not pad a packet. Send it at the correct length.

Command	Length	Function
0	4	Set active frequency (three bytes, LSB first)
1	4	Set standby frequency (three bytes, LSB first)
2	1	Flip active and standby frequencies
3	1	RX volume UP 3db
4	1	RX volume DOWN 3db
5	2	Set RX volume. Value 0-31.
9	1	Flip back course
10	2	Set back course. Value 0 or 1.
12	1	RX Squelch UP
13	1	RX Squelch DOWN

14	2	Set RX Squelch. Value 0-31.
15	1	Flip Audio ID filter on/off state
16	1	Flip scanning state (active ↔ inactive)
17	1	Flip Audio Voice filter on/off state
18	2	Setup menu functions. Please see RS232 protocol description for details on this.
19	1,2,6	Beep control. Activates a beep tone sequencer for headset output. If length 1 = single beep, 40mS if length 2 = if data=0 then stop any beep active. If length 6 = First data byte = 1, bytes 2,3,4,5 are beep pattern, LSB first, Each “1” is beep active. Data byte 6 is duration of every bit in pattern in milliseconds. Pattern play starts with bit 0 of pattern.
20	2	Audio ID and Voice set filter on/off. See RS232 protocol for values.
21	1	Receiver test. Opens squelch for two seconds.