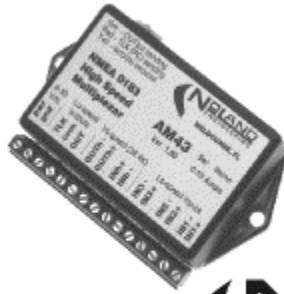


NMEA 0183 HI-SPEED MULTIPLEXER



Model AM43 USER MANUAL



This manual covers version 1.1. Future versions of this product may contain enhancements not covered herein.

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1. GENERAL DESCRIPTION

The AM43 Multiplexer combines up to four NMEA 0183 instruments (talkers) into multiple NMEA 0183 outputs. It supports both standard and high speed baud rates, 4800-38,400 for full AIS compatibility. Three outputs are provided, a lo-speed output (**OUT**) at 4800 baud, a hi-speed output (**OUTh**) at 38,400 baud, and a **TLK** output for PC generated data. The outputs normally go to NMEA listeners such as a radar, chartplotter, or repeater. A multicolor status LED shows data flow and error conditions.

A USB computer interface is also included. This interface receives all of the combined data from the instruments but can also send data back to the instruments, which will appear at the **TLK** port of the AM43. This can be used for downloading waypoints, sending steering commands, error monitoring and more.

Installation of the AM43 is simple. All connections to instruments are made via a terminal strip. The unit begins operating as soon as power is applied. No initialization or setup is required. The USB connector provides 2-way data communication to/from a computer. The AM43 may be operated either with or without the USB connection. Some configuration options are user programmable (see Appendix A).

To assist in installation and troubleshooting, a multicolor LED is located the top left rear of the AM43. The LED will flicker green when valid NMEA sentences are being received on any of the four inputs. The LED glows red when valid NMEA sentences are received from the USB interface. It will flashes yellow for a half-second if an error is detected, and simultaneously send an error identification sentence to the PC output (USB).

2. INSTALLATION

Installation of the AM43 requires connection to a power source and to NMEA talkers and listeners. All connections are made via a fifteen position terminal strip (see Figure 1). A description of the connections is given in Table 1. Any unused connections open may be left disconnected. A USB connector is provided on the rear for connection to a computer, if desired.

Power/Ground Connection. The power (PWR) and ground (GND) connections are located at one end of the terminal strip. The power source can be anywhere in the 8-30 Vdc range. There is no ON/OFF switch on the AM43 due to its low power consumption.

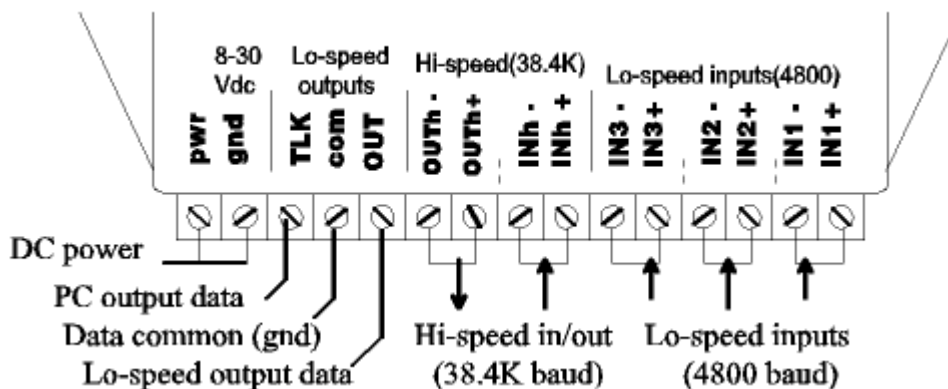


Figure1 AM43 Connections

Table 1. Interface Description

PWR, GND	Ships' power (8-30VDC), 50 mA. typical current draw.
TLK	NMEA 0183 'Talker' output for data coming from PC (via USB). 4800 baud, fixed.
com	Common (data ground) terminal for TLK and OUT outputs.
OUT	Combined output from the IN1-IN3 inputs. 4800 baud, fixed.
OUTh +, OUTh -	Combined output from all inputs, IN1-IN3 and INh. RS-422, 38.4K baud (default).
INh +, INh -	Hi-speed input for AIS or other NMEA 0183-HS data. 38,400 baud (default)
IN1-IN3 +, IN1-IN3 -	Lo-speed inputs for regular NMEA 0183 data. 4800 baud, fixed (exc. IN1, which can be reprogrammed to 9600 baud)
USB Conn.	USB interface to computer (virtual COM port). Any baud rate can be set in PC for this interface.

NMEA 0183 Inputs. The four AM43 input connections are labeled **IN1**, **IN2**, **IN3**, and **INh**. **IN1 – IN3** are set for 4800 baud, but **IN1** can be reprogrammed to 9600 baud, if required (see Appendix A). **INh** is a hi-speed input, which is set to 38,400 baud. AIS data, or encapsulated data, should always be sent to this input. If necessary, the **INh** baud rate can be changed (see Appendix A).

Always connect the "+" terminal of each talker to the corresponding "+" or "A" terminal of each listener. Likewise, connect the "-" terminal of each talker to the corresponding "-" or "B" terminal of each listener. In some cases a device will not have "+/-" or "A/B" connections, but rather only a "Data in" or "Data out" which is referenced to ground. These are known as "single-ended" devices. An example of connecting a single-ended signal (e.g., RS-232) to an AM43 input is shown in Figure 2.

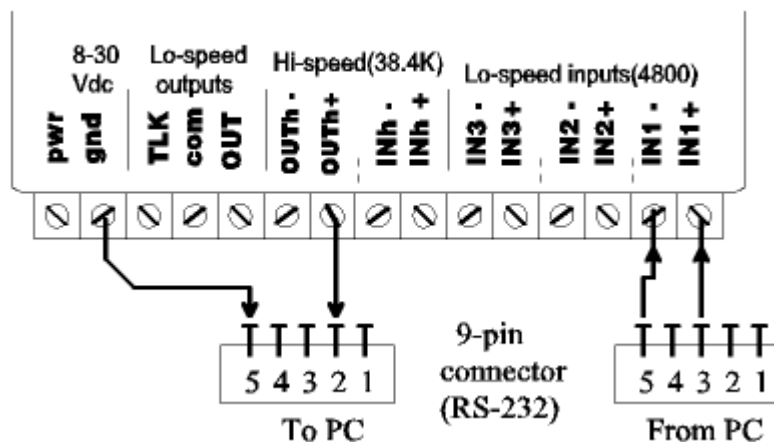


Figure 2. Connecting Single-ended Devices

NMEA 0183 Outputs. The AM43 has 3 NMEA 0183 outputs, **OUT** for lo-speed (4800 baud) devices, **OUTh** for hi-speed (38,400 baud) devices, and **TLK** specifically for sentences from the PC. The lo-speed **OUT** terminal only has combined data from the three lo-speed inputs (**IN1 – IN3**). The **OUTh** output, however, has the combined data from all four inputs. AIS units usually send and receive data at 38,400 baud while most other instruments use 4800 baud.

The lo-speed **OUT** terminal has combined data from the lo-speed inputs (**IN1 – IN3**). The baud rate for this output is fixed at 4800. The **OUTh** output (**OUTh+**, **OUTh-**) gets the combined data from all four inputs. The main purpose of this output is to combine data from the hi-speed input, **INh**, with the other inputs (**IN1-IN3**) into a single hi-speed output. This output is

differential RS-422. It can, however, drive an RS-232 listener, such as a PC, as shown in Figure 2. The baud rate of this output is set to 38,400 per the NMEA 0183-HS (Hi-Speed) standard but can be changed (see Appendix A).

TLK Output. This output is specifically for data from the PC (via USB). This would normally be data such as waypoints, routes, or steering commands. The data rate is fixed at 4800 baud. A special feature of the AM43 is its ability to redirect **OUT** data to the **TLK** terminal when data from the PC is lost. This **OUT - TLK** switchover is useful if a device like an Autopilot is receiving steering commands from a PC, but then loses this data. After a 5-second delay, all data from the **OUT** would also appear at **TLK**. This gives the listener (e.g., Autopilot) a backup source of data. This switchover function must be user enabled (see Appendix A).

USB Connector. The USB connector on the rear of the AM43 provides a computer interface. The USB gets all the same data as **OUTh** plus any error sentences generated by the AM43. The USB interface requires a software driver be installed on the computer to which it is connected. The driver converts the USB connection into a “Virtual COM Port” so that any software expecting a Serial “COM_” port can send and receive data. The user can set the baud rate of the “Virtual COM port” to any value desired.

Typical Installation. A typical AM43 installation with a computer connected to the USB interface might resemble Figure 2. In this example, a computer is present to collect all the data from onboard instruments and also to send steering commands to an autopilot and send waypoints to the GPS. The GPS provides position information while the autopilot provides heading. Any other instruments, such as a chartplotter, may obtain the combined data from the OUT terminal. The hi-speed interfaces (INh, OUTh) are for AIS, Radars and other equipment operating at 38.4K baud.

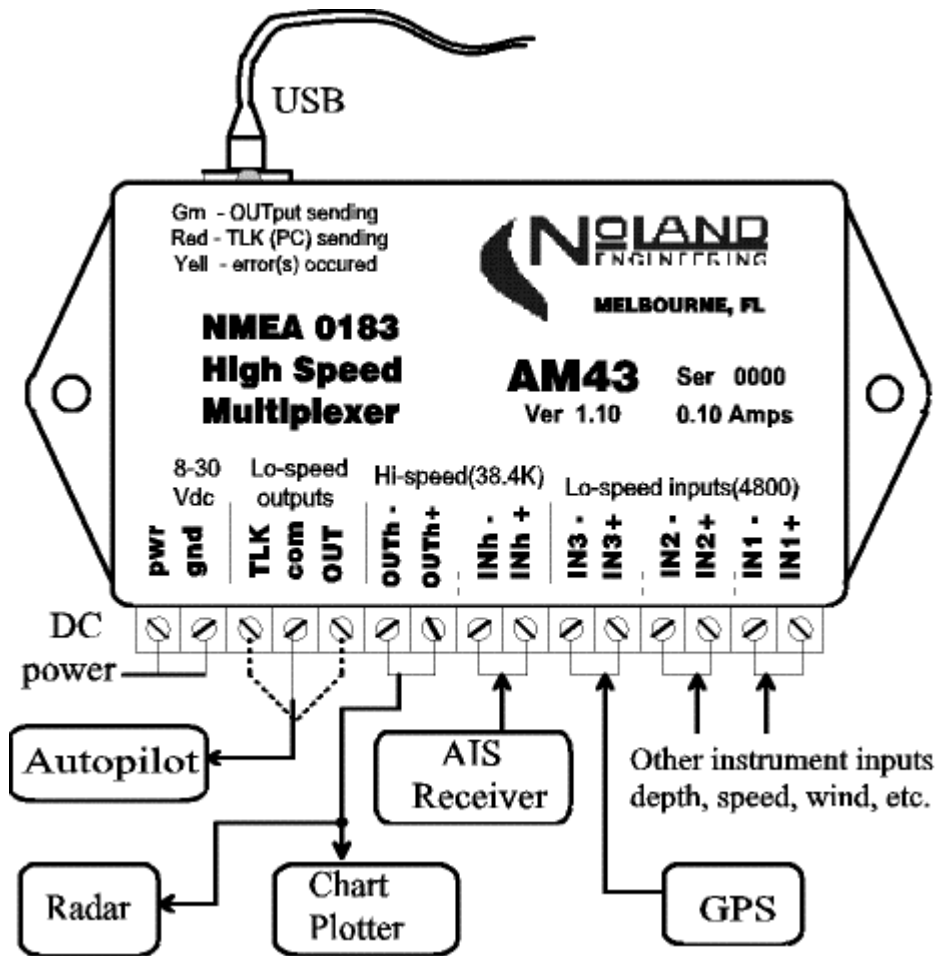


Figure 3. Typical Installation

The AM43 can also be used without the USB connection. To connect to a computer or other device with an RS-232 port, connect to the **OUT** terminal as shown. To connect the **OUTH** signal to an RS-232 input, use only the **OUTH+** terminal and leave the **OUTH-** terminal disconnected. Figure 3 shows the connection. An RS232 interface can also be directly connected to **OUT** or **TLK** in a similar fashion

Driver Software Installation (Windows NT,2000,XP). USB operation requires a USB Serial Port driver be installed. Updates to these procedures may be found on the 'readme.txt' file on the supplied CD-ROM.

- 1) If using Microsoft VISTA, disconnect your PC from the Internet.
- 2) Apply DC power to AM43. Disconnect or turn off all inputs.
- 3) Insert "AM43 Driver Disk" into disk drive of computer.
- 4) Connect USB cable from your PC to the AM43.
- 5) When the "New Hardware Wizard" window appears, DO NOT let "Windows" search for the Driver. (You will select the location).
- 6) Continue on through the Wizard and select "Install from specific" location when that option appears.
- 7) Point the Wizard to your CD-Rom "Drivers" directory and continue. Ignore warning message about "Digitally Signed Driver"
- 8) When finished, your AM43 is ready to use with your PC.

Software driver installation is complete. To determine which COM port number was assigned to the USB serial port, look under Windows "Device Manager, "double click ports (COM and LPT), and look for "USB Serial Port (COM #)". If any problems occur, please reference the "Readme.txt" file on the "AM43 Driver CD" installation disk.

3. OPERATION

Once the AM43 is installed and power is applied, the unit begins operating automatically. A flashing green LED indicates data is being received by one or more of the inputs. NMEA 0183 sentences sent by the PC (via USB) will cause the red LED to flash. Any errors in the data will cause a half-second yellow flash. Any reconfiguration of the AM43 must be done through the USB connection and a simple terminal program (see Appendix A).

Status LED. A multicolor LED sits in a recess on top of the AM43. The colors and their meaning are summarized in Table 2. The LED will only show one color at a time as determined by its priority. Yellow has highest priority to show an error has occurred. Red has next highest priority and will be seen when data is sent to the TLK output. Green will only show if neither of the other colors is displayed and data is received by an input.

Table 2. LED Status Meanings

Color/State	Priority	Meaning
Yellow Steady ~ 1/2 sec	highest	An error has occurred, and an error identification sentence is being sent to the PC.
Red Flickering	middle	A valid sentence from the PC (via USB) is being sent to the TLK output.
Green Flickering	lowest	A valid sentence from one of the four inputs is being sent to the outputs.

Whenever the yellow LED is displayed, an error message is sent to the USB interface. The yellow color remains lit for approximately 1/2 second. This makes it easier to discriminate from the red color. Refer to "Troubleshooting" (section 4) for more about the error messages.

Data Combining. Combining data from marine navigational instruments is the primary function of the AM43. Under the NMEA 0183 Standard, all data is transmitted as ASCII characters assembled into specific sentences. The format of every sentence is defined in the Standard.

Every sentence begins with a dollar sign (\$) and ends with a carriage return and linefeed, (<CR><LF>). Immediately following the "\$" is a five character identifier which defines the type of instrument and the specific sentence being sent. Following the identifier are data fields separated by commas.

Encapsulation sentences are a recent addition to the NMEA standard introduced with AIS. They begin with a “!” rather than a “\$”, and the data is illegible in a Terminal Window because of its encoding, which is not standard ASCII like NMEA 0183 data. Encapsulated data is used little outside AIS instruments. The AM43 will pass encapsulation sentences through **INh** only.

To view NMEA 0183 data, a terminal program such as “Hyperterminal” is needed.. The following settings are used to view NMEA 0183 data:

Baud Rate	4800 (38,400 for -HS Standard)
Data Bits	8
Parity	none
Stop Bits	1
Flow Control	none

NMEA 0183 devices may be either talkers or listeners or both. Data is typically sent once each second.

4. TROUBLESHOOTING

A useful feature of the AM43 is the detection and reporting of errors. There are five types of errors, which can be detected, in any of the five internal channels (4 inputs + talker). An error message identifies both the channels and types of errors that have occurred. It is available at both the USB interface and the **OUT+/OUT-** terminals. The error message is sent simultaneously with the error LED (yellow) being displayed.

The error message identifies the error channels and types with an alphanumeric code. The format is as follows:

\$PNOLE, c, t

where *c* represents an alphanumeric code identifying the error channel(s), and *t* represents an alphanumeric code identifying the error types.

The codes for a single error and their meaning are presented in Table 3. The error message is sent only once each half second when errors are present. The message will contain a summary of all error channels and types which occurred during the previous interval (~1/2 sec).

Table 3. Single Error Codes

CODE	ERROR CHANNEL	ERROR TYPE
1	IN1	sync
2	IN2	char
4	IN3	dolr
8	INh	lnfd
G(16)	TLK	ovfl

The meaning of the error types is as follows:

- sync** This is a synchronization, or framing, error caused by an invalid START or STOP bit, usually from corrupted data.
- char** This is a character error which occurs when an 8-bit ASCII character is detected.
- dolr** This is an error generated when a “\$” (start of sentence) character is not received when expected.
- lnfd** This is an error generated by a missing linefeed character or a sentence containing too many characters.
- ovfl** This is a buffer overflow error which occurs when more data is coming into the AM43 than it can send out.

In most instances only a single channel will have an error, but there may be several errors occurring during the reporting interval. For example, synchronization errors will usually occur simultaneously with character errors and possibly dollar and/or linefeed errors. If an input is connected or disconnected “on-the-fly” while it is sending data, an error will most likely occur. If an input is reverse polarized, it will generate continuous error messages about twice per second.

As an example, the sentence

\$PNOLE,4,7

indicates that **IN3** had **sync**, **char**, and **dolr** errors. We know this because 7 is the sum of 1(sync) + 2(char) + 4(dolr). Each of the five types of errors is assigned a binary power (1, 2, 4, 8, F). The sum of any of these binary powers equals a unique number, which can be decomposed into the simple error types. F quantities over 9, letters are used to represent the quantities 10(A), 11(B), 12(C), 13(D) ... and so on.

The encoding of the error channel follows this same scheme used for error type. Table 4 provides codes, which represent multiple error types and multiple error channels. The “TLK” error code and the “ovfl” error code are not shown in Table 4, because they rarely occur in practice. If a “TLK” or “ovfl” error occurs with other errors, Table 5 can be used to decipher the codes.

Table 4. Multiple Error Codes

CODE	ERROR CHANNEL(S)	ERROR TYPE(S)
3	IN2 + IN1	char + sync
5	IN3 + IN1	dolr + sync
6	IN3 + IN2	dolr + char
7	IN3 + IN2 + IN1	dolr + char + sync
9	INh + IN1	lnfd + sync
A(10)	INh+ IN2	lnfd + char
B(11)	INh + IN2 + IN1	lnfd + char + sync
C(12)	INh + IN3	lnfd + dolr
D(13)	INh + IN3 + IN1	lnfd + dolr + sync
E(14)	INh + IN3 + IN2	lnfd + dolr + char
F(15)	INh + IN3 + IN2 + IN1	lnfd + dolr + char + sync

Table 5. Multiple Error Codes including TLK & ovfl

CODE	ERROR CHANNEL(S)	ERROR TYPE(S)
H(17)	TLK+IN1	ovfl+sync
I(18)	TLK+IN2	ovfl+char
J(19)	TLK+IN2+IN1	ovfl+char+sync
K(20)	TLK+IN3	ovfl+dolr
L(21)	TLK+IN3+IN1	ovfl+dolr+sync
M(22)	TLK+IN3+IN2	ovfl+dolr+char
N(23)	TLK+IN3+IN2+IN1	ovfl+dolr+char+sync
O(24)	TLK+INh	ovfl+lnfd
P(25)	TLK+INh+IN1	ovfl+lnfd+sync
Q(26)	TLK +INh+IN2	ovfl+lnfd+char
R(27)	TLK+INh+IN2+IN1	ovfl+lnfd+sync
S(28)	TLK+INh+IN3	ovfl+lnfd+dolr
T(29)	TLK+INh+IN3+IN1	ovfl+lnfd+dolr+sync
U(30)	TLK+INh+IN3+IN2	ovfl+lnfd+dolr+char
V(31)	TLK+INh+IN3+IN2+IN1	ovfl+lnfd+dolr+char+sync

Testing with Status LED

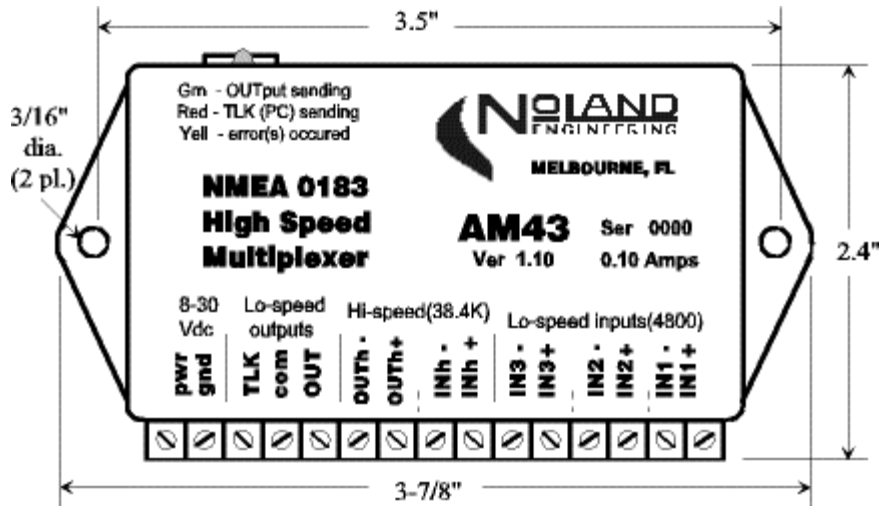
The LED provides a convenient means to test the AM43 in place. This is because the AM43 will always produce an output whenever any of the five input channels (4 + talker) is stimulated. If valid data is detected, the LED will flash red, yellow, or green as appropriate and data will be sent to the proper output.

If an input has invalid data, the error LED will light and an error sentence will be transmitted identifying the problem. If a computer is connected to the AM43, the error message can be observed with a terminal program such as "Hyperterminal." These tests are simple, requiring no special equipment.

5. AM43 TECHNICAL SPECIFICATIONS

Supply Voltage	8-30 VDC
Supply Current	50 mA. max
Input Drive Voltage	2-14 V (Active State)
Input Impedance	1K Ohms (Min.)
OUTh Output drive	4V Differential (RS-422)
Output drive (OUT, TLK)	4V, 50 mA. (max)
INh/OUTh baud rate	4800 – 38,400 (selectable)
Size	3.5" x 2.4" x 0.9"
Weight	6 oz.

WARRANTY. NoLand Engineering, Inc., provides a two-year replacement warranty against manufacturing defects and component faults. Inquiry for warranty replacement may be made directly to NoLand Engineering via phone, fax, or e-mail. Include the model number and serial number of your unit with any inquiry.



APPENDIX A Programming Instructions

Introduction. The AM43 is capable of accepting certain commands and taking appropriate action such as a device reset. The commands are also used to configure various options, such as baud rate selection. All programming is done through the PC (USB) interface.

Although programming can be done while the unit is operating, it is easier to stop data flow while programming is being done. This can be done with the “stop device” command, or all inputs can simply be disconnected or turned off. With the device connected to a computer, a terminal window (e.g., Hyperterminal) is used for programming.

Commands typed into the terminal window are sent to the AM43, which will check their validity and take appropriate action. All commands begin with an “@” character followed by another character which defines the action to take. Some actions will need additional characters (options) to more specifically define the action. A list of command characters and options is given in Table A-1.

Programming Example

An example will demonstrate how to program the AM43. With the device connected to a computer and a terminal window open and configured for the correct COM port, we are ready to send a command. If the device is currently receiving data, we can stop the data flow by typing

@<

This causes the data flow to stop. If we now type

@?

We will get a list of the current configuration options.

TABLE A-1 AM43 Commands (Factory presets are shown in **bold**.)

Command	Action	Options	Comments
<	Stop device	(n/a)	Stop data flow (i.e., for programming)
>	Reset (restart) device	(n/a)	Same as power disconnect-reconnect
?	Help / query configuration	(n/a)	Shows help / shows current device configuration
B or b	High baud rate (INh/OUTh)	0,1,2,3	4800, 9600, 19200, or 38400
I or i	IN1 baud rate select	0 ,1	0 4800 1 9600
T or t	OUT-TLK switchover	0, 1	0 Enable 1 Disable
E or e	Error reporting on/off	0, 1	1 OFF 2 ON

Assume you now want to reconfigure the high baud rate for 19,200. By typing **@B2** the high baud rate will be reconfigured to 19,200. It will remain configured this way unless it is reconfigured sometime in the future. To verify the configuration change was accepted, you can again type **@?** which will show the current configuration. In this particular case, the actual baud rate change does not take effect unless power is removed and reapplied (forced reset) or the ‘reset’ command (**@>**) is sent.

The “@I” command is rarely used but is available for certain specialized users. It is used to increase **IN1** baud rates to 9600.

The “@E” command turns error reporting on or off. Turning error reporting off does not affect operation of the error (yellow) LED.

The “@T” command, **OUT-TLK** switchover, is described in “**TLK** output”.

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