

NOVATECH INSTRUMENTS

INSTRUCTION MANUAL

Model DDS8mh, Precision Programmable DDS Clock Generator

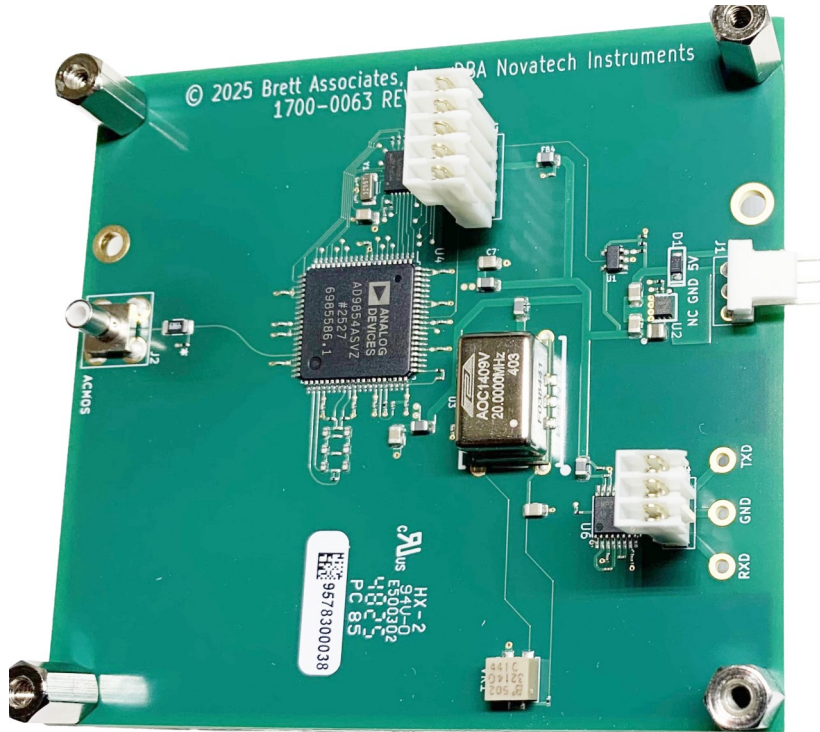


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1.0 DESCRIPTION

1.1 The Model DDS8mh is a 48-Bit Direct Digital Synthesized (DDS) Clock Generator on a small circuit board with an asynchronous serial control port (RS232). The DDS8mh provides one programmable 3.3V CMOS output signal which can be set from 100Hz to 100 MHz in steps of 1μHz.

2.0 SPECIFICATIONS

2.1 OUTPUT

TYPE: 3.3V CMOS Output, TTL Compatible for VIH

OUTPUT IMPEDANCE: 50Ω.

PROGRAMMABLE FREQUENCY: 100Hz to 100MHz in 1μHz steps.

ACMOS/TTL AMPLITUDE: $V_{OL} < 0.5V$, $V_{OH} > 2.5V$ into 15pF load, series terminated. Rise and Fall Times $< 5ns$. Duty Factor: 45-55%. Use series or capacitively-coupled parallel termination.

2.2 CONTROL

Output frequency (48-bits) controlled by sending text commands over a bit-serial interface port (RS232) at 19.2kBaud.

2.3 ACCURACY AND STABILITY

0.3ppm at calibration. Stable to an additional $\pm 0.2ppm$ per year over the operating temperature range.

2.4 OPERATING TEMPERATURE RANGE

-40F to +160F

2.5 POWER REQUIREMENTS

+5Vdc (+4.75 to +5.25) @ $< 1.0A$.

2.6 SIZE

86mm by 88.9mm. Max. height 17mm.

2.7 CONNECTORS

SMB for CMOS output, 3-pin 2.54mm header for power, 3-pin 2.54mm header or solder terminals for RS232 serial cable connection..

NOTE

There is a removable IDC protective cap on the three pin header used for serial communication. Remove this cap if using this header.

3.0 HARDWARE INSTALLATION

WARNING:

The DDS8mh contains static sensitive components. Before opening the package, follow appropriate static precautions. Failure to follow static precautions may damage the DDS8mh.

3.1 POWER CONNECTION

The input power is applied through connector J1, a 3-pin IDC header. The pin assignments are marked on the circuit board. Two of the pins are used and the third pin is not connected. The two connections are +5Vdc, and ground. A mating connector is TE Connectivity part number 3-640441-3.

3.2 POWER SUPPLY.

The quality of your power supply affects the performance of the DDS9mh. The supply should be free of ripple and noise ($< 50mV$). Even though extensive filtering is used internal to the DDS9mh, a quiet and well regulated power supply will ensure optimum performance.

3.3 SERIAL PORT.

The DDS8mh is controlled by using an asynchronous serial port (RS232) set to 19200 Baud, 8 bits, 1 stop bit, no parity and no hardware flow control.

When using a standard 9-pin D-sub connector at the host computer/controller, please note that the data **TO** the DDS8mh is on pin 3 of your connector (labeled RXD on the DDS8mh); the data **FROM** the DDS8mh is on pin 2 (labeled TXD on the DDS8mh) and the COMMON return is on pin 5 (labeled GRN on the DDS8mh).

The serial port connections can be made at the DDS8mh by using a header connected to J4 or by soldering the serial cable wires to the nearby solder points that are connected to J4. A mating IDC connector is TE Connectivity part number 3-640441-3.

DDS8mh Serial Commands are not case sensitive. End all commands with a CR or CRLF. Legal commands will return an OK. Illegal commands will return a ?0.

3.4 SIGNAL OUTPUT

There is one AC MOS clock output signal located on SMB connector J4. The output frequency is programmable from 100 Hz to 100MHz. The factory default output frequency is 10MHz.

3.5 MOUNTING

Six mounting holes are provided on the board. These holes are electrically connected to circuit common and may be used for shield connections. Clearance is provided for up to 3mm on the bottom side when mounting to a conductive chassis or case. The hole size is 3.15mm.

NOTE:

The DDS8mh is cooled by convection. Verify that there is adequate free air flow around the board when mounting in an enclosure. Approximately three Watts are dissipated.

Hole Number	(x,y) Location in mm
1	5.08, 3.81
2	22.86, 3.81
3	78.73, 3.81
4	78.73, 85.09
5	22.86, 85.09
6	5.08, 85.09

Table 1: Mounting Hole Locations.

Hole 1 is at the top left corner as shown on the photo on the front page of this manual. The x axis is top to bottom. The y axis is left to right.

Table 2: RS232 Serial Commands (Not case Sensitive)

RS232 Command	Function
F0 xx.xxxxxxxxxxxx	Set Frequency in MHz to nearest 1μHz. Decimal point required. <i>(Leave a space between the F0 and the xx.xxxxxxxxxxxx)</i>
E x	Echo. x=D for echo D isable, x=E for echo E nable. <i>(Leave a space between the E and the x.)</i>
S	Saves current settings in Flash memory. Saved state used as default upon next power up or Reset. Use the “CLR” command to restore to factory default values.
R	Reset. This command resets the DDS8mh. Saved settings are retained. This is the same as cycling power
CLR	Clear. This command clears saved settings and restores factory default values.
Q	Returns the current frequency setting and the firmware version number.
QUE	Returns 80 character HEX string. For factory use only.

4.0 OPERATING INSTRUCTIONS

4.1 POWER AND WARMUP

Apply +5Vdc power to the DDS8mh. It takes approximately 1 second to initialize. Commands sent during this time will be ignored or may cause erroneous operation.

Specifications are met within approximately 30 minutes after applying power.

4.2 SENDING COMMANDS

Once power is applied, all that is required for operation is to send appropriate commands to the DDS8mh using the serial port. Commands are not case sensitive and must end with any combination of Carriage Return (CR) or CRLF. See Table 2 on page 3 for a list of the valid DDS8mh commands.

The user must properly format the serial commands. An "OK" will be returned if the command is accepted. A "?0" will be returned if the command is not accepted.

Sending the Q command will return the current DDS8mh frequency setting and the firmware version number.

For maximum interface speed, it is suggested that Echoing be disabled by sending the "E D" command. This will allow the host to send characters at a faster rate.

NOTE:

The NT Terminal windows application is included with the DDS8mh. This program enables you to conveniently send commands to the DDS8mh and display the responses. It has a "COM Port" menu where you can view the available COM ports and select the COM port number that is connected to your DDS8mh. It also enables you to set the windows computer baud rate to the DDS8mh baud rate of 19200 baud.

5.0 THEORY OF OPERATION

The DDS8mh uses a Texas Instruments microcontroller that responds to serial commands and then computes and sends a 48-bit frequency tuning word to a AD9854 DDS IC.

The AD9854 DDS IC is a 48-Bit Direct Digital Synthesizer (DDS) integrated circuit. It accepts a clock signal from the DDS8mh master oscillator and generates output frequencies up to 100MHz.

The AD9854 has an internal clock multiplier to step up the frequency from the master oscillator. This stepped up clock is used to increment the phase of the AD9854 phase accumulator. The phase step size determines the output frequency. This phase step size is computed from the frequency tuning word sent from the microcontroller. The stepped up master oscillator clock signal advances the phase on every clock cycle and this creates the output frequency.

The DDS8mh master oscillator determines the frequency accuracy of the DDS8mh. The DDS8mh uses a precision 20MHz Voltage Controlled Oven Controlled Crystal Oscillator (VCOCXO) as the master oscillator. The frequency of this oscillator can be fine tuned using an on board tuning potentiometer.

The 3.3V CMOS output from the AD9854 DDS IC is connected through a 50Ω resistor to an SMB connector.

6.0 PERFORMANCE/FUNCTIONAL TEST

6.1 SETUP

Power up the DDS8mh and connect your host controller.

NOTE:

Allow the DDS8mh to warm up for at least 30 minutes.

6.2 VERIFY FREQUENCY ACCURACY

Set the DDS8mh output sequentially to each value in the Frequency Test Point Table 4. Connect a frequency counter with a ± 0.01 ppm or better timebase, 50Ω termination and 0.01 Hz resolution to the DDS8mh SMB output connector J2. Verify that the DDS8mh meets the accuracy specification shown in Table 4.

6.3 AC MOS VERIFICATION

Using a short 50Ω coaxial cable, connect the DDS9mh output (J2) to the recommended oscilloscope set for 50Ω termination. Using the values of Table x, verify that the output duty factor ranges from a minimum of 45% high and 55% low to a maximum of 55% high and 45% low.

Set the frequency to 10kHz. Change the termination from 50Ω to $1M\Omega$ on the oscilloscope. Verify that the 50Ω amplitude is 1/2 that of the $1M\Omega$ amplitude.

6.4 CALIBRATION

The DDS8mh has one adjustable component. This is potentiometer labeled VR1 on the circuit board. VR1 is a five turn trim pot that can be used to change the output frequency by about ± 0.9 ppm. Calibration should be performed only if the DDS8mh fails the performance test or is repaired. Routine adjustments are not recommended nor generally required.

The adjustment in paragraph 6.5 will set the DDS8mh to 1/10 the specification limit frequency values.

NOTE:

Allow the DDS8mh to warm up for at least 30 minutes before performing this adjustment.

Table 3 Recommended Test Equipment

Item	Minimum Specification	Recommended
Oscilloscope	300 MHz 50 Ω	Tektronix TDS3032B
Frequency Counter	350 MHz	HP53132A
Counter Time Base	10 MHz < ± 0.01 ppm	Novatech Instruments Model 1450B Rb Std.

Table 4 Frequency Test Points

Frequency	Tolerance
100kHz	± 0.03 Hz ± 1 LSD
10MHz	± 3 Hz ± 1 LSD
50MHz	± 15 Hz ± 1 LSD
99MHz	± 30 Hz ± 1 LSD

6.5 FREQUENCY ADJUSTMENT USING VR1.

Send an "F0 10" command to the DDS8mh to set the frequency to 10MHz and monitor the frequency with the recommended frequency counter. Use a small straight slot screw driver and adjust VR1 to obtain a reading of 10MHz ± 0.3 Hz

WARRANTY

NOVATECH INSTRUMENTS warrants that all instruments it manufactures are free from defects in material and workmanship and agrees to replace or repair any instrument found defective during a period of one year from date of shipment to original purchaser.

This warranty is limited to replacing or repairing defective instruments that have been returned by purchaser, at the purchaser's expense, to NOVATECH INSTRUMENTS and that have not been subjected to misuse, neglect, improper installation, repair alteration or accident. NOVATECH INSTRUMENTS shall have the sole right to final determination regarding the existence and cause of a defect.

This warranty is in lieu of any other warranty, either expressed or implied, including but not limited to any warranty of merchantability or fitness for a particular purpose. In no event shall seller be liable for collateral or consequential damages. Some states do not allow limitations or exclusion of consequential damages so this limitation may not apply to you.

All instruments manufactured by NOVATECH INSTRUMENTS should be inspected as soon as they are received by the purchaser. If an instrument is damaged in shipment the purchaser should immediately file a claim with the transportation company. Any instrument returned to NOVATECH INSTRUMENTS should be shipped in its original shipping container or other rigid container and supported with adequate shock absorbing material.

This warranty constitutes the full understanding between NOVATECH INSTRUMENTS and the purchaser and no agreement extending or modifying it will be binding on NOVATECH INSTRUMENTS unless made in writing and signed by an authorized official of NOVATECH INSTRUMENTS.

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