NOVATECH

INSTRUMENTS

INSTRUCTION MANUAL

Model 409C, 171 MHz, 4-Channel Signal Generator

Model 409C

Table of Contents

409C Rear Panel

NOTE:

This manual applies to Model 409C with Firmware version 0.3 or later.

1.0 DESCRIPTION

1.1 The Model 409C is a four-channel Direct Digital Synthesized (DDS) Signal Generator in a small table top case with USB serial control. The 409C provides four independent, phase-synchronous sine wave output signals, which can be set from 0.0 Hz (DC) to 171 MHz in 0.1 Hz steps

1.2 A Table feature enables users to store frequency, phase, amplitude and dwell time. The 409C can then run through the table automatically or step through it on command from the serial port or from an external hardware trigger.

1.3 The 409C has a rear panel 14-pin header connector (J8) that enables the user to synchronize output updates using external hardware triggering.

1.4 The –AC option provides two rear panel mounted SMA connectors that can also be used to trigger and synchronize 409C output updates using external hardware triggering.

1.5 The /R option adds a rear panel BNC connector that accepts an external 10MHz reference input. This option phase locks the internal master oscillator to the external reference, with no binary round-offer errors. When this feature is used the accuracy and stability of the output are equal to those of the reference.

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2.0 SPECIFICATIONS

2.1 OUTPUTS

TYPES: Four independently programmable, phase synchronous, sine wave outputs.
IMPEDANCE: 50Ω.
RANGE: 0.0 Hz to 171 MHz in 0.1 Hz steps (Sine out, int. clock).
SINE AMPLITUDE: Programmable from 0.000 to 1.000 Vpp into 50Ω.
PHASE: Programmable from 0 to 359.99 degrees.
FLATNESS: ±3dB from 1 kHz to 150 MHz referenced to amplitude at 35 MHz, full scale.

2.2 TABLE

Stores up to 14,250 rows containing frequency, phase, amplitude, row number and a dwell time in non-volatile memory. Each row can contain data for up to four output channels.

2.3 CONTROL

Output frequencies (32-bits), amplitudes (10-bits) and phases (14-bits) are controlled by sending commands from the USB serial port or by executing rows saved in the 409C table. All outputs and other settings can be saved in non-volatile memory.

2.4 FREQUENCY ACCURACY AND STABILITY

Accuracy: <±1.5ppm at 10 to 40°C. Stable to an additional ±1ppm per year, 18 to 28°C. (Internal Clock)

2.5 EXTERNAL REFERENCE (/R OPTION): External Reference must be 10 MHz, ±5ppm. Automatically detected. Internal clock is locked to and tracks this value. Level must be 0.2 to 0.5 Vrms, sine or square wave, 50Ω.

2.6 SPECTRAL PURITY

(Typ. 50Ω load, Internal Freerunning Clock, full-scale output)

Phase Noise: <-120dBc, 10 kHz offset, 10 MHz out.

Spurious:

<-60dBc below 10 MHz (typ. 300MHz span)
<-60dBc below 40 MHz
<-55dBc below 80 MHz
<-50dBc below 160 MHz

Harmonic:

<-65dBc below 1 MHz
<-55dBc below 20 MHz
<-45dBc below 80 MHz
<-35dBc below 160 MHz
(channel-channel isolation: <-60dBc)

2.7 POWER REQUIREMENTS
+4.5 to +5.5 VDC < 1 Amp. AC adapter provided.

2.8 SIZE
39mm H, 107mm W, 172mm L, not including connectors.

2.9 CONNECTORS
BNC for Sine Outputs. USB 2.0 Type B female for USB Serial Control. 2.5mm center positive power receptacle for +5 volts input. 14 pin header for logic I/O.

2.10 LOGIC I/O (J8 AND –AC OPTION)
Voh >=2.4V and Vol <=0.4V when series terminated. Output Rise and fall times <100ns.

2.11 OPTIONS
OPTION /R: Adds rear mounted BNC connector to accept external 10MHz clock input.

OPTION -AC: Provides SMA connectors on the rear panel for IOUD and TS signals. The SMA connectors serve the same function as pins on the rear mounted J8 header connector. The J8 connector is a standard feature on the 409C.

3.0 HARDWARE INSTALLATION

3.1 Power Connection. The input power is applied through a 2.5mm center-positive power connector on the rear panel. A solid green light on the front panel LED indicates power is on.

3.2 Power Supply. The quality of your power supply affects the performance of the 409C. The supply should be free of ripple and noise (<50mV). Even though extensive filtering is used internal to the 409C, a quiet and well regulated power supply will ensure optimum performance. The supplied AC-adapter has been tested for proper operation.

3.3 USB Serial Interface Installation. The 409C is controlled from a computer that must have a USB driver made by Silicon Labs. This driver can be found at https://www.silabs.com/developers/usb-to-uart-bridge-vcp-drivers. A Silicon Labs VCPdriver for Microsoft windows is included on the USB memory stick that comes with the 409C. To install this driver select the CP210xVCPInstaller… application that matches you computer and run it.

Connect the 409C to your computer using the provided cable. The USB Type A connector on the cable plugs into your computer and the USB Type B connector plugs into the 409C. After the 409C is connected to a computer with the Silicon Labs USB driver installed, the computer will automatically create a virtual COM port.

3.5 Virtual COM Port Settings. The Default settings for the 409C COM port are 115.2 kBaud, 8 bits, 1 stop bit, no parity and no hardware flow control.

NOTE:

*The **SOF8_409C** windows application is included with the 409C. This program has a "COM Port" menu where you can view the available COM ports and select the COM port that is connected to your 409C. The SOF8_409C software automatically sets your selected COM port to the 409C default COM port settings.*

3.7 Serial Commands. Commands are not case sensitive and must end with any combination of Carriage Return (CR), Line Feed (LF) or CRLF. A response code is returned after sending a command. See Table 1 for a list of the response codes and Tables 2 and 3 for a list of the serial commands.

3.8 Query Command. The **Q** command returns the present state of the 409C non-volatile parameters. See Tables 2 and 3 for an explanation of the values returned by the **Q** command.

```
Q
F0=4.0000000 P0=0.00 V0=1.000
F1=10.0000000 P1=0.00 V1=1.000
F2=10.0000000 P2=0.00 V2=1.000
F3=10.0000000 P3=0.00 V3=1.000
VS=1 M=N I=A TSCALE=1
TRNG=00000 - 14249
TS input: Disabled
Firmware version: 0.3
OK
```

Table 1 Response and Error Codes

Error Code	Meaning
OK	Good Command Received
?0	Unrecognized Command
?1	Invalid Frequency
?4	Invalid Phase
?6	Invalid Parameter
?7	Invalid Amplitude
?8	Invalid Baud Rate
?A	Invalid Amplitude
?C	Invalid Channel Number
?D	Invalid Dwell Time
?E	Empty Row in Active Range
?F	Invalid Frequency
?M	Invalid Parameter
?N	Invalid Table Row Number
?P	Invalid Phase
?R	Table is Running
?T	Invalid Table Command
?V	Invalid Calibration Value
?W	Invalid Active Row Range

3.9 Connector J8. The J8 header connector provides access to the IOUD and TS signals. It is mounted on the rear panel. The pin numbers from left to right when facing the rear panel are 13, 11, 9, 7, 5, 3, 1 (top) and 14, 12, 10, 8, 6, 4, 2 (bottom). +IOUD is on pin 1 and +TS is on pin 3. The other odd number pins are not used. All bottom row, even numbered pins are grounded. A plug compatible, six inch long, 14-pin ribbon cable is included.

3.9 Rack Mounting. An optional 1U rack adapter is available for mounting up to four 409C into a rack panel.

4.0 OPERATING INSTRUCTIONS

4.1 Apply Power

Plug the 5Vdc connector from the AC Power Adapter into the rear panel connector labeled 5V.

After power is applied, the 409C takes approximately 500ms to initialize. Commands sent during this time will be ignored or may cause erroneous operation. After all the power is applied and all signal cables and serial communication cables are installed and operating , send the 409C the "R" (Reset) command .

4.2 Warmup. Specifications are met within approximately 15 minutes of power up.

4.3 Commands. After the 409C has been installed in the customer application system, all that is required for operation is to send the appropriate serial commands as shown in Tables 2 and 3 on pages 5 and 6.

4.4 Response Codes. The user host computer software must properly format the serial commands. Incorrect formatting will result in a response error code being returned. See Table 1 for a list of response error codes.

4.5 Echo. For maximum interface speed, it is suggested that Echoing be disabled by using the "E d" command. This will allow the host to send characters at a faster rate. Even when Echo is disabled, the 409B will respond with an "OK" for a correctly received data command.

4.6 Baud Rate. A special command, "Kb x", is available if you wish to set a baud rate that is different from the default of 115.2KBaud. The value set by this command is volatile and not saved in EEPROM. Upon power up, reset or clear, the 409B defaults to 115.2KBaud. The available "Kb x" commands are:

KB 0 sets baud rate to 9600
KB 1 sets baud rate to 19200
KB 2 sets baud rate to 38400
KB 3 sets baud rate to 57600
KB 4 sets baud rate to 115200 (default)
KB 5 sets baud rate to 230400
KB 6 sets baud rate to 460800

4.7 Phase Alignment. Phase relationships are maintained by appropriate use of the "M" and "I" commands. The "M" command has special modes "M a" and "M n". "M a" means automatically clear phase at the end of each command. This will clear the phase register each time any command is performed. This is important when all outputs must be phase aligned. However, it will cause a phase jump in the output.

Table 2: Serial Commands (Not Case Sensitive)

Serial Command	Function
Fn xxx.xxxxxxx	Set **Frequency** of output "n" in MHz to nearest 0.1Hz. n=0, 1, 2 or 3. Decimal point not required. 0.00 sets a channel to DC. Maximum setting: 171.1276031 MHz. Single tone mode.
Pn xxx.xx	Set **Relative Phase** of output "n" in degrees. n=0,1,2 or 3. xxx.xx = 0.00 to 359.99. Single tone mode.
Vn x.xxx	Set the **Amplitude** of output channel "n". n=0,1,2 or 3. The amplitude indicates the signal level in Vpp when driving a 50 ohm load. Maximum amplitude setting is x = 1.000 . The default amplitude is set to the maximum. If the amplitude scale factor is not 1, the Vn command specifies the output amplitude before the amplitude scale factor is applied.
Vs n	Set the output **Amplitude Scale Factor**. n=1 for full scale, n=2 for one half scale, n=4 for one quarter scale and n=8 for one eighth scale. All channels are scaled equally
E x	Serial **Echo** control. x=D for Echo Disable, x=E for Echo Enable
R	**Reset.** This command resets the 409C to the same state as after power-up or cycling power, except the baud rate remains unchanged (cycling power will reset the baud rate to 115.2KBaud).
CLR	**Clear.** This command resets all factory default values except for the values stored in table memory. Use the **TCLEAR** command to reset the table to an empty state.
S	**Save.** Saves Frequency, Amplitude, Amplitude Scale Factor, Relative Phase, Phase Reset Mode, Update Mode, Active Table Range, Table Dwell Scaling and Echo settings to flash memory. Does not save the Table Rows. Use TSAVE to save Table Rows. Saved values will be the default settings upon next power up or reset. Use the "CLR" command to return to factory default values.
Q	Returns the current values of the non-volatile settings and the firmware version.
M x	**Phase Mode**. x=n means the phase will not be reset with every update. This is the default mode. x=A means the phase will be reset on every update. x=S will force a manual update on all phases.
I x	**I/O Update (IOUD).** If x=a, then an IOUD update pulse is automatically sent at the end of each serial command. This is the default. If x=m, then an IOUD update pulse must be sent manually. If x=p then a manual IOUD update pulse is sent. If x= e, then the IOUD is changed from an output to an input. If x=s, then external TS inputs are enabled. If x=d the external TS inputs are disabled.

Table 3: Serial Commands For Table (Not Case Sensitive)

Serial Command	**Table Functions** (A bracket set […] indicates optional parameters)
T r d c f p a [c f p a] [c f p a] [c f p a]	**T Command.** Enters a row into the table. Where r=row, d=dwell, c=channel, f=frequency, p=phase and a=amplitude. One channel set consisting of 'c f p a' values is required. Up to three additional channel sets as indicated by [...] is optional. The entire T command must be on one line.
TSCALE x	**Dwell Scaling Command.** 'x' can be 1 or 4. x=1 is the default and sets the maximum dwell time to 8191.875 microseconds. If x=4 then all the dwell times are multiplied by 4 and the maximum dwell time becomes (4 x 8191.875 = 32.7675) milliseconds. Parameter 'x' is saved using the 'S' command.
TSAVE	**Save to Flash Command**. The T Command creates table data in RAM memory. The TSAVE command saves this RAM table data to flash memory. The table only operates on data that is in flash memory.
D x y	**Display Table**. Reads and displays the table values from row x to row y.
TRNG x y	**Table Range Command**. Makes a range of rows in the table **Active**. The TRUN and TONCE commands only operate on the Active rows. The active rows start at row x and include all rows up to and including row y. Default is the entire table from row 0 to 14249. The
TRUN [x y]	**Run Table Command.** Saves all table rows to flash memory if they have been entered but not saved and starts the table continuously looping through the active table rows. If the optional x and y parameters are entered then the table will loop from row x to row y. Also sets the IOUD signal to an output and disables the TS hardware inputs.
TONCE [x y]	**Run Table Once Command**. Saves all table rows that have been entered but not saved and causes the table to run once through the active table rows. If the optional x and y parameters are entered then the table will run once from row x to row y. Also sets the IOUD signal to an output and disables TS hardware inputs.
TSTOP	**Stops** the table from running. The state of the channels will be the sames as they were when the table was stopped.
TS [x]	**Table Step Command.** Causes the table to move to the next active row. Does not save table data in RAM to flash memory. You must use the TSAVE command to save to RAM. If the optional 'x' parameter is included it causes the table to go to row x.
TCLEAR	**Clear Table Command.** Resets all table rows in the table flash memory to the empty state.

4.8 Phase Synchronous. The "M n" command turns off the automatic clearing of the phase register. This is the default mode. In this mode, the phase register is left intact when a command is performed. Use this mode if you want frequency changes to remain phase synchronous, with no phase discontinuities.

4.9 Command Execution. Further control of phase relationships and timing of command execution can be exercised by using the "I x" commands. The default mode is automatic (x=a) in which a command is parsed and executed immediately following the end of the serial input sequence. In manual mode (x=m), an update pulse will not be sent to the DDS chip automatically. This is useful when it is important to change all the outputs to new values simultaneously. Use external triggering or the "I p" command to cause a manual update. Sending "I x" where x=e, x=s or x=d controls the function of the IOUD and TS control logic. (See Section 9)

4.10 Amplitude Matching. For applications which require precise amplitude matching between the channels, the recommended method is to use the "Vn x.xxx" command to adjust the channels to match.

4.11 Table Mode. The Model 409C contains Flash memory capable of storing up to 14249 rows of data in a table format. Each row can specify the frequency, phase and amplitude of each channel in any combination of channels. Any channels that are not specified in a row will not change when the row is run. The row also stores a dwell time that specifies how long the channel settings specified by the row are held before stepping to the next row. The dwell time is only used when running the table. To run the table send a **TRUN [x y]** or **TONCE [x y]** command. You can also manually step through the table using the **TS [x]** command. The table mode enables you to update the 409C outputs very quickly since running the table eliminates the need to communicate over the USB port every time you send a frequency, phase and/or amplitude command.

4.12 Dwell Time. When running the table, one row is in dwell mode at the same time the next row is being loaded into the AD9959 registers. To allow time for this loading there is a minimum dwell time requirement that is a function of the size of the following row. This limit is as follows:

13 microseconds when next row has 1 channel
19 microseconds when next row has 2 channels
25 microseconds when next row has 3 channels
31 microseconds when next row has 4 channels

The resolution and range of the dwell time is controlled by the **TSCALE** command. **TSCALE** can be set to 1 or 4. **TSCALE** = 1 is the default and sets the allowable range from the minimum above to 8191.875 microseconds. Setting **TSCALE** = 4 multiplies all existing dwell times by 4 and makes the allowable range the minimum to 32.7675 milliseconds.

4.13 Table Data Entry. The T command along with the **TSAVE** command are used to enter data into the 409C Table. An example T command for entering one output channel is as follows:

T 1 100 0 10 180 0.8

In this example the row number is 1, the dwell time is 100 microseconds, there is one output channel setting and it is channel 0 which is set to 10MHz, 180 degrees phase and 0.8Vpp amplitude. Channels 1, 2 and 3 will not be changed. There must be a space separating each parameter and any channel included must contain frequency, phase and amplitude values. All T commands must be on a single line and end with a carriage return line feed. T commands store the data in RAM. The row data must be in Flash memory to operate as a table. The **TSAVE** command, the **TRUN [x y]** command and the **TONCE [x y]** command will each move any rows that are in RAM memory to table flash memory.

Another Example T command:

T 500 31 0 10 180 0.8 1 11 270 0.9 2 12 359.99 0.955 3 13 90 1

This example enters four output channels in row number 500 with a dwell time of 31 microseconds. Row 500 sets output channels 0,1,2 and 3 to frequencies 10,11,12 and 13MHz. The phases are set to 180, 270, 359.99 and 90 degrees and the amplitudes are set to 0.8, 0.9, 0.955 and 1vpp.

4.14 Display Table Contents. The **D x y** command will return the contents of the table from row x to row y. If there is no data in these rows or if some rows have no data then the **D x y** command will return "xxxx Empty Row", where xxxx is the row number, for the rows with no data.

4.15 Active Rows. The **TRNG x y** command makes the table rows from row x to row y the Active Rows. The **TRUN [x y]** command with no optional [x y] parameters causes the 409C to loop through all the active rows continuously until a **TSTOP** command is received. The **TONCE [x y]** command with no optional [x y] parameters will run the active rows one time. If you send **TRUN [x y]** or **TONCE [x y]** and include the optional x and y parameters then the active rows are from row x to row y and the 409C will step through the table from x to y continuously (**TRNG**) or one time (**TONCE**).

4,16 Single Stepping the Table. The **TS [x]** command can be used to execute any single row in the table as designated by the x row parameter. Note that the **TS [x]** command does not move table data from RAM memory to flash table memory so you may need to use the **TSAVE** command before using the **TS [x]** command. Also, you cannot use the **TS [x]** command if the table is running. If you execute the **TS** command without including the optional x parameter, then the manual steps will start at the beginning of the active row as set by the **TRNG** command. Once you manually step to the end of the active rows, the next **TS** command will take you back to the first active row.

4.24 Table Synchronization with External Events. For precision timing application it is recommended that external table synchronization be used. This involves triggering table operations using customer supplied external hardware. See Section 9 for detailed instructions.

5.0 THEORY OF OPERATION

5.1 Block Diagram. Please refer to the Simplified System Block Diagram in Figure 1 on the next page for the following discussion.

5.2 System Clock. The 409C master clock oscillator generates a frequency of 28.633,115,306666667 MHz. This is fed to the AD9959 where it is multiplied by 15 to produce a System Clock Frequency of 429.4967296 MHz.

5.2 DDS Frequency Generation. At every cycle of the 409C System Clock, the AD9959 integrated circuit increments the phase of an internal register by a phase value calculated from the frequency command sent to the AD9959. The AD9959 converts this phase value to a sinusoidal amplitude level and then sets the values of the on-chip 10-bit digital-to-analog converters. The analog signals from these converters are filtered by differential 7th-order elliptical low pass filters, amplified and sent to the 409C output connectors.

5.4 Maximum Frequency. The 409C theoretical output frequency is limited to a maximum of 1/2 the system clock frequency. While it is possible to generate an output near 50% of the system clock, the distortion would be unacceptable. Therefore, the 409C frequency output is limited to 40% of the 429 MHz system clock frequency by 7th-order elliptical low pass analog filters. This output limit is 171 MHz.

5.5 Lock to 10MHz Reference. When option /R is added to the 409C and an external 10MHz reference is connected to the 409C rear panel, the Master clock is phase locked to the external 10MHz reference signal and the accuracy of the Master clock is then equal to the accuracy of the external reference.

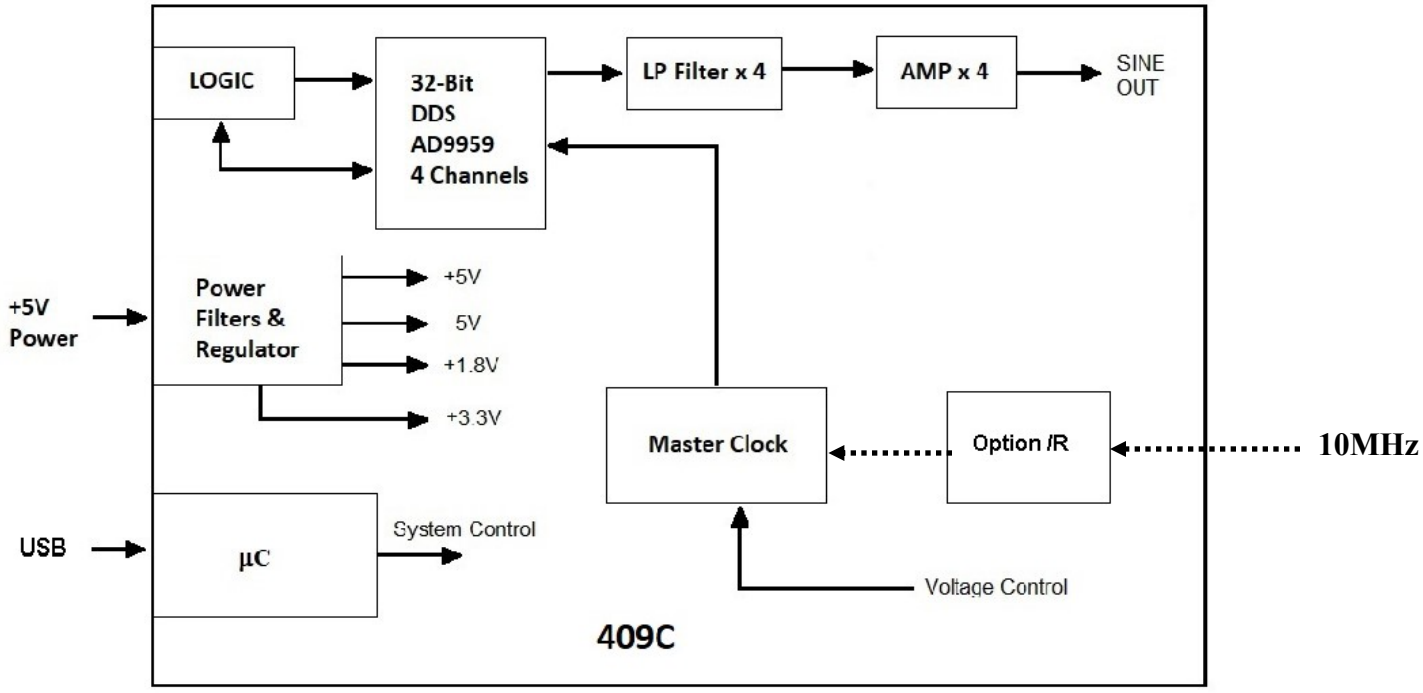

Figure 1

Simplified System Block Diagram

6.0 PERFORMANCE TEST

6.1 Setup. Power up the 409C and connect your host controller. Maintain the 409C in a stable environment of 18-28°C.

NOTE:

Allow the 409C to warm up for at least 15 minutes and verify there is a steady green light on the front panel LED before performing any measurements. For best results, the 409C should be verified in its installed environment.

6.2 Test Equipment. See Table 4 on the next page for a list of recommended test equipment to perform the following measurements.

6.3 Verify Frequency Accuracy. Set the output sequentially to each value in Table 5. Connect the recommended frequency counter set to 50Ω termination and 1 Hz resolution. Verify the limits show in Table 5. Test all channels to verify functionality of all outputs. If you do not use an external reference for the frequency counter, be sure to add the error of your counter to the tolerance.

6.4 Verify Amplitude. Set the frequency of the 409C to 10MHz. Connect the 409C to the oscilloscope set for 50Ω termination. Verify a reading of 1Vpp ±0.25Vpp on all four outputs.

6.5 Verify Amplitude Control. Leave the output frequency set to 10MHz. Send the command "Vn 0.5" to each channel, where "n" is the channel number being tested. Verify that the amplitude on each channel decreases by one-half. Send the "R" command to reset the levels before performing the next tests.

6.6 Verify Output Flatness. Set the 409C outputs to 35MHz and observe the output amplitudes. Change the 409C frequencies to the values of Table 5 on each channel. Verify that the amplitude reading remains within ±3dB (x1.414 to x0.707) of the value at 35MHz. (Limit upper frequency to 150 MHz.)

6.7 Return the 409C to normal operation and default values by sending the "CLR" command.

6.8 This concludes the performance test of the 409C.

7.0 CALIBRATION

7.1 The 409C has one adjustable component: Y2 frequency. Y2 is located on top of the master oscillator (see photo). Calibration should be performed only if the 409C fails the performance test or if the unit has been repaired. Routine adjustments are not recommended nor generally required. This procedure assumes that the 409C has failed the performance test or has been repaired.

WARNING:

Calibration of the Model 409C requires that the case be opened. Calibration should be performed only by qualified personnel. The internal components are static sensitive.

7.2 Remove the two phillips head screws on the rear panel. Tip the rear panel away from the instrument and slide the top cover off. Be careful not to unduly flex the connecting wires.

7.3 The adjustments shown are set to one half the frequency accuracy specification value.

NOTE:

Allow the 409C to warm up for at least 15 minutes before performing any adjustments. For optimum performance the 409C should be calibrated in an environment similar to its installation.

NOTE:

If your unit has the /R option installed, the oscillator adjustment is the same, except the oscillator location has moved to the adapter board.

7.4 Frequency Adjust, Y2. Set the output of the 409C to 10.0000000 MHz using the command "F0 10.0000000". Connect output of channel 0 to your frequency counter set for 50 Ω termination. Adjust Y2 using a non-metallic adjustment tool for 10.000000 MHz, ±7.5 Hz.

Table 4: Recommended Test Equipment

Item	Minimum Specification	Recommended
Oscilloscope	300 MHz 50Ω	Tektronix TDS3032B
50Ω Termination	50Ω ±1%	
Frequency Counter	180 MHz	HP53132A
Counter Time Base	10 MHz <±0.1 ppm	Novatech Instruments Model 2960AR
External Clock	400 MHz	Novatech Instruments Model 440A

Table 5: Frequency Test Points

Frequency	Tolerance
100 kHz	± 0.15 Hz ±1 LSD
1 MHz	±1.5 Hz ±1 LSD
10 MHz	±15 Hz ±1 LSD
30 MHz	±45 Hz ±1 LSD
50 MHz	±75 Hz ±1 LSD
100 MHz	±150 Hz ±1 LSD
170 MHz	±255 Hz ±1 LSD

8.0 OPTION /R: LOCK TO 10MHz REFERENCE

8.1 The /R option consists of a small circuit board that is mounted inside the 409C. It provides locking and tracking circuitry to phase lock the internal master oscillator to an external 10MHz reference.

8.2 A 10MHz reference must be connected to the rear panel BNC connector labeled 10MHz input. See paragraph 2.5 for the required specs of this signal. The 10MHz input signal is automatically detected and, if within a lock range of approximately ±5ppm, it is locked to and tracked by a narrow-band phase lock loop.

8.3 If an input signal is not detected, the unit will default to the internal free-running oscillator and perform identically to a 409C without the /R option.

8.4 The front panel LED will display four conditions:

Steady Green: unit is locked to a stable external reference or is using the internal free running master clock.

Blinking Green: unit is stabilizing to a free running condition. This occurs upon powerup or if the reference is removed.

Steady Red: unit detects an external input, but cannot lock to it.

Blinking Red: unit has detected a 10MHz external signal and is attempting to lock. This will occur if the 409C had previously been free running.

8.5 When changing the reference mode, the phase lock loop may take several minutes to stabilize to the final resolution of the 409C. Changing from a blinking LED to a stable LED indicates that the process is completing, but you should verify the outputs.

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9.0 EXTERNAL TIMING CONTROL USING J8 & OPTION –AC.

9.1 Description. Option –AC adds two rear mounted SMA connectors, labeled IOUD and TS, that can be used for triggering and synchronizing 409C outputs. These signals are in parallel with the IOUD and TS pins on the rear mounted header connector J8. The logic levels for these pins are 0V for logic 0 and 3.3V for logic 1.

9.2 IOUD Output vs Input. By default, the IOUD signal is an output indicating that the microcontroller has triggered an update. The "I e" command changes IOUD from an output to an input and requires that an external trigger pulse IOUD high to update the 409C outputs.

9.3 IOUD Used as Output. The IOUD signal is pulled down internally to ground. When the 409C microcontroller updates the 409C, it pulses IOUD high. The actual trigger happens on the rising edge of this signal and this rising edge can be read by the users hardware.

9.4 TS Input. The TS input connector is disabled by default. It can be enabled using the IS command. When enabled it functions just like the "TS" serial command. If a table is not running and the TS input is enabled, then applying a trigger signal to the TS connector will step through the active rows of the table. The TS input is pulled down inside the 409C. Pulsing the TS input high, will trigger the update on the positive edge of the pulse. An edge occurring sooner than the minimum dwell time will be ignored.

9.5 External Triggering when IOUD is an Input. The AD9959 DDS ASIC must be preloaded with a new set of values prior to applying an external IOUD trigger. Preloading is done with the TS command or by applying a trigger signal to the TS connector. Once preloaded, the 409C can be triggered to update all outputs by applying a trigger pulse to the IOUD connector. The trigger signal must pulse IOUD high, the update will happen on the rising edge.

9.6 More Precise Timing with External Triggering. Using external triggering enables the user to take control of exactly when the outputs are updated. This avoids the uncertainty regarding the exact amount of time the processor will take to move data from Table Flash to the AD9959 DDS ASIC registers. While the user must still allow upwards of 10 microseconds for this data to move, the timing of the trigger update is decoupled from this time uncertainty. Thus, this method enables the user to more easily synchronize updates with external events. External triggering can be used with the table and it can also be used without the table when the user is sending serial commands.

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.

NOVATECH INSTRUMENTS

United States of America

206.301.8986 Voice

http://www.novatechsales.com/

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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 mis-use, 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.

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