

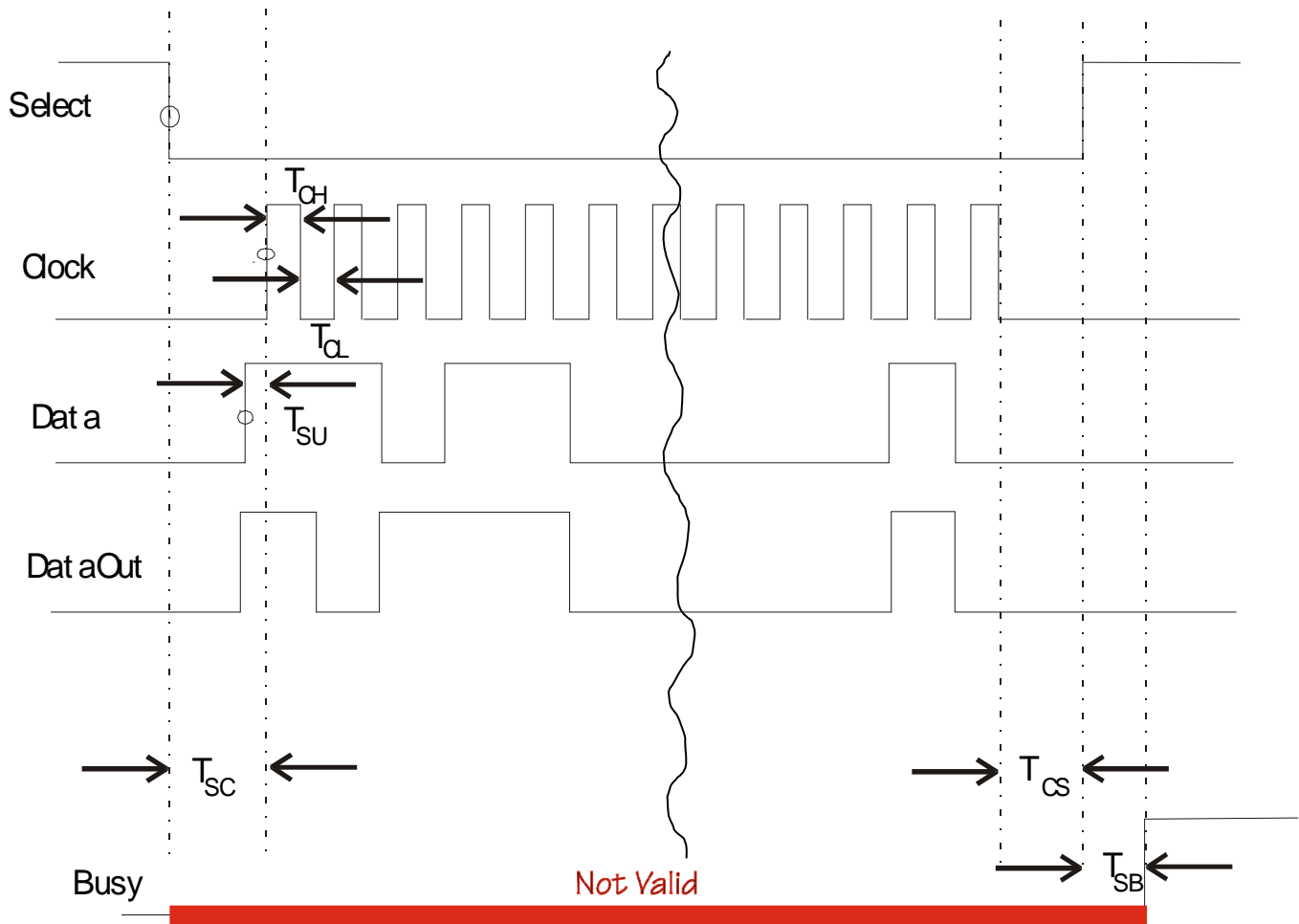
Programming Information for the Micro Lambda Multiloop Synthesizer

Rev 9 1-12-09

The MLSN or MLSW is programmed using a 5 wire bus. The lines are:

Select	Input	Active Low. Enables the shifting of data into the internal command buffer. Also serves as a command terminator when it goes HIGH. The status of the BUSY line should be checked before activating this line. Note: All command + data, command strings must be sent using a single Select Line Cycle.
Clock	Input	Data is clocked into the unit on the rising edge (Positive Edge Clocked) and Data Out is valid at this time. The maximum clock rate of this line is 50 usec. For best performance the status of the DataOut line should be checked before sending the first Clock. This line should be maintained in a LOW state at the application of Select to prevent confusion.
Data In	Input	Input data pin. Data is sent MSB first. Data must be stable 1 usec. Before the Clock line goes high and 1 usec. After the clock goes low. (Setup / Hold time)
BUSY	Output	This line is used to indicate that the unit is busy processing other commands or doing its internal housekeeping. Before sending a Select = TRUE the status of this line should be checked to ensure that it is LOW (NOT Busy). Any command initiated by setting Select Low while BUSY is High may result in lost data and uncertain results. NOTE: The unit can be programmed without using this line if sufficient time is allowed between Clocks and between commands. The time required varies between commands. <i>This mode is not recommended as there are some events that occupy the microcontroller other than the serial communications.</i>
DataOut	Output	This line is used to pass internal status information from the synthesizer. Data is guaranteed to be valid on the falling edge of the clock signal. Data is sent out MSB first. In addition, this line is used as a communication 'handshake' line. Once Select has gone LOW the DataOut line will be taken HIGH to indicate that the unit is listening. It will remain HIGH until the first data is sent out which is initiated by the first rising edge of Clock. DataOut will be returned to LOW after Select has been released. Note: with all read commands, send a 2nd "Dummy" byte for the read cycle.

In addition to the lines above there is a unit status line, LOCK Status, which is a static line which only indicates the overall health of the unit – specifically, that all of the internal phase locked loops are locked.



- $T_{sc} > 2 \text{ usec}$ select low before first clock
- $T_{cs} > 2 \text{ usec}$ clock low before chip select high
- $T_{su} > 2 \text{ usec}$ data stable before rising edge of clock
- $T_{ch} > 2 \text{ usec}$ minimum clock high time
- $T_{cl} > 2 \text{ usec}$ minimum clock low time
- $T_{sb} > 10 \text{ usec}$ (time to wait before sampling 'BUSY')

Data/Clock Setup time = $>1 \text{ usec}$.
 Data/Clock Hold time = $T_{ch} + 1 \text{ usec}$.

Note: This timing diagram supports Ver. 52 and greater MLSN / MLSW firmware. Otherwise refer to this document, Rev. 6 or earlier.

The user commands are:

Command	Description
?	Reports Status of all internal phase locked loops; three loops are indicated by bits 0, 2, and 3. The other bits are internal variables with of no particular interest to the user. Note: with read commands, send a 2nd “Dummy” byte for the read cycle.
>	Recalls the synthesizer state from the next sequential saved memory location. If the last location accessed was the 99 th , the ‘>’ would recall the 100 th location. Using this command the user can get the maximum step rate from the unit. (Used in conjunction with the NR command only.)
f	Frequency command (binary). The ASCII ‘f’ is followed by 34 bits of frequency data. The data is in straight binary format with the LSB representing 1 Hz. (i.e. 3.456789012 GHz would be commanded by: f0011001110000010100110101000010100 (‘f’ followed by CE0A6A14 Hex) Note: All command + data, command strings must be sent using a single Select Line Cycle.
F	Frequency command (ASCII). This accepts the frequency in MHz in straight ASCII format. i.e. 3.456789012 GHz would be commanded by F3456.789012. Note: All command + data, command strings must be sent using a single Select Line Cycle.
L	Sets the LOCK ALARM output polarity; L1 sets the unit for LOCK == positive true; L0 sets the unit for LOCK == negative true. (pin 13 of J1; Lock Alarm)
MW	Sets the unit for external analog sweep mode. The unit is kept ‘coarse-tuned’ to the last frequency and the external analog sweep input (Ext. WB FM) deviates the frequency approximately 2 GHz/volt. The external narrow-band FM is also enabled.
NR	Recalls a synthesizer state from the specified location. (one of 1000 saved using the NS command) ‘NR’ (ASCII) followed by a hex (Data) address of 0x0063 would recall the instrument state stored in the 99 th decimal location.
NS	Stores the present state of the synthesizer in the specified location. (One of 1000 available); ‘NS’ (ASCII) followed by a hex (Data) address of 0x0064 would store the present state of the synthesizer in the 100 th (decimal) location.
R	Programs the Reference frequency. Range 5 to 100 MHz; 1 MHz resolution. e.g. R25.0 would set the external reference frequency to 25 MHz.
RF	Turns the RF output off/on: RF0 = RF off, RF1 = RF on. Default is ON, a power supply cycle will clear RF off mode.
SP	Synthesizer Preset – Clears all nonvolatile memory settings to factory default. (>= Version 32 Firmware); Typically used to clear erroneous settings in the unit.
T	Reads internal temperature information. Responds with degrees C in a one byte response (signed char). Range: -40 to +80; Note: Since the T command is only one byte long and the command needs to be processed before the unit can acquire the temperature data, the data returned is always one command behind. Thus if you want the present temperature the T command should be sent twice and the second data used.
VF	Programs the secondary VCO frequency synthesizer (second LO opt., J3) frequency. The characters are sent in ASCII format. i.e. VF1000.0 would set the synthesizer 2 nd output PLL for 1000.0 MHz

Wideband Analog Sweep Mode: This mode allows the unit to be swept (unlocked) across its frequency range at a rate of up to 2 mS/GHz with a minimum retrace time of 10 mS. The unit can be swept at any lower speed and retrace time with no problem. The analog sweep input sensitivity is 2.0 GHz/volt. The unit will sweep from the last frequency it was set to (0 volts at the WB analog input) to the stop frequency (X.XX volts at the WB analog input) ie. 2-10 GHz, unit programmed to 2 GHz - analog sweep on, ramp = 0.0 to 4.0 Volts - 16 mS ramp / 10 mS retrace, unit sweeps 2.0 to 10.0 GHz. The WB analog sweep input accepts a differential ramp voltage in the range of +/- 10 volts and the voltage applied must keep the units frequency within its specified range. This mode is enabled using the external analog sweep command (MW1).