Model 5721 - Tunable Tri Notch Filter
486 - 750MHz

RF & MICROWAVE TECHNOLOGY

FEATURES

The UHF Tunable Tri-Notch filter is designed with 3 independent lumped element notch filters.

The design topology for the filter was selected to achieve constant absolute notch bandwidth over the 486-750MHz frequency range.

Each notch can be programmed to turn on (active mode) or off (bypass mode).

Each notch is tunable over a specific frequency range (or tuning zone). The tuning frequency step for each notch is 100KHz (tuning resolution).

The filter is equipped with internal temperature compensation that regulates the Temperature Drift of the Notch Frequency and keeps the notch rejection better than 15dB over the entire operating temperature range.

The usable passband frequency range is 225 to 750MHz.

Specifications

Passband Frequency Range	225 to 750MHz
Notch 1 Frequency Range	486 – 559.9MHz**
Notch 2 Frequency Range	560 – 649.9MHz**
Notch 3 Frequency Range	650 – 750MHz**
Notches Rejection (± 2MHz)	15dB min
Notches Passband Insertion Loss (All Notches Off)	1.3dB max
Notch IL Rejection at ±10MHz (One Notch Active)	5.3dB max
Notch IL Rejection at ±10MHz (Two Notches Active)	5.9dB max
Notch IL Rejection at ±10MHz (All Notches Active)	6.5dB max
Impedance (Input/Output)	50 Ω
VSWR	2.5:1
Temperature Range	-40°C to +85°C
Notch Drift Over Temperature	Internally Compensated
RF Power Handling	+25dBm
IIP3	TBD
DC Power	
DC Voltage	3.3 VDC ±0.3 VDC
DC Current Max	55mA
Control Interface	SPI Serial Input
Tuning Resolution	100KHz
Switching Speed, 90% RF Power (typical)	< 50µsec
Dimensions [L x W x H]	1.70 X 1.80 X 0.35 inches 43.20 X 45.20 X 8.90 mm

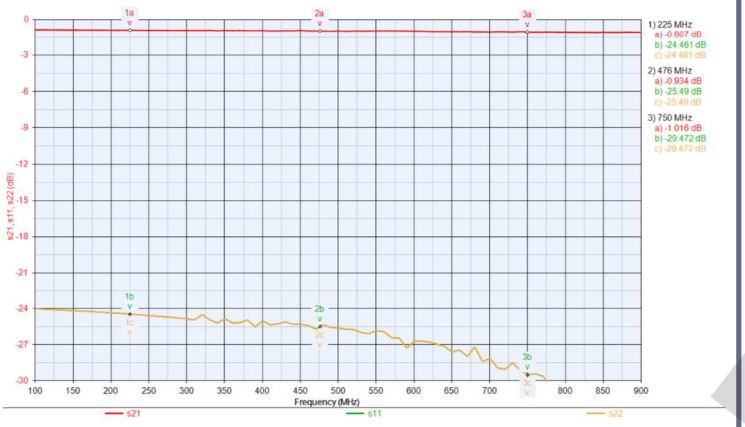
*Assuming other notches in bypass mode.
**The 560MHz and 650MHz break points between the three may be adjusted (±15MHz) and will be finalized during prototype development.

Note: Parameters subject to change

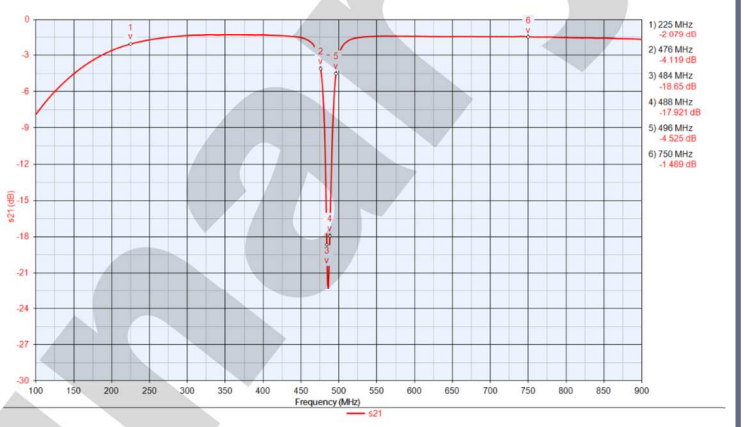
RoHS COMPLIANT

Frequency Response

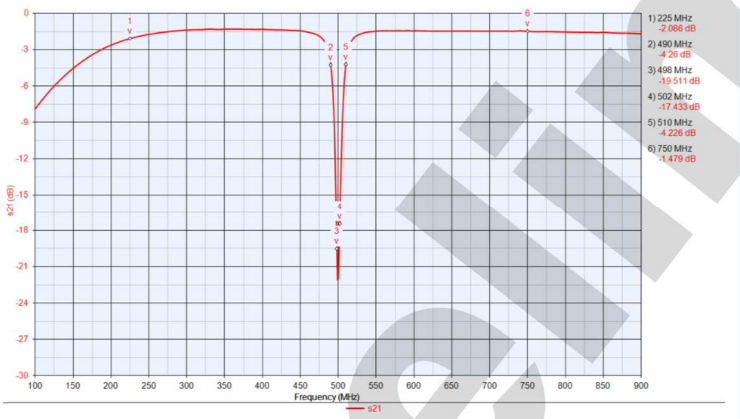
All notches in bypass mode



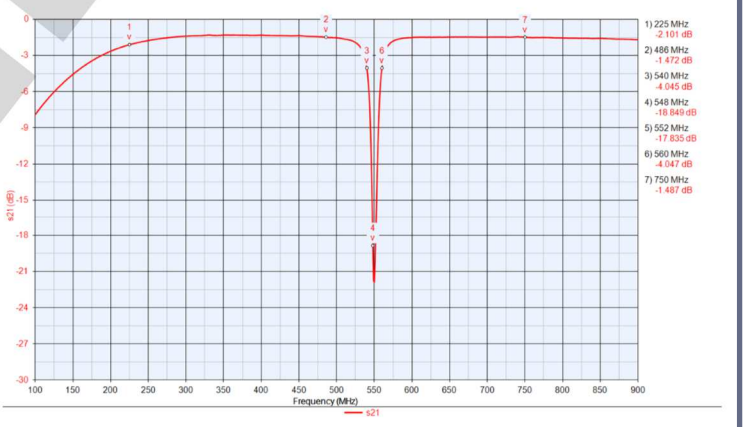
N1 at 486MHz (start address), others in bypass mode



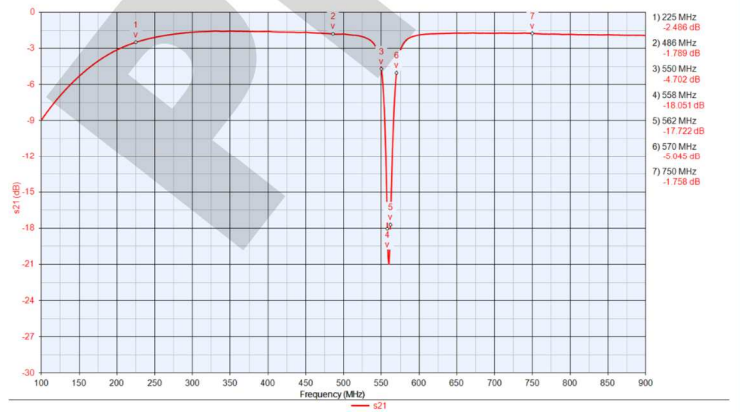
N1 at 500MHz



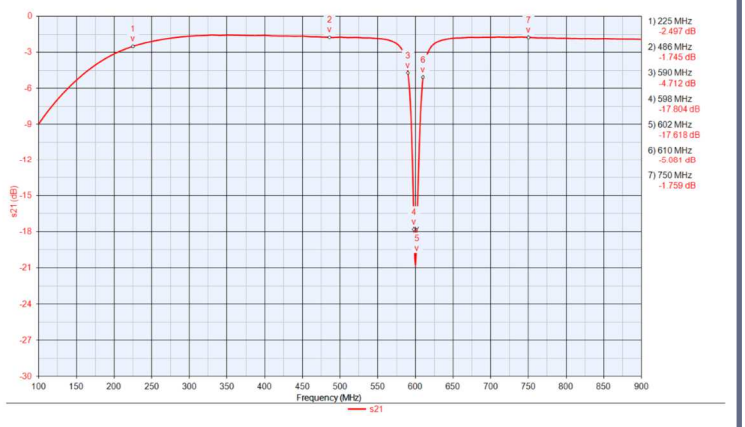
N1 at 550MHz



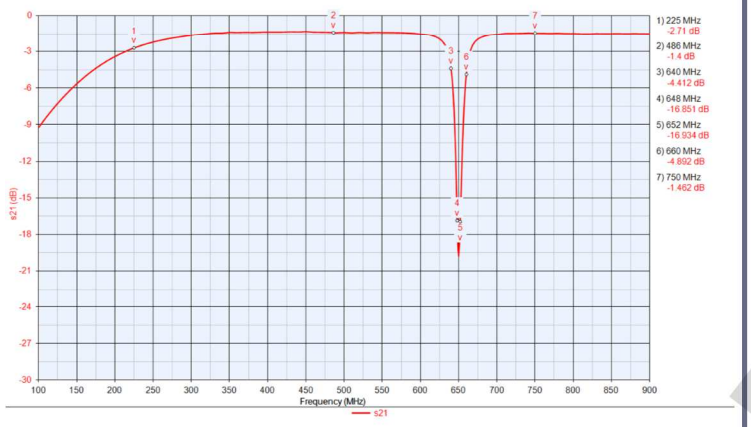
N2 at 560MHz



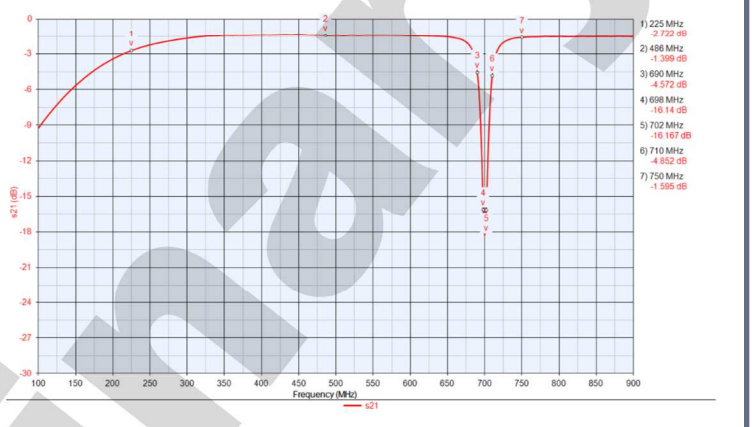
N2 at 600MHz



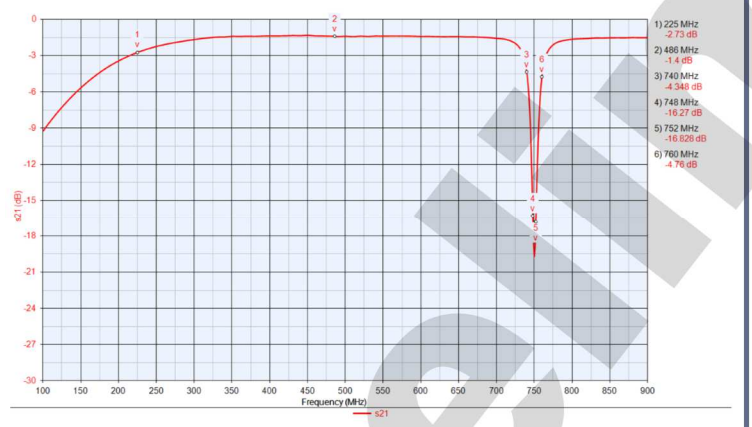
N3 at 650MHz



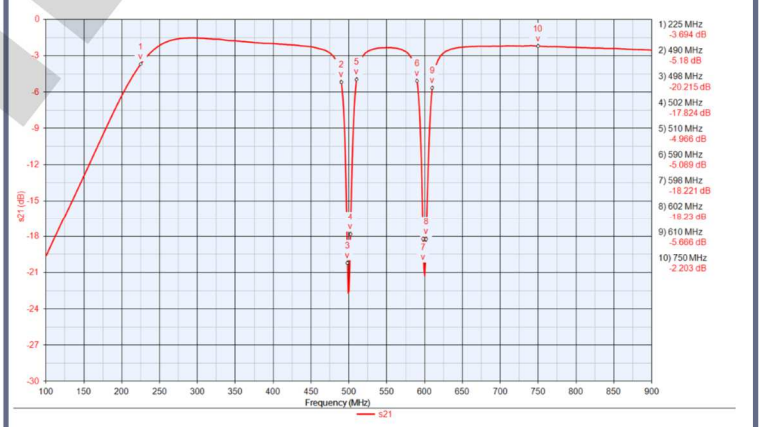
N3 at 700MHz



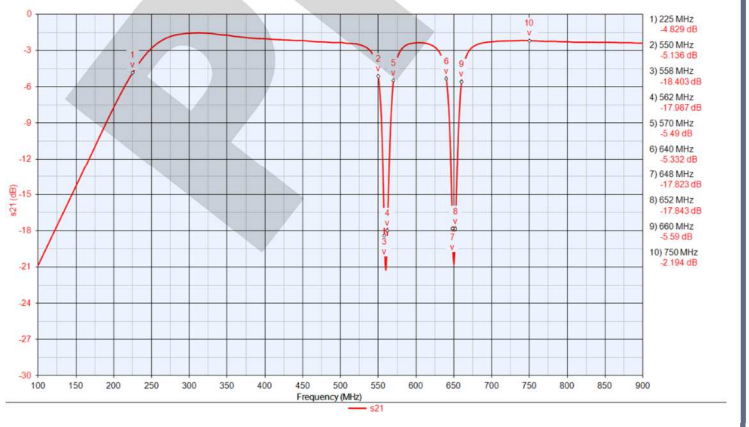
N3 at 750MHz



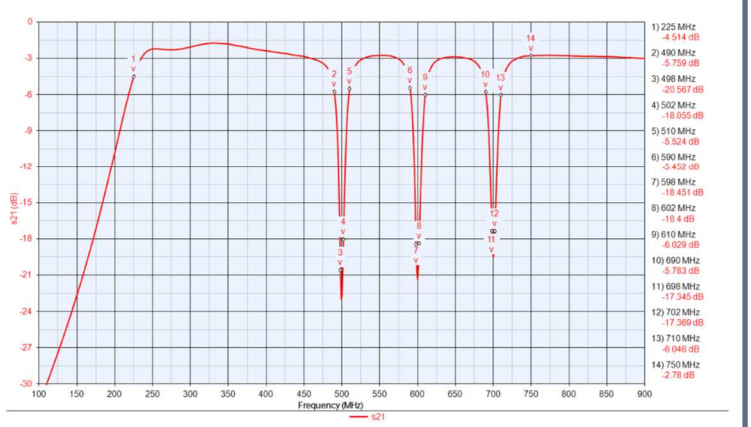
N1 at 500MHz, N3 at 600MHz



N2 at 560MHz, N3 at 650MHz



N1 at 500MHz, N2 at 600Mhz, N3 at 700MHz



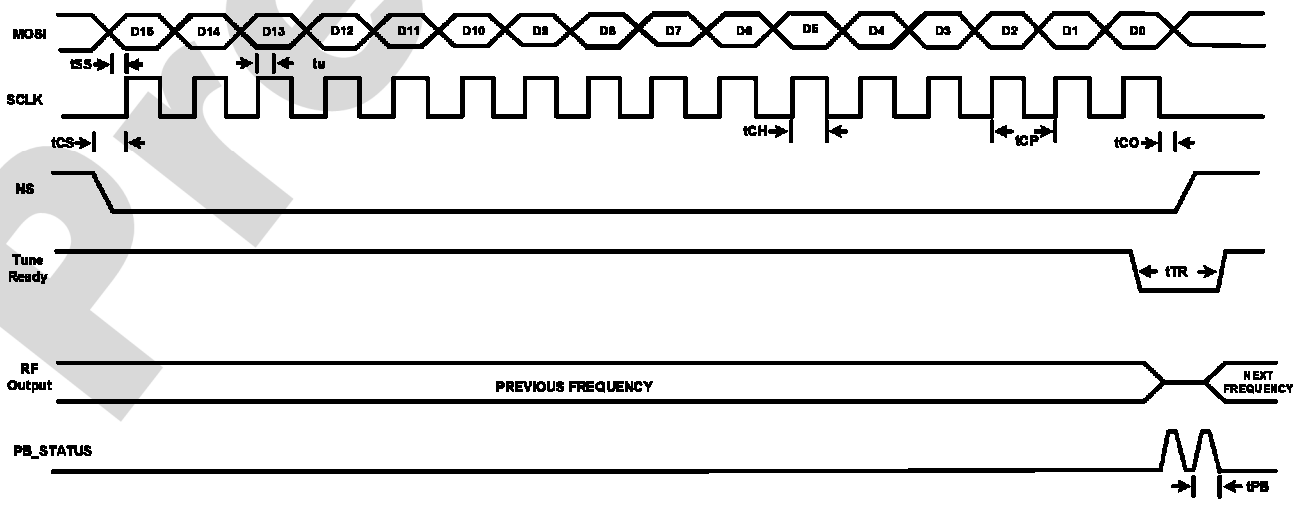
Notch(n) Serial Address Input Timing Diagram

When the SPI_NS line is shifted low, the Tune_Ready line be at a high logic state to indicate the unit is ready to accept the tune word. Tuning of the filter starts when the last data clock (16th) pulse of the address is sent to the unit while the SPI_NS (Notch Select) is low. When the filter tuning is complete the Tune_Ready line will go high to indicate the filter tuning is complete. Reset the SPI_NS line high after sending the 16th clock bit to allow the unit to reset after the filter tuning is complete.

The PB_STATUS line indicates when the filter output is disrupted by the RF Bypass switches changing state. The PB_STATUS line will go to a High logic state whenever the bypass switches change state. The PB_STATUS line will go high whenever any Notch channel is tuned to a new frequency, or a Notch channel By-pass mode is changed.

Symbol	Parameter	Min	Max	Units
tSS	Setup time MOSI Data to SPICLK	50		ns
tu	Hold Time MOSI Data From SPICLK		0	ns
tCH	Clock High Time	50		ns
tCL	Clock Low Time	50		ns
tCP	Clock Period	100		ns
tCS	Chip Setup Time (NS falling edge to SPICLK start)	100		ns
tCO	Chip Setup Time (NS rising edge to SPICLK end)	100		ns
tTR	Tune_Ready indicator		50	us
tACC	Access time from Last (16th) SPICLK edge to Fo		50	us
tPB	Passband Status Line Disruption at any Notch tune or Bypass Mode change instance		2.6	us

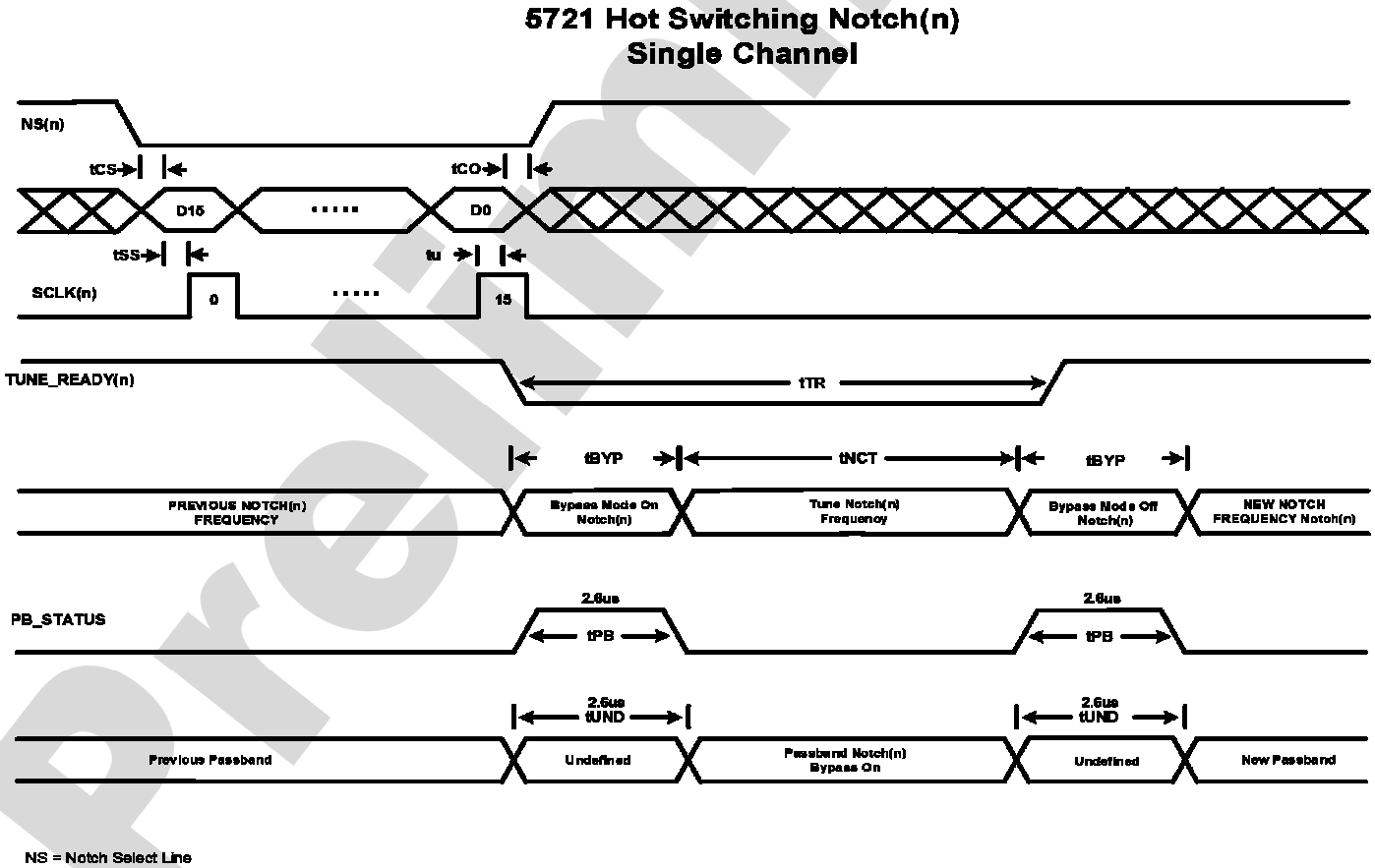
5721 ADDRESS PROTOCOL



Notch(n) Hot Switching

Hot Switching is allowed when the unit is tuning. It is not required to have the RF input turned off while the unit is tuning. When the unit is tuning, the RF Passband will go in to the Bypass Mode during tuning with the following Steps:

- Unit will go into Bypass mode and the Tune_Ready line will go to a low state.
- The Passband will be in an undefined state (tUND) for up to 2.6us in which time NO RF signal will pass through the unit.
- The Passband will return after tUND is complete and the unit will be in RF bypass mode.
- The Unit will tune the notch (n) to the new notch frequency (tNCT) for up to 40us while in bypass mode.
- Once the notch(n) tuning is complete the unit will turn off the RF bypass switch.
- The Tune_Ready ;line will go to a High logic state to show the unit has processed the tune word and is returning to the RF Bypass mode off.
- The Passband will be in an undefined state (tUND) for up to 2.6us in which time NO RF signal will pass through the unit.
- The Passband will return after tUND and will be set at the new notch(n) frequency and the RF Passband will be active.



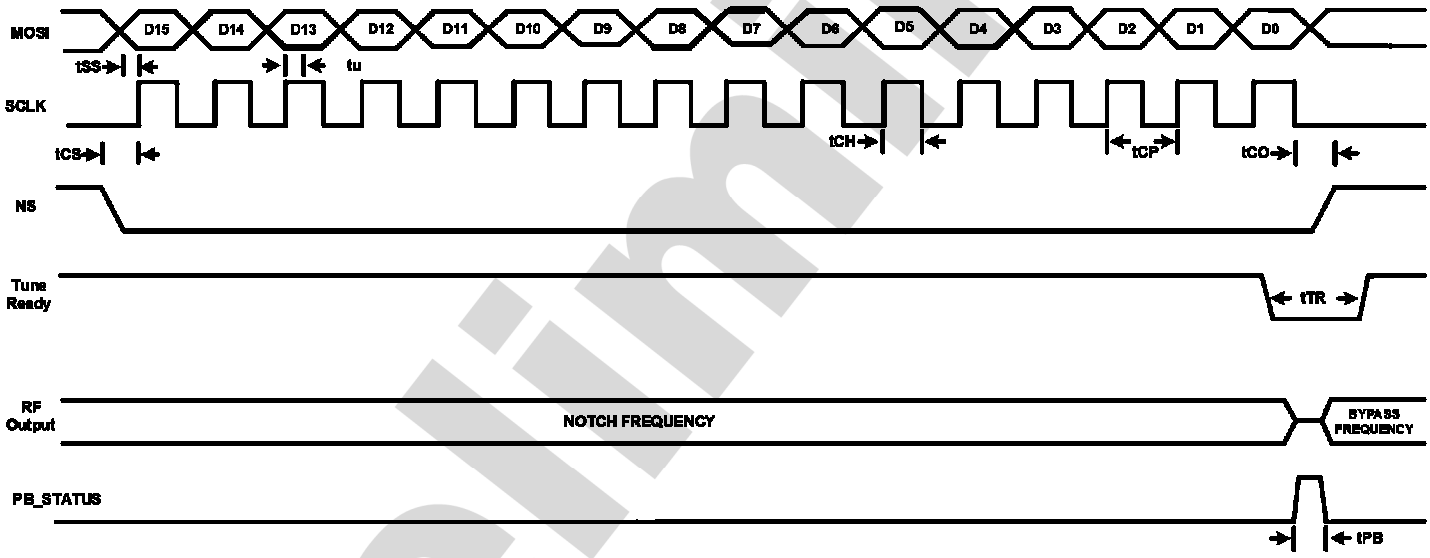
Note: This hot switching timing diagram also applies during temperature compensation, whenever the unit temperature changes by more than 2.5°C

Notch(n) Bypass Enable

When D15 of any selected notch(n) is set to logic “1” in the notch(n) tune word, the selected notch(n) will be set to Bypass mode on. In this state the selected notch(n) will be bypassed.

The PB_STATUS line will go to a high state to indicate the RF line is disrupted. During this time the RF output will be low as the RF switches change state. After the RF switches have changed state, the PB_STATUS line will go low to indicate the RF line is enabled and the RF input of the selected notch(n) is at the RF output of the selected notch(n).

5721 ADDRESS BYPASS ENABLE PROTOCOL

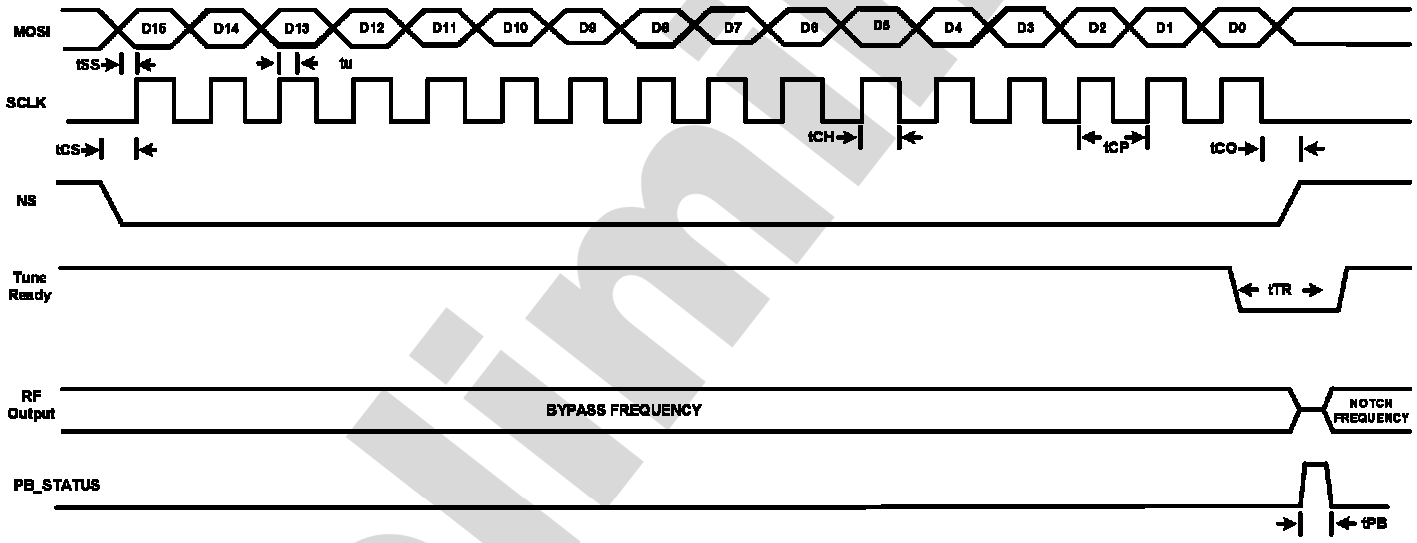


Notch(n) Bypass Disable

When D15 of any selected notch(n) is set to logic “0” in the notch(n) tune word, the selected notch(n) will be set to Bypass mode off. In this state the selected notch(n) will be enabled.

The PB_STATUS line will go to a high state to indicate the RF line is disrupted. During this time the RF output will be low as the RF switches change state. After the RF switches have changed state, the PB_STATUS line will go low to indicate the RF line is enabled and the selected Notch(n) will be enabled.

5721 ADDRESS BYPASS DISABLE PROTOCOL



Notch(n) Input and Output Signal Voltage Levels

Symbol	Parameter	Conditions	Min	Typ	Max	Units
FMAX	Maximum Serial Input Frequency		-		10	MHz
VIH	HIGH - level input voltage	VCC = 3.0 V to 3.6 V	1.7		VCC - 0.3	V
VIL	LOW- Level input voltage	VCC = 3.0 V to 3.6 V	-0.3		0.8	V
VOH	HIGH - level output voltage	VCC = 3.0 V to 3.6 V	2.4	3.0		V
VOL	LOW - level output voltage	VCC = 3.0 V to 3.6 V	-		0.45	V

Address Control Table

Notch Selection			**Address Selection**												
D15 MSB	**D14**	**D13**	**D12**	**D11**	**D10**	**D9**	**D8**	**D7**	**D6**	**D5**	**D4**	**D3**	**D2**	**D1**	**D0 LSB**
BP*	**0****	**0****	**Filter Tune Address*** **												

* 0 = Notch function Active, 1 = Notch function Bypass
.** Set D14 and D13 to zero except when addressing Unit ID, Firmware Revision, or Production Date Code
*** Refer to Address Table for selected notch start and end addresses.

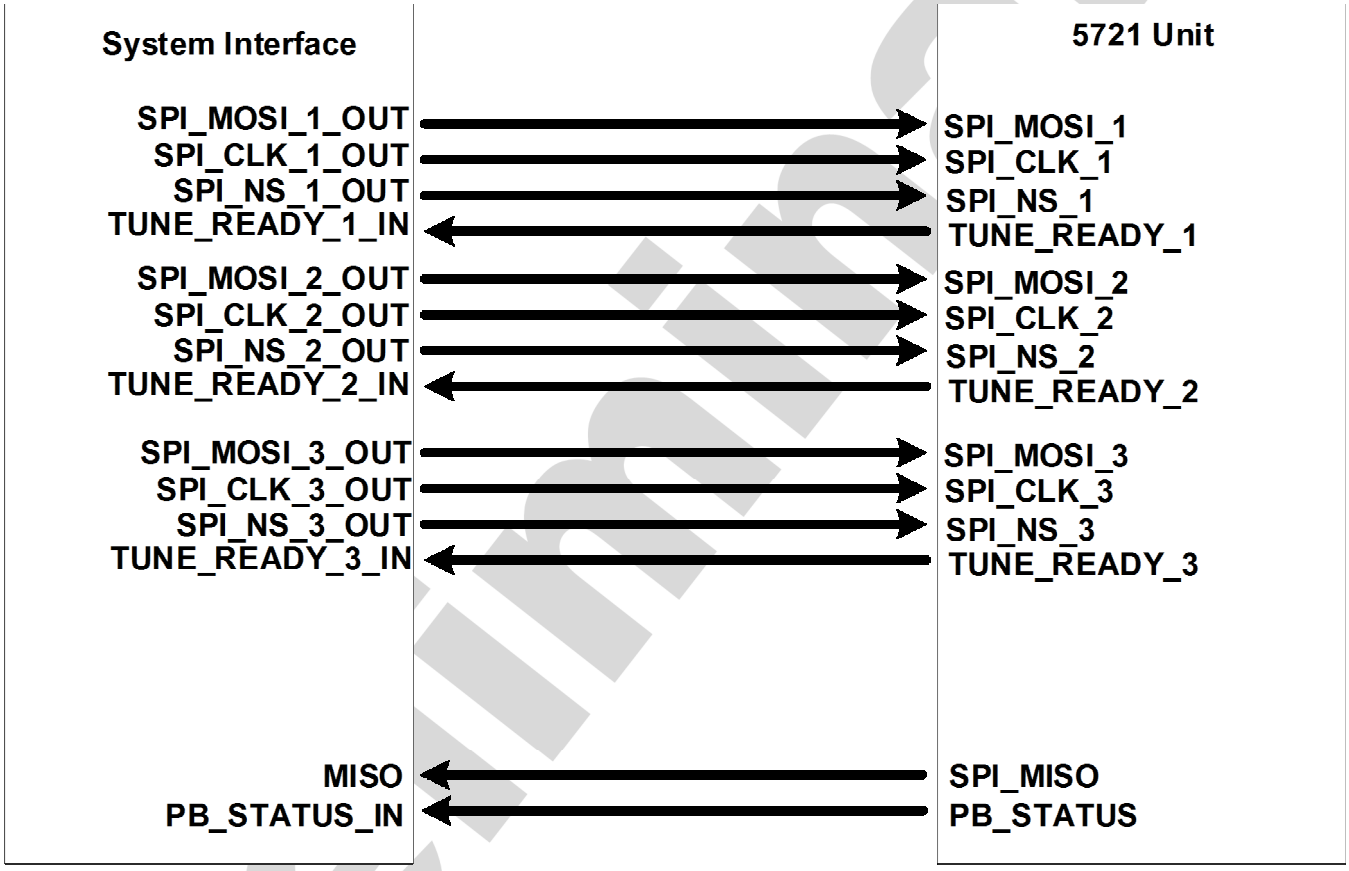
Address Table

Notch	**Start Address**	**End Address**	**Frequency Range**
1	4860	5999	486.0 - 599.9MHz *
2	6000	6499	600.0 - 649.9MHz *
3	6500	7500	650.0 - 750.0MHz *

* If address sent outside the frequency range, the filter remains in previous state

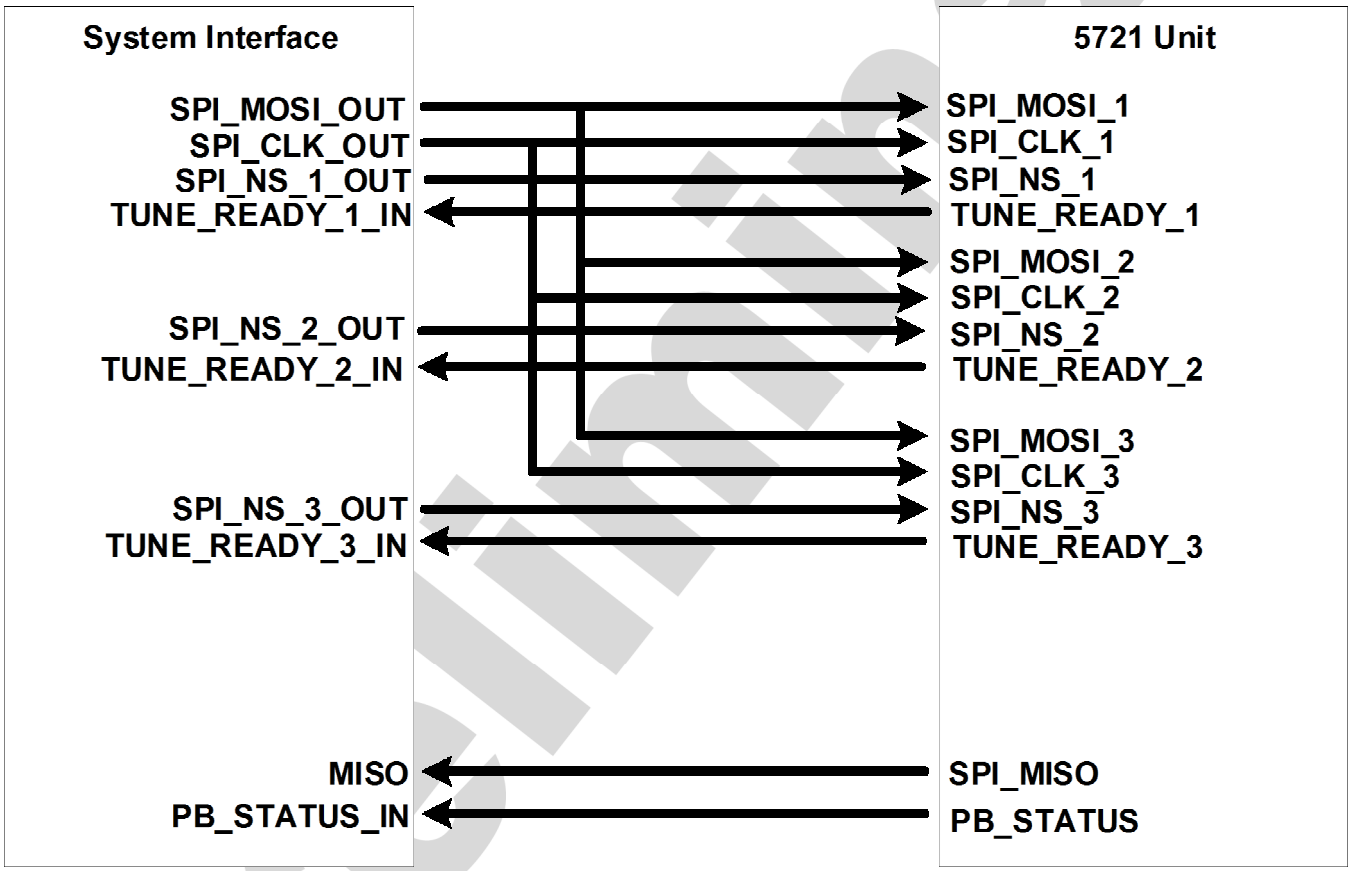
Parallel Notch Tuning Setup

- The control of the filter is through SPI interface (serial).
- The Notch Channels can be tuned simultaneously per the setup below as an example.
- Each Notch channel can be tuned to a different frequency simultaneously.



Parallel Notch Tuning Setup Common Clock and Data

- The control of the filter is through SPI interface (serial).
- The only a single Notch Channel is tuned.
- The selected Notch channel is tuned to a different frequency.



Device Commands and Addressing

The 5721 is designed to interface directly to the Serial Peripheral Interface (SPI) interface. The instructions and Addressing are listed in the table below. All instructions, addresses, and data are transferred with the MSB first and start with a High to Low transition if the SPI_NS line. Send the READ UNIT ID, READ UNIT FW CODE, and READ UNIT PRODUCTION DATE through Notch Channel 1 SPI address lines.

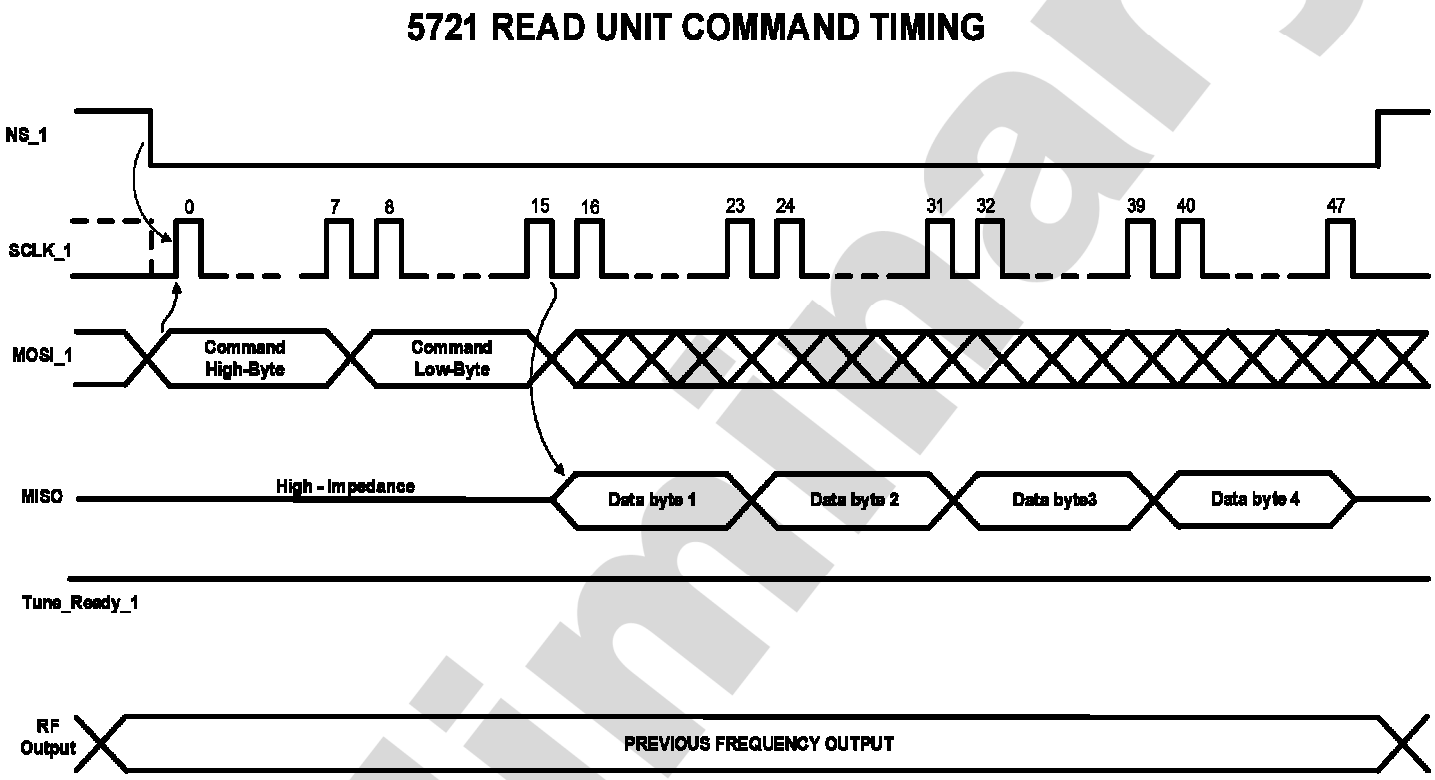
Instruction Name	Instruction Format	Operates On	Operation Description
Normal operation Bypass off	0000 1010 1111 0011 - 00011101 0100 1100	Notch Tuning	Tune Notches no bypass
READ UNIT ID	1011 1000 0000 0000	Unit ID Register	Read 4-digit Unit ID code (ASCII)
READ UNIT FW CODE	1101 1100 0000 0000	Unit FW Register	Read FW code 4-letter code (ASCII)
READ UNIT PRODUCTION DATE	1111 1110 0000 0000	Unit Date Register	Read 4-digit Unit Date Code (ASCII)

READ UNIT ID: The 5721 Quad Notch Filter will send a 4-digit ID “5720” in ASCII code when the command is sent to the unit. The unit will stay at the last Notch frequency when the command is sent.

READ UNIT FW CODE: The 5721 Quad Notch Filter will send a 4-digit Firmware ID in ASCII code when the command is sent to the unit. The unit will stay at the last Notch frequency when the command is sent.

READ UNIT PRODUCTION DATE: The 5721 Quad Notch Filter will send a 4-digit date in MMYY format in ASCII code when the command is sent to the unit. The unit will stay at the last Notch frequency when the command is sent.

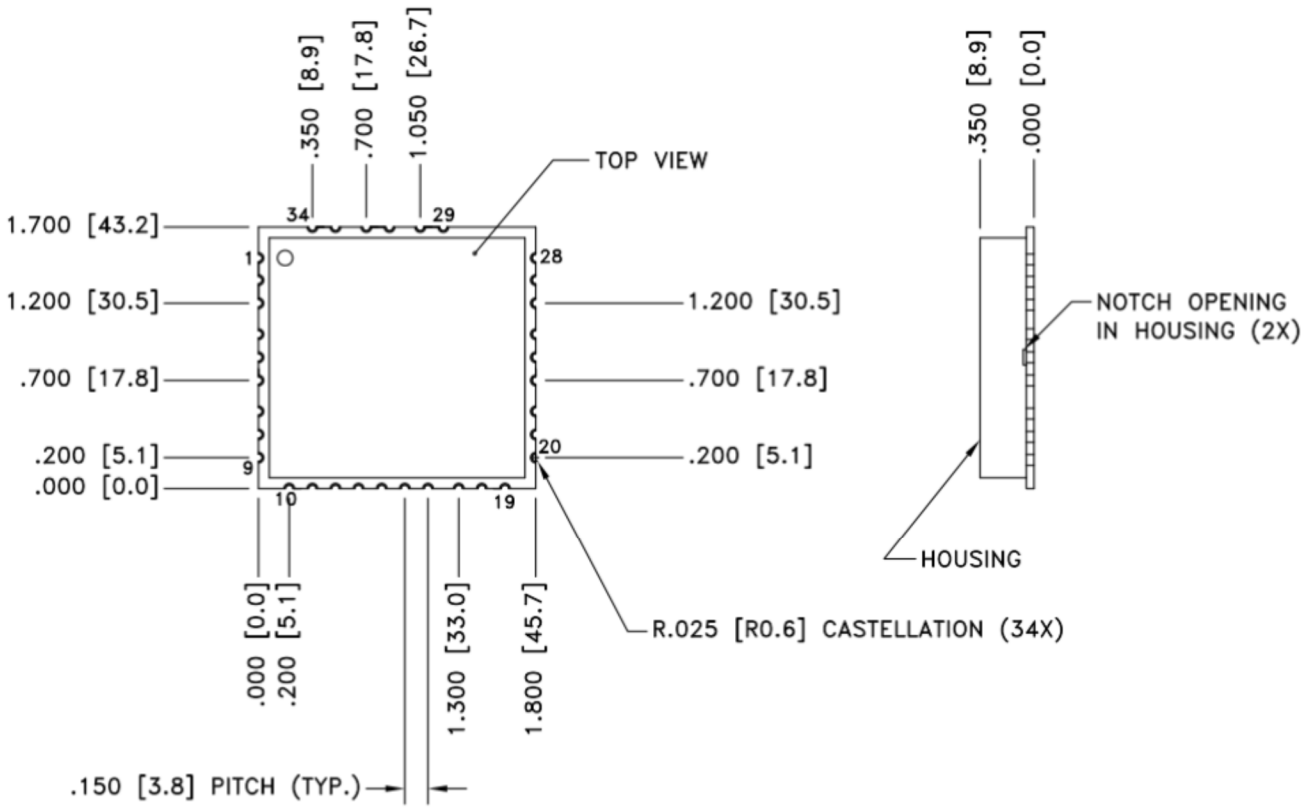
Device Command Timing

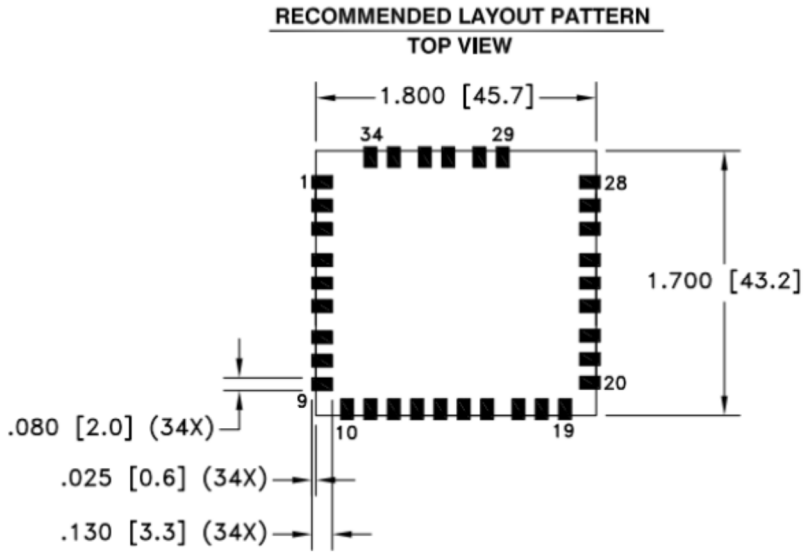


The Read Unit Command Timing applies to the following commands:

- **Read Unit ID**
- **Read Unit FW Code**
- **Read Unit Production Date**

Mechanical





PIN DESIGNATORS				
PIN NUMBER	DESCRIPTION		PIN NUMBER	DESCRIPTION
1	NC		18	SPI_CLK_2
2	NC		19	TUNE_READY_1
3	NC		20	SPI_MOSI_2
4	GND		21	SPI_NS_2
5	RF_IN		22	TUNE_READY_2
6	GND		23	GND
7	NC		24	RF_OUT
8	GND		25	GND
9	NC		26	GND
10	NC		27	VCC (+3.3V)
11	NC		28	GND
12	SPI_MISO		29	GND
13	NC		30	SPI_MOSI_3
14	SPI_CLK_1		31	SPI_NS_3
15	SPI_MOSI_1		32	TUNE_READY_3
16	PB_STATUS		33	SPI_CLK_3
17	SPI_NS_1		34	NC

NOTES:
1. TOLERANCES ±.010 [0.25] UNLESS OTHERWISE SPECIFIED.
2. DIMENSIONS ARE INCHES [mm].

Environmental Specification Standards

Lead Plating:

- ELECTROLESS NICKEL, TYPE 1, CLASS 1, Cu/Ni P7, 100 MICRO INCHES (0.0001 INCHES) MINIMUM, IMMERSION GOLD PLATE 2 TO 6 MICRO INCHES (0.000002 TO 0.000006 INCHES) ON OUTER LAYERS.

Temperature:

- High temperature shall meet MIL-STD-810E, Method 501.3, Procedure I to 85°C storage, and procedure II to 85°C operating.
- Low temperature shall meet Method 502.3, Procedure I to -57°C storage, and Procedure II to -40°C operating.

Vibration:

- MIL-STD-810E Method 514.4 Ground Mobile Test Procedure I, Test Condition I - 3.4.7

Shock:

- MIL-STD-810E Procedure I, Method 516.4 - Functional Shock.

Reflow:

- TBD

Cleaning:

- Recommend cleaning solvents used which meet ODC (Ozone Depleting Chemical) requirements.
- Solvents containing methylene chloride or other epoxy solvents should be avoided since these will attack the epoxy encapsulation material of some components.
- Ultrasonic cleaning not recommended.

Moisture Sensitivity Level:

- MSL 3

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