SNIA SFF TWG Technology Affiliate

SFF-TA-1004

Former Draft Specification for

Tunable QSFP+ / QSFP28 Memory Map for ITU Frequencies

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SECRETARIAT: SFF TA TWG

ABSTRACT: This draft specification formerly defined the extensions to SFF-8636 needed to support tuning to the ITU frequency grid.

REASON FOR EXPIRATION: Obsolete

This draft specification is no longer relevant to the industry. If tunability is required for QSFP modules, then refer to CMIS or vendor specific registers. The information contained in this draft specification is obsolete and therefore this document is now expired.

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SFF-TA-1004

Specification for

Tunable QSFP+ / QSFP28 Memory Map for ITU Frequencies

Rev 0.0.10 January 23, 2018

Secretariat: SFF TA TWG

Abstract: This specification defines extensions to SFF-8636 needed to support tuning to the ITU frequency grid.

This specification provides a common reference for systems manufacturers, system integrators, and suppliers.

This specification is made available for public review at http://www.snia.org/sff/specifications and written comments are solicited from readers via http://www.snia.org/feedback. Comments received by the members will be considered for inclusion in future revisions of this specification.

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Change History

Rev 0.0.9
- Initial revision

Rev 0.0.10
- Removed page 0 byte 224 bits, use 221 bit 5 and page 22h register 128.7 instead
- Corrected template
- Updated referenced document revisions

- Foreword

The development work on this specification was done by the SNIA SFF TWG, an industry group. Since its formation as the SFF Committee in August 1990, the membership has included a mix of companies which are leaders across the industry.

When 2 1/2" diameter disk drives were introduced, there was no commonality on external dimensions e.g. physical size, mounting locations, connector type, connector location, between vendors. The SFF Committee provided a forum for system integrators and vendors to define the form factor of disk drives.

During their definition, other activities were suggested because participants in SFF faced more challenges than the form factors. In November 1992, the charter was expanded to address any issues of general interest and concern to the storage industry. The SFF Committee became a forum for resolving industry issues that are either not addressed by the standards process or need an immediate solution.

In July 2016, the SFF Committee transitioned to SNIA (Storage Networking Industry Association), as a TA (Technology Affiliate) TWG (Technical Work Group).

Industry consensus is not a requirement to publish a specification because it is recognized that in an emerging product area, there is room for more than one approach. By making the documentation on competing proposals available, an integrator can examine the alternatives available and select the product that is felt to be most suitable.

SFF meets during the T10 (see www.t10.org) and T11 (see www.t11.org) weeks, and SSWGs (Specific Subject Working Groups) are held at the convenience of the participants. Material presented to SFF becomes public domain, and there are no restrictions on the open mailing of the presented material by Members.

Many of the specifications developed by SFF have either been incorporated into standards or adopted as standards by ANSI, EIA, JEDEC and SAE.

For those who wish to participate in the activities of the SFF TWG, the signup for membership can be found at:

http://www.snia.org/sff/join

The complete list of SFF Specifications which have been completed or are currently being worked on by the SFF Committee can be found at:

http://www.snia.org/sff/specifications See Doc #: SFF-8000

If you wish to know more about the SFF TWG, the principles which guide the activities can be found at:

http://www.snia.org/sff/specifications See Doc #: SFF-8032

Suggestions for improvement of this specification will be welcome, they should be submitted to:

http://www.snia.org/feedback

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1. Scope

This specification defines extensions to SFF-8636 needed to support tuning to the ITU frequency grid.

SFF-8665 defines the QSFP28, and SFF-8679 defines the QSFP+ Module electrical specification. SFF-8636 defines the 2-wire management interface.

To avoid possible conflict with legacy tuning systems designed to SFF-8636, the frequency grid tuning commands of this specification supplement rather than supplant the wavelength definitions of SFF-8636. These frequency grid tuning commands are detailed in Section 4.

1.1 Application Specific Criteria

This specification applies to any QSFP+ or QSFP28 module supporting DWDM tunability.

1.2 Copyright

1.3 Disclaimer

herein or for incidental or consequential damages in connection with the furnishing, performance, or use of this specification.

Suggestions for revisions should be directed to http://www.snia.org/feedback/

2. References

2.1 Industry Documents

- SFF-8636	Management Interface for Cabled Environments
- SFF-8665	QSFP+ 28 Gb/s 4X Pluggable Transceiver Solution (QSFP28)
- SFF-8679	QSFP+ 4X Hardware and Electrical Specification
- ITU-T G.694.1	Spectral grids for WDM applications: DWDM frequency grid
- ITU-T G.698.1	Multichannel DWDM applications with single-channel optical Interfaces
- ITU-T G.698.2	Amplified multichannel DWDM applications with single channel optical interfaces
- OIF-ITLA-MSA-01.3	Integratable Tunable Laser Assembly Multi Source Agreement

2.2 Sources

There are several projects active within the SFF TWG. The complete list of specifications which have been completed or are still being worked on are listed in http://www.snia.org/sff/specifications See Doc #: SFF-8000.

2.3 Conventions

The dimensioning conventions are described in ANSI-Y14.5M, Geometric Dimensioning and Tolerancing. All dimensions are in millimeters, which are the controlling dimensional units (if inches are supplied, they are for guidance only).

The ISO convention of numbering is used i.e., the thousands and higher multiples are separated by a space and a period is used as the decimal point. This is equivalent to the English/American convention of a comma and a period.

American	French	ISO
0.6	0,6	0.6
1,000	1 000	1 000
1,323,462.9	1 323 462,9	1 323 462.9

2.4 Abbreviations

For the purpose of this SFF Specification the following units and abbreviations apply:

AC	Active Cable
AO	Active Optical cable
b	binary (suffix to preceding binary based number)
C	degrees Celsius (thermal unit associated with a value)
C	Conditional upon another parameter which is optional
d	decimal (suffix to preceding decimal based number)
dB	decibel (base 10 logarithmic unit)
dBm	decibels above one milliwatt (i.e., 10dBm)
Gbps	gigabits per second (i.e., 10^9 bits per second)
GHz	gigahertz (i.e., 10^9 cycles per second)
h	hexadecimal (suffix to preceding hexadecimal based number)
Hz	hertz (i.e., cycles per second)
kHz	kilohertz (i.e., 10^3 cycles per second)
km	kilometer (i.e., 10^3 meters)

LSB Least Significant Bit
m meter (unit of length)
mA milliampere (i.e., 10^-3 amperes)
Mbps megabits per second (i.e., 10^6 bits per second)
MHz megahertz (i.e., 10^6 cycles per second)
ms millisecond (i.e., 10^-3 seconds)
MSB Most Significant Bit
mV millivolt (i.e., 10^-3 volts)
mW milliwatt (i.e., 10^-3 watts)
nm nanometer (i.e., 10^-9 meters)
ns nanosecond (i.e., 10^-9 seconds)
O Optional
P-P peak-to-peak
PAM4 Four-level pulse amplitude modulation
PC Passive Cable
ps picosecond (i.e., 10^-12 seconds)
R Required
s second (unit of time)
SM Separable Module
TC Temperature Controller (e.g. thermo-electric cooler)
uA microampere (i.e., 10^-6 amperes)
um micrometer (i.e., 10^-6 meters)
us microsecond (i.e., 10^-6 seconds)
uV microvolt (i.e., 10^-6 volts)
uW microwatt (i.e., 10^-6 watts)
V volt (unit of electrical potential)
W watt (unit of electrical power)

								MSB			8-bit field				LSB
MSB							16-bit field								LSB
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

3. Definitions

3.1 Fixed versus Free

3.1.1 Fixed

The terminology "fixed" is used to describe the gender of the mating side of the connector that accepts its mate upon mating. This gender is frequently, but not always, associated with the common terminology "receptacle". Other terms commonly used are "female" and "socket connector". The term "fixed" is adopted from EIA standard terminology as the gender that most commonly exists on the fixed end of a connection, for example, on the board or bulkhead side.

3.1.2 Free

The terminology "free" is used to describe the gender of the mating side of the connector that penetrates its mate upon mating. This gender is frequently, but not always, associated with the common terminology "plug". Other terms commonly used are "male" and "pin connector". The term "free" is adopted from EIA standard terminology as the gender that most commonly exists on the free end of a connection, for example, on the cable side.

3.2 Passive Cable

In this specification, a passive cable only requires power to operate the management interface circuitry.

3.3 Active Cable

In this specification, an active cable requires power for circuitry that is integral to any of the TX/RX high speed serial channels supported by the cable. In addition, the active cable requires power to operate the management interface.

3.4 Pluggable Transceiver Module

In this specification, a pluggable transceiver module requires power for the management interface and for the circuitry integral to the TX/RX high speed serial channels supported by the module. The module also has a media dependent interface (MDI), such as a duplex single mode fiber or a parallel multimode fiber connector. The high speed electrical interface of the module may contain equalizers and retimers (CDRs) which are managed by registers defined in this management interface specification.

4. General Description

4.1 Specification Objective

This specification describes and allows for module tunability on a DWDM grid, both by wavelength and by channel number. It also describes a narrow tunability option (i.e., tunability within a subset of the entire channel space). Advertisement and indicator flags are defined for the host to determine the new features described and made available from this specification, in the modules that supports this specification. This specification defines new bits in the existing memory map as defined by SFF-8636 to indicate support for DWDM tunability and support of Page 22h, as detailed in Section 5.

4.2 Operation

Several options for tunability are made available depending on the module's advertised capabilities. Modules may support and advertise tunability by either channel number or by wavelength. Modules may also advertise narrow tunability (a subset of the possible DWDM tuning range).

4.2.1 Full Tunability By Channel Number

For modules that support full and wide tunability by channel number, the module will advertise the allowed channel numbers.

When the module provides full tunability the following register bits will be advertised:

- Tunable DWDM By Channel Number Bit (Page 22, Register 128, Bit 1) will be 1
- However, Narrow Tunable DWDM Bit (Register 128, Bit 4) will be a 0.

The following registers are provided to support the Full Tunability feature:

- Registers to advertise the first and last channels
- Register to advertise the channel spacing
- Additionally, a Channel Number Offset advertisement register is provided in case the grid does not start with Channel Number 0.

The host can program any channel between and including the first and last advertised frequency, by programming the desired channel number in the Channel Number Register.

The module will automatically respond by changing to a new target frequency as specified by the following equation:

Desired Frequency = [(Channel Number - Channel Number Offset) * Grid Spacing] + First Frequency

For example, if the advertised grid configuration is:

- First Frequency: 192.0 THz
- Grid Spacing: 0.1 THz
- Channel Number Offset: 20d

Then programming Channel Number 25d would result in 192.5 THz, and programming Channel Number 49d would result in 194.9 THz.

Note that the channel numbers, as defined above, do not necessarily have to conform to the ITU grid definition. These numbers only define the possible integer values that may be written to the Channel Number register.

4.2.2 Narrow Tunability By Channel Number

Modules that support narrow tunability by channel number, will advertise the following register bits:

- Tunable DWDM By Channel Number Bit (Page 22, Register 128, Bit 1) will be a 1
- Narrow Tunable DWDM Bit (Page 22, Register 128, Bit 4) will also be set to 1
- Additionally, the first and last channel numbers allowed will be advertised

If a selected channel number is either lower than the number advertised in the First Channel Allowed register, or, is higher than the number advertised in the Last Channel Allowed register, then the Bad Channel Requested latch will be set, and, the module will not change the frequency.

4.2.3 Full Tunability By Wavelength

For modules that support full tunability by wavelength, the module will advertise the global shortest and longest wavelength supported. To select a new wavelength, the host will program the desired wavelength into the Wavelength Set register. The module will respond by changing the wavelength to the desired target, within a module-specified accuracy.

When the module is Tunable by Wavelength, the following register bits will be advertised:

- Tunable DWDM By Wavelength Bit (Page 22, Register 128, Bit 0) will be a 1
- Narrow Tunable DWDM Bit (Page 22, Register 128, bit 4) will be set to 0
- Additionally, the global shortest and longest wavelength supported will be advertised.

4.2.4 Narrow Tunability By Wavelength

Modules that support narrow tunability by wavelength will advertise the following register bits:

- Tunable DWDM By Wavelength Bit (Page 22, Register 128, Bit 0) will be a 1
- Narrow Tunable DWDM Bit (Page 22, Register 128, Bit 4) will be set to 1
- Additionally, the shortest and longest wavelength supported by the module will be advertised.

If a selected wavelength is either lower than the wavelength advertised in the First Wavelength Allowed register, or, is higher than the wavelength advertised in the Last Wavelength Allowed register, then the Bad Channel Requested latch will be set, and, the module will not change its wavelength .

4.3 Tx Dither

Tx Dither can be important for suppression of Stimulated Brillouin Scattering (SBS). Support for Tx dithering is indicated by Page 22h, Byte 128, Bit 2. Note that modules that support Tx dithering, will have the dithering enabled by default.

5. Changes to the SFF-8636 Memory Map

Tunable QSFP+ / QSFP28 will implement A0h as in SFF-8636 with the modifications herein.

Upper Page 0, Byte 221, Bit 5, shall indicate support for Page 22h. The tunable Control/Status bits will be coded in the newly defined Upper Page 22h Bytes 128-255, and will be accessible when the Page Select Byte is set to support Page 22h.

TABLE 5-1 PAGE SELECT

A0h Address	Bit	Description
Lower Page 0 Byte 127	All	Page Select Byte Entry. For Tunable QSFP+ / QSFP28 Control/Status = 22h

TABLE 5-2 PAGE 22H SUPPORT

A0h Address	Bit	Description
Upper Page 0 Byte 127	5	Page 22h implemented per SFF-TA-1004. When this bit is 1, page 22h is implemented as described in SFF-TA-1004. When this bit is 0, page 22h is not implemented.

6. New Register Definitions

Register definitions in Upper Page 22h bytes 128-255 described in the remainder of this section will be based on the Page Select Byte set to 22h. All undefined registers in 22h bytes 128-255 are reserved and are set to 00h.

6.1 General Advertisement

General advertisement registers are defined in Upper page 22h, byte 128.

TABLE 6-1 GENERAL ADVERTIZEMENT REGISTER

Upper Page 22h Address	Bit	Description of Transceiver
Byte 128	7	Tunability supported. = 1 Tunability is supported by the transmitter = 0 Tunability is not supported by the transmitter
Byte 128	6-5	Reserved
Byte 128	4	Narrow Tunable DWDM = 0 Tunability not limited to narrow range = 1 Tunability limited to narrow range
Byte 128	3	Reserved
Byte 128	2	Tx Dither = 0 Not supported = 1 Supported
Byte 128	1	Tunable DWDM by Channel Number Supported = 0 Not supported

		= 1 Supported
Byte 128	0	Tunable DWDM by Wavelength Supported = 0 Not supported = 1 Supported

Byte 128, Bit 7, shall indicate Tunable Wavelength capability. When it is 1, the transmitter is tunable. When it is 0, the transmitter is not tunable.

When Byte 128, Bit 1 is 1, then tunability by channel number is supported. In this case, the host may write to the Channel Number Set register (Byte 144-145) to change the channel.

If channel number tuning is supported, but the module advertises narrow tuning (Byte 128, Bit 4 is 1), then the allowed values in the Channel Number Set register are limited to the range specified in the Allowed Channel number registers (Bytes 159-162).

When Byte 128, Bit 0 is 1, then tunability by wavelength is supported. In this case, the host may write to the Wavelength Set register (Bytes 146-147) to change the wavelength.

If wavelength tuning is supported, but the module advertises narrow tuning (Byte 128, Bit 4 is 1), then the allowed values in the Wavelength Set register are limited to the range specified in the Allowed Wavelength registers (Bytes 176-179).

6.2 Module Channel and Wavelength Support

Module channel and wavelength support registers are defined in Upper page 22h, Bytes 132-141 and 157-185.

TABLE 6-2 TUNABLE BY CHANNEL NUMBER CAPABILITIES

Upper Page 22h Address	Size	Name	Description
Byte 132 (MSB) & 133(LSB)	2 Bytes	LFL1	Tunable Lasers First Frequency (THz)
Byte 134 (MSB) & 135(LSB)	2 Bytes	LFL2	Tunable Lasers First Frequency (GHz*10), in units of 0.1 GHz
Byte 136 (MSB) & 137(LSB)	2 Bytes	LFH1	Tunable Lasers Last Frequency (THz)
Byte 138 (MSB) & 139(LSB)	2 Bytes	LFH2	Tunable Lasers Last Frequency (GHz*10), in units of 0.1 GHz
Byte 140 (MSB) & 141(LSB)	2 Bytes	LGrid	Laser’s minimum supported grid spacing (GHz*10), i.e., in units of 0.1 GHz
Byte 157 (MSB) & 158(LSB)	2 Bytes	ChOffset	Channel Number Offset Used to calculate allowed channel numbers
Byte 159 (MSB) & 160(LSB)	2 Bytes	NTfirst	Narrow Tunable (selection by channel number) First channel allowed
Byte 161 (MSB) & 162(LSB)	2 Bytes	NTlast	Narrow Tunable (selection by channel number) Last channel allowed
Byte 176 (MSB) & 177(LSB)	22 Bytes	LFW1	Narrow Tunable (by wavelength) Allowed Laser Wavelength First (Shortest) Units of 0.05 nm

Byte 178 (MSB) & 179(LSB)	2 Bytes	LLW1	Narrow Tunable (by wavelength) Allowed Laser Wavelength Last (Longest)Units of 0.05 nm
Byte 182 (MSB) & 183(LSB)	22 Bytes	GLFW1	Global Laser Wavelength First (Shortest) Units of 0.05 nm)
Byte 184 (MSB) & 185(LSB)	2 Bytes	GLLW1	Global Laser Wavelength Last (Longest) Units of 0.05 nm

6.3 Control Registers

Frequency and wavelength control commands are detailed in the table below.

TABLE 6-3 FREQUENCY AND WAVELENGTH CONTROL COMMANDS

Upper Page 22h Address	Bit	Name	Description
Byte 144 (MSB) Byte 145 (LSB)	All	Channel Number Set	Requested target channel number Channel Number tunability.
Byte 146 (MSB) Byte 147 (LSB)	All	Wavelength Set	Requested wavelength for tunability
Byte 148-150	All	Reserved	Reserved
Byte 151	7-1	Reserved	Reserved
Byte 151	0	Tx Dither Disable	1 disables Dither 0 enables dither

When using register 144-145 to set the desired channel number, refer to section 4.2.1 for details. The channel number is a 16-bit integer number, with MSB in register 144 and LSB in register 145. A 2-byte write sequence must be used to set this value.

For modules that are narrow tunable by channel number, Bytes 144-145 must be between the Narrow Tunable First channel allowed (159-160) and the Narrow Tunable Last channel allowed (161-162), with both boundary values inclusive.

When using Bytes 146-147 to set the desired wavelength, refer to Section 4.2.3 for details. The wavelength is a 16-bit number in units of 0.05 nm.

For modules that are fully tunable by wavelength, Bytes 146-147 must be between the Global Laser Wavelength First (182-183) and Global Laser Wavelength Last (184-185) register values, with both boundary values inclusive.
For modules that are narrow tunable by wavelength, Bytes 146-147 must be between the Narrow Tunable Allowed Laser Wavelength First (176-177) and Narrow Tunable Allowed Laser Wavelength Last (178-179) register values, with both boundary values inclusive.

For modules that support Tx Dither operation (Page 22, Byte 128, Bit 2 is set to 1), the dither is enabled by default. The dither can be disabled by setting Tx Dither Disable (Page 22, Byte 151, Bit 0) to 1.

6.4 Digital Diagnostics and Alarms

6.4.1 SFF-8636 Diagnostics Information

QSFP28 SFF-8636 (Page 20h, 21h) already defines frequency error capabilities as well as TEC current monitoring.

Per SFF-8636:
Laser Frequency parameter, if supported, monitors the difference (in frequency units) between the target center frequency and the actual current center frequency. It is a 16-bit signed 2s complement value in increments of 10 MHz. Thus, the total range is from -327.68 GHz to 327.67 GHz.

See SFF-8636 for register definitions for real-time digital monitor reporting, high/low alarm/warning threshold definitions and alarm/warning flags.

For wavelength tunable modules, the frequency error can be converted to a wavelength error by the host.

6.4.2 Additional Diagnostics Information

Upper Page 22h, Byte 168 is the status register containing unlatched status bits for TEC Fault, Wavelength Unlock, and Tx Tune (i.e., tuning operation is in process, and, is not yet completed).

TABLE 6-4 CURRENT STATUS REGISTER DEFINITION

Upper Page 22h Address	Bit	Name	Description
Bytes 168	7	Reserved	Reserved
Bytes 168	6	TEC Fault	TEC Fault indicates current status
Bytes 168	5	Wavelength Unlocked	Wavelength Unlocked Condition
Bytes 168	4	Tx Tune	Identifies Tx is not ready due to tuning
Bytes 168	3-0	Reserved	Reserved

- TEC Fault (Byte 168, Bit 5) – TEC Fault is asserted when TEC is not able to main the required laser temperature.
- Wavelength Unlocked (Byte 168, Bit 5) – Wavelength Unlocked condition is asserted when the module is in Low Power Mode or when channel tuning is in progress
- Tx Tune (Byte 168, Bit 4) – Tx Tune goes high if tuning is in progress, during which the module is not ready to accept a new channel change request.

Upper Page 22h Byte 172 is the latched status register containing additional status indicators and alarms for channel change operations, Tx dither support requests that cannot be supported, and, Latched TEC Faults as outlined in the Table 4.10.

TABLE 6-5 LATCHED STATUS REGISTER DEFINITION

Upper Page 22h Address	Bit	Name	Description
Bytes 172	7	Reserved	Reserved
Bytes 172	6	L-Tec Fault	Latched TEC Fault = 1 (if TEC Fault goes to 1) = 0 after read operation
Bytes 172	5	L-Wavelength Unlocked	Latched Wavelength Unlocked Condition
Bytes 172	4	L-Bad Channel	Latched Bad Channel Requested (i.e., a Channel Number outside of the support

			range has been requested)
Bytes 172	3	L-New Channel	Latched New Channel Acquired (i.e., a channel change operation has been completed)
Bytes 172	2	L-Unsupported Tx Dither	Latched Unsupported TX Dither Request (i.e., a Tx Dither has been request in a module that does not support Tx dithering)
Bytes 172	1-0	Reserved	Reserved

- Latched-TEC Fault (Byte 172, Bit 6) – Latched TEC Fault goes high when TEC Fault goes high. The flag clears itself on status read
- Latched-Wavelength Unlocked (Byte 172, Bit 5) – Latched Wavelength Unlocked goes high and asserts when Wavelength Unlocked flag (Byte 168, Bit 5) goes low to indicate that the tuning is complete. Latched-Wavelength Unlocked clears itself on status read.
- Latched-Bad Channel (Byte 172, Bit 4) – Latched Bad Channel goes high when either the module receives a channel change request while in low power mode, or, when the requested channel cannot be supported by the channel. Latched Bad Channel clears itself on status read.
- Latched-New Channel (Byte 172, Bit 3) – Latched New Channel is asserted when the module locks itself to the new requested channel. Latched-New Channel clear itself on status read.
- Latched-Unsupported Tx Dither (Byte 172, Bit 2) – Latched Unsupported Tx Dither asserts itself when a Tx Dither has been requested in a module that does not support Tx Dither.

7. Tuning Process and Timing

7.1 Tuning Registers

The process to change the module frequency by using either the channel number or by wavelength is outlined herewith.

- A module can be assigned a new channel by writing to the appropriate registers.
    - When the module supports frequency change by channel number, the host may write to the Channel Number Set registers (Page 22, Bytes 144 and 145 for MSB and LSB respectively).
    - When the module supports frequency change by wavelength, the host may write to the Wavelength Set registers (Page 22, Bytes 146 and 147 for MSB and LSB respectively).

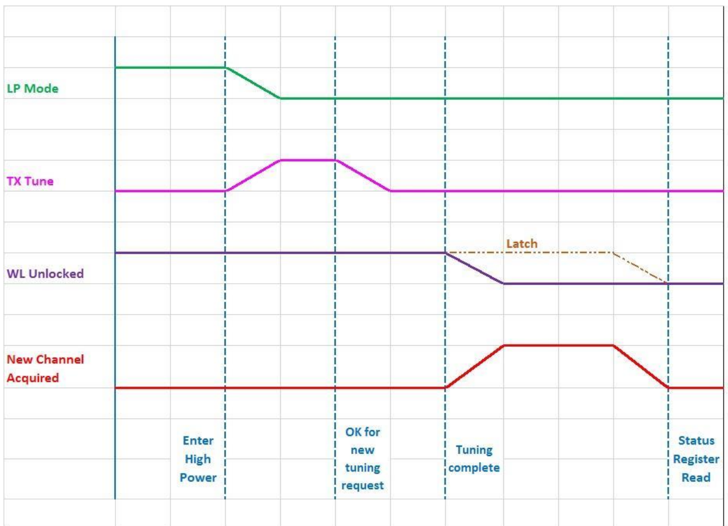
This specification describes tuning a module to a requested frequency while the module is in low power mode and high power mode.

7.2 Module in Low Power Mode

- Modules will report Wavelength Unlocked while in the low power mode. Wavelength Unlocked begins High in Low Power State
- Module will report a Latched-Bad Channel requested High (Page 22, Byte 172, Bit 4) until it is powered up.

- A module in low power mode can then be taken to a high power state after a power up.
- When the module begins to power up, the Tx Tune Flag (Page 22, Byte 168, Bit4) will be asserted or set, the Wavelength Unlocked will continue to remain High.
- Upon completion of power up, Tx Tune Flag will clear itself, indicating that it is ready to accept a new channel request, even as th module works internally to lock itself to the previous requested channel. During the time that it works to lock itself to the requested channel, the Wavelength Unlocked (Page 22, Byte 168, Bit 5) continued to remain high.
- Upon a successful power-up into the desired channel or wavelength, the Wavelength Unlocked flag will clear (Page 22, Byte 168, Bit 5).
- The Latched-New Channel Acquired flag (Page 22, Byte 172, Bit 3) will assert and the Latched-Wavelength Unlocked Flag (Page 22, Byte 172, Bit 5) will also assert to indicate that the channel change operation has been completed. Both these status registers will Clear on Read.

FIGURE 7-1 CHANNEL TO CHANNEL SWITCHING IN LOW POWER MODE



7.3 Module in High Power Mode

A module that is already in a high power state can be tuned by writing to the appropriate tuning registers specified in Section 7.1.

- When the module is tuned while in high power mode, the module will report an assert on Tx Tune, and Wavelength Unlocked will remain high until the tuning is complete.
- Upon completion of power up, Tx Tune Flag will clear itself, indicating that it is ready to accept a new channel request, even as the module works internally to lock itself to the previous requested channel. During the time that it works to lock itself to the requested channel, the Wavelength Unlocked (Page 22, Byte 168, Bit 5) continued to remain high.
- Upon a successful power-up into the desired channel or wavelength, the Wavelength Unlocked flag will clear (Page 22, Byte 168, Bit 5).
- The Latched-New Channel Acquired flag (Page 22, Byte 172, Bit 3) will assert and the Latched-Wavelength Unlocked Flag (Page 22, Byte 172, Bit 5) will also assert to indicate that the channel change operation has been completed. Both these status registers will Clear on Read.

FIGURE 7-2 CHANNEL TO CHANNEL SWITCHING IN HIGH POWER MODE