



48500 Kato Road  
Fremont, CA 94538 USA

## Product Specification

**C-Band, 50GHz Ch. Spacing  
Dual-Collimator Tunable Filter**

Part No.:  
TO-1C2CT801

Revision: 2.1

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## TO-1C2CT801

### C-Band 50GHz Channel Spacing Dual-Collimator Tunable Filter

**Revision 2.1**

**July 11, 2016**

#### Revision History

Rev.	Date	Revision History	Originated by	Signed by
1.0	1/25/2012	Initial release	Jinping Chen	Danny Yu
2.0	4/15/2016	Revised Wavelength Tuning Range from 1528.77–1562.23 nm to 1526.827~1570.005 nm	Stephanie Hung	James pang
2.1	7/11/2016	Revised Corporate address to 48500 Kato Road	Stephanie Hung	James pang



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## 1. Scope

This document describes the optical, mechanical, and electrical specifications for Optoplex C-band, 50GHz channel spacing, dual-collimator tunable filter.

## 2. Product Description

Optoplex's Tunable Optical Filter is based on a patented micro-optic design and thin-film coating technology. The wavelength tuning is achieved by varying the incident angle of the incoming light beam on the thin-film filter. Each device can be used to select (drop) one particular ITU channel at a given configuration. The device can be also continuously tuned over the wavelength tuning range.

## 3. Optical Specifications

Parameter	Unit	Specification
Wavelength Tuning Range	nm	1526.827 ~ 1570.005 (190.95 ~ 196.35 THz)
Wavelength Tuning Resolution	pm	< 20
Bandwidth <sup>1</sup> @ 1.0 dB	GHz	>16
Bandwidth <sup>1</sup> @ 3.0 dB	GHz	25 (Typical)
Bandwidth <sup>1</sup> @ 20 dB	GHz	<85
Peak Insertion Loss <sup>1</sup> (without connector)	dB	<5.0
Polarization Dependent Loss <sup>1</sup>	dB	<0.3 @ CW
Polarization Mode Dispersion	ps	0.5
Chromatic Dispersion <sup>1</sup>	ps/nm	<± 100 within CW ±5 GHz
Wavelength Setting Error <sup>2</sup>	GHz	< ±4
Wavelength Repeatability <sup>2</sup>	GHz	±1
Wavelength Temperature Dependence	pm/°C	< ±1 (Typical)
Return Loss	dB	>40
Maximum Input Optical Power	mW	300
Tuning Speed (channel to channel, depending on originating and destination channels)	s	<10

1. Over the stated spectral and operating temperature ranges and all polarization states
2. Related to mechanical accuracy at a given temperature

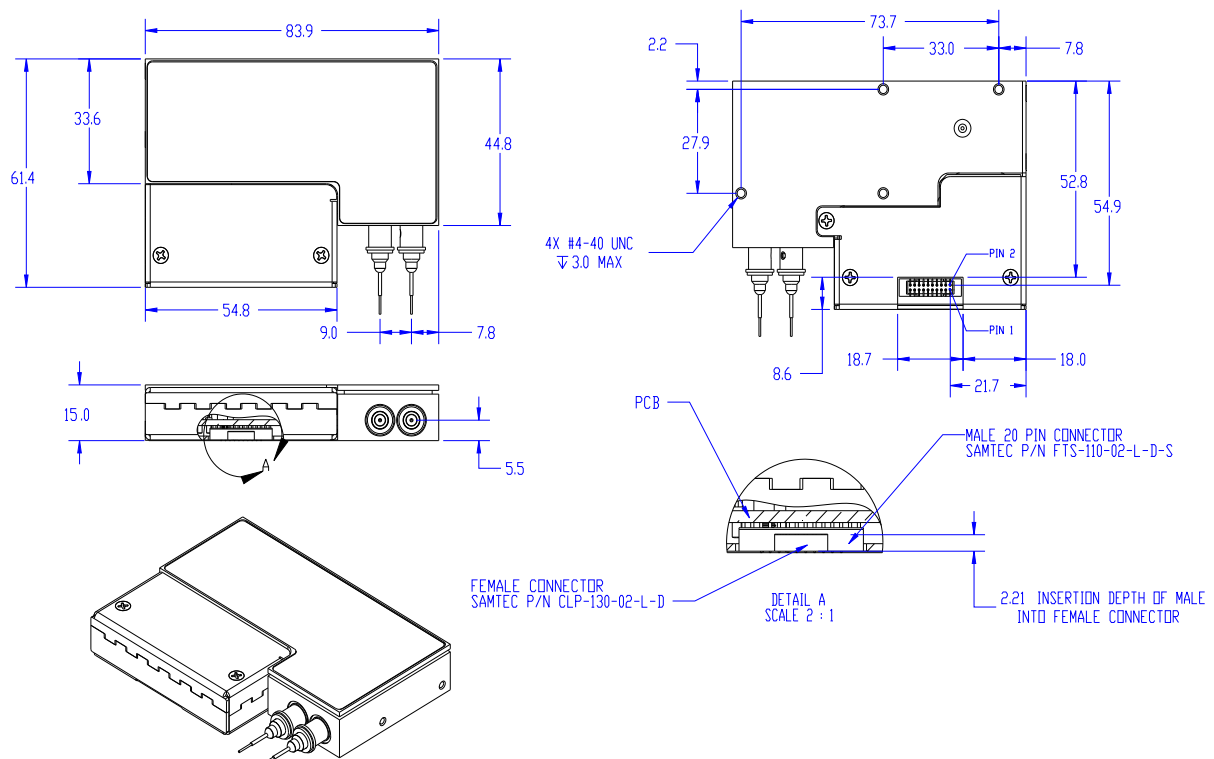
#### 4. Environmental Specifications

Parameter	Unit	Specification
Operating Temperature	°C	0 ~ 65
Storage Temperature	°C	-40 ~ 85
Operating Relative Humidity	%	5 ~ 85
Storage Relative Humidity	%	5 ~ 95 @ Room Temperature

#### 5. Mechanical Specifications

Parameter	Specification
Fiber Type	9/125 Corning SMF-28
Fiber Jacket	900 micron strippable tight buffer
Fiber Length	880 ± 100 mm (input and output fibers)
Connector Type	LC/UPC (with fusion sleeves)

This device is with a dual-collimator mechanical design. The mechanical specifications are shown in the following drawings.



## 6. Electrical and Communications Interface Specifications

Tunable filter module is controlled through RS232 interface. Peak and idle tuning power consumptions are < 1800 mW and < 300 mW, respectively. Pinouts and specification of electrical connector are given below:

Pin #	Signal Name	Level	Pin Type	Description
1	VCC-IN	5VDC	Power In	Supply voltage – Logic
2	VSS	5VDC Return	Power In	Return for 5VDC – Logic
3	VMM-IN	5VDC Motor	Power In	Supply voltage – Stepper motor
4	VSM	5VDC Return	Power In	Return for stepper motor supply voltage
5	ENBL	TTL & LVTTL	Input	Logic voltage supply Enable **
6	ENBM	TTL & LVTTL	Input	Motor voltage supply Enable **
7	Reserved	-	-	Do not connect
8	Shield		Input	Non-current carrying shielding connection to chassis
9	Tx	TTL & LVTTL	Output	UART respond output
10	Rx	TTL & LVTTL	Input	UART command input
11	GND	UART GND	Input	UART Ground
12	Reserved	-	-	Do not connect
13	Reserved	-	-	Do not connect
14	Reserved	-	-	Do not connect
15	ERR	TTL & LVTTL	Output	Error Detected, If not use, leave floating
16	Reserved	-	-	Do not connect
17	Reserved	-	-	Do not connect
18	/RST	TTL & LVTTL	Input	Device Reset. If not use, leave floating Internally pulled to VCC with 200K ohm resistor
19	OPT	TTL & LVTTL	Output	Customized output function pin, TBD
20	/CMPT*	TTL & LVTTL	Output	Motion Completed, If not use Leave floating

\* This pin function is only available with firmware version 16 or higher.

\*\* Must not leave floating. Either pull hi to enable or pull low to disable.

The absolute maximum rating voltage range of pin 5, 6 and 18 is -0.3V ~ +6V.

The input logic level of pin 5 and 6 is maximum logic low = 0.8V, minimum logic high = 2.0V.

Pin 18 has the maximum low = 1.0V and minimum high = 2.8V.



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On Optoplex PCB, Connector (Header) P/N: Samtec FTS-110-02-L-D-S  
Matching Mating Connector (Socket) P/N: Samtec CLP-110-02-G-D

**Pin 1, VCC-IN:** Logic Voltage: +5VDC  $\pm$  0.25VDC supply voltage.  
Logic Current: 180 mA continuous, 250 mA power-up maximum (ENBL=5V)  
Logic Shut-Down Current: < 1  $\mu$ A maximum, <0.2  $\mu$ A typical (ENBL=0V)

**Pin 2, VSS:** 5VDC. Return for logic voltage VCC-IN.

**Pin 3, VMM-IN:** Motor Voltage: +5VDC  $\pm$  0.25VDC motor voltage.  
Motor Current: 70 mA stand-by, 150 mA average moving, 250 mA power-up maximum (ENBM=5V)  
Motor Shut-Down Current: < 1  $\mu$ A maximum, <0.2  $\mu$ A typical (ENBM=0V)

**Pin 4, VSM:** 5VDC. Return for stepper motor supply voltage VMM-IN.

**Pin 5, ENBL:** This is an input-only signal. Must not leave floating, either pull hi to enable or pull low to disable. Use this pin to disable power to tunable module's logic supply (VCC-IN) to conserve power.

**Pin 6, ENBM:** This is an input-only signal. Must not leave floating, either pull hi to enable or pull low to disable. Use this pin to disable power to tunable module's motor supply (VMM-IN) to conserve power.

**Pin 8, Shield (Shield):** This pin is connected to the chassis (enclosure) of the device. This pin should be used to shield the device from environmental EMI noise.

**Pin 9, RS232 Transmit (TX):** This pin is a LVTTTL level (TTL compatible) output. This pin is used for serial transmission of the RS232 echo and data strings.


**Pin 10, RS232 Receive (RX):** This pin is a LVTTTL level (TTL tolerant) input. This pin is used for receiving commands via the device's RS232 interface.

**Pin 11, RS232 Ground (GND):** This pin provides ground potential for the RS232 RX and TX data pins. This pin is internally connected to pin 2, VSS.

**Pin 15, Error, (ERR):** This is an output-only signal. When a channel switching command is started, this pin will be lowered to logic low. When an error is detected during channel switching, this pin will be raised to logic high.

**Pin 18, External Reset, (/RST):** This is an input-only signal. Internally it is pulled-up via a 200K Ohm resistor to VCC. When this input is Low, the device will be placed in a reset state.

- This bit must be kept High or Unconnected during normal operation.
- It is desired, but not required to keep this bit Low during power on and off.

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**Pin 20, Motion Completed, or BUSY (/CMPT):** This is an output-only signal. When a channel switching command is started, this pin will be raised to logic high. When channel switching is finished, this pin will be lowered to logic low. Device will ONLY accept command “K” (Kill) when this pin is at logic high. (This pin function is only available with firmware version 16 or higher.)

**Pin 7, 12 ~ 14, 16, 17 and 19, Reserved:** Reserved connection. Do not connect these pins.



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## 7. Tunable filter UART (RS232) Communication Protocol

### Requirements:

UART port setting:

Baud Rate: 9600  
Data Bits: 8  
Parity: None  
Stop Bits: 1  
Flow Control: None

ASCII Command Characters:

H, C, K, M, L, numbers, and "?".  
No termination character.  
All received characters are echoed back to the transmit line.  
All commands are case sensitive.  
Illegal characters will be echoed with "I".  
Illegal channel number will be echoed with "I".

### **H** Home Command (This command is no longer required to initialize the device)

Syntax: H

Operands: None

Description: Initiate Home Search Sequence

Returns: H

Example:

Send	Receive	Comments
<b>H</b>	<b>H</b>	Initiate home search sequence

Proper Home Command Implementation:

1. Send **?R**, delay for 50 ms, read from serial port and verify that the device is responding correctly.
2. Send **H**, delay for 50 ms, read echoed **H** from serial port.
3. Delay 6 sec, send **?H**, delay 50 ms, read response to see if home is complete (**?HHC**).
4. If home is not complete (**?HHN**), retry steps 2~3. If home still not complete, something is not right with the power supply or the unit.

### **C** Set Channel (To use factory calibrated channels only)

Syntax: Cnnnn

Operands:  $0001 \leq nnnn \leq 0512$  Actual max. range is model dependent

Description: Initiate Wavelength Change to Set Channel Center Wavelength

Returns: Cnnnn



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Example:

Send	Receive	Comments
<b>C0015</b>	<b>C0015</b>	Initiate set channel

Proper Set Channel Implementation: (Example to set to Channel 15)

1. Send **C0015**, delay for 50 ms, read echoed **C0015** from serial port.
2. Delay for 7 sec, send **?C**, delay for 50 ms, read response from serial port. If returned **?CC0015**, then set channel is completed. If returned **C0000**, then set channel has failed.

More Efficient Set Channel Implementation: (Example to set to Channel 15)

1. Send **L0064**, delay for 50 ms, read echoed **L0064** from serial port. This will enable Auto RDY reply.
2. Send **C0015**, delay for 50 ms, read just the echoed **C0015** from serial port (4-bytes only).
3. Read from serial port every 30 ms until RDY is received.
4. Send **?H**, delay for 50 ms, read echoed **?HHC**. (If received **?HHN**, Set channel command have failed, make sure pin-6 ENBM is enabled at high)
5. Send **?C**, delay for 50 ms, read echoed **?CC0015**. (If received **?CC0000**, Set channel command have failed, make sure channel number is valid)

## **K** Kill All Motion

Syntax: K

Operands: None

Description: Stop home, or Stop set channel sequence

Returns: K

Example:

Send	Receive	Comments
<b>K</b>	<b>K</b>	Send kill command, current channel reset to zero

## **M** Move (To move to any wavelength; Always preceded by L commands)

Syntax: Mnnnn

Operands:  $0000 \leq nnnn \leq 9999$

Actual range is unit dependent

Do not move outside of the specified range for the unit,  
damage to the unit may occur.

Description: Move Motor to Commanded Position.

Returns: Mnnnn

Example:

Send	Receive	Comments
<b>M7000</b>	<b>M7000</b>	Move Motor to Position 7000

Proper Move Command Implementation: (Example to move to position 7000)

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1. Send **L0002** to enable move command, delay 50 ms, read echoed **L0002** from serial port.
2. Send **M7000**, delay 50 ms, read echoed **M7000** from serial port.
3. Delay 2 sec, send **?M**, delay 50 ms, read response from serial port. If returned **?MM7000** then move is complete and successful.

#### More Efficient Move Command Implementation: (Example to move to position 7000)

1. Send **L0066**, delay for 50 ms, read echoed **L0066** from serial port. This will enable Auto RDY reply and M-command.
2. Send **M7000**, delay for 50 ms, read just the echoed **M7000** from serial port (4-bytes only).
3. Read from serial port every 30 ms until RDY is received. (If "T" is received, the commanded move position is out of range for this device)
4. Send **?H**, delay for 50 ms, read echoed **?HHC**. (If received **?HHN**, Set move command have failed, make sure pin-6 ENBM is enabled at high)
5. Send **?M**, delay for 50 ms, read echoed **?MM7000**. (If received any other positions, Set channel command have failed, make sure commanded position is valid)

## **L** Set Program Lock Bit

Syntax: Lnnnn

Operands: 0000 ≤ nnnn ≤ 0255      Only 8 bit number is allowed

bit0: (not used in OADM)

bit1: Enable M Commands

bit2: (not used in OADM)

bit3: Enable zero holding current during standby (To save some power, but sacrifice position accuracy)

bit4: (not used in OADM)

bit5: Disable Software Limit (Reserved for Optoplex use only, damage to device may occur)

bit6: Enable Auto RDY Reply

Default at Power Up: 0000

Description: Set Program Lock Bit

Returns: Dnnnn

Example:

Send	Receive	Comments
<b>L0002</b>	<b>L0002</b>	Enable M Command
<b>L0064</b>	<b>L0064</b>	Enable Auto RDY Reply, the device will return RDY when H, C, or M command is finished



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#### ? Quarry

Syntax: ?c

Operands: c ∈ [H,C,R,M,L]

Description: Quarry for home status or set channel status

Returns: ?c[HC,HN]

Examples:

	Send	Receive	Comments
	<b>?H</b>	<b>?HHC</b>	Home Completed
<b>or</b>	<b>?H</b>	<b>?HHN</b>	Home Not completed Possible causes: 1. Kill command received while homing. 2. Home index not found.

	Send	Receive	Comments
	<b>?C</b>	<b>?CC0015</b>	Set channel completed, current channel number is 15
<b>or</b>	<b>?C</b>	<b>?CC0000</b>	Set channel not completed Possible causes: 1. Kill command received while setting channel. 2. Set channel failed due to over-temperature or component failure.

Send	Receive	Comments
<b>?R</b>	<b>?Rrev0063...</b>	Read software revision (the first 4 digits 0063). The rest of characters after FW version number are for tunable filter's internal status for debug purpose only. Please ignore them.

Send	Receive	Comments
<b>?M</b>	<b>?MM4096</b>	Read current motor position

Send	Receive	Comments
<b>?L</b>	<b>?LL0064</b>	Read current program lock bits

#### **J Jog (To move in small wavelength increments around current wavelength)**

Syntax: Jnnnn

Operands: 0001 ≤ nnnn ≤ 0006      Actual range is unit dependent

Description: Jog Motor relative to current position

Returns: Jnnnn



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Example:

Send	Receive	Comments
<b>J0001</b>	<b>J0001</b>	Move Motor by -3 steps relative to current position
<b>J0002</b>	<b>J0002</b>	Move Motor by -2 steps relative to current position
<b>J0003</b>	<b>J0003</b>	Move Motor by -1 steps relative to current position
<b>J0004</b>	<b>J0004</b>	Move Motor by +1 steps relative to current position
<b>J0005</b>	<b>J0005</b>	Move Motor by +2 steps relative to current position
<b>J0006</b>	<b>J0006</b>	Move Motor by +3 steps relative to current position

## 8. Qualification and Reliability

The Optoplex Tunable Filter has passed Qualification Test. Refer to the *Tunable Filter Qualification Report*, DOC # REL-002-003 Rev 1.1.

## 9. Certification Requirements

If a requirement is met by certification, each production device shall be certified to meet that requirement before shipment and these requirements shall be certified over the temperature ranges indicated. The certification data sheet shipped with each product device shall include these final test data. The certification testing for insertion loss shall be performed without connectors to ensure consistent testing results.

Certification Data Requirements	Testing Condition	Pass/Fail Criteria
Peak Insertion Loss	0, 23 and 65°C	To Spec
Passband @ 1 dB	0, 23 and 65°C	To Spec
Bandwidth @ 20 dB	0, 23 and 65°C	To Spec
PDL	0, 23 and 65°C	To Spec

## 10. Device Labeling

Each device shall have a label including the following information

- |                            |                             |
|----------------------------|-----------------------------|
| A. Supplier name:          | Optoplex Corporation        |
| B. Device name:            | C-band 50GHz Tunable Filter |
| C. Supplier part number:   | <b>TO-1C2CT801</b>          |
| D. Supplier serial number: | Txxxx-xxxxxx                |