# BW10-10x0-T-T
# Application Notes

**7 Pin Open Lens cap package with TEC**

This application note describes handling precautions and power up procedure for 10x0nm sweep sources.

## Table of Contents

## 1. ESD handling and precautions

Electrostatic discharge (ESD) can damage the devices permanently and the device does not any ESD protection circuits. Therefore, it is very important to ensure proper ESD protection. Place the packed device on an ESD protected workstation i.e. before removing the ESD protection bag. You must wear a wrist strap and appropriate smocks made from dissipative material. Note that the smocks must be closed to ensure proper ESD protection. A good side for further ESD information is https://www.esda.org/about-esd/


CAUTION: Device is very sensitive to electrostatic discharge.

## 2. Transient pulse suppression and other precautions

Transient pulses can damage the devices in a system environment. Please ensure proper voltage and current filtering and especially transient pulse suppression of the signals fed into the devices when developing driving circuits.

The laser and tuning circuits should both be driven with floating sources. Do not use sources with earth ground If sources with earth ground cannot be avoided, please ensure that only one of the sources has earth ground or else that the earth ground of both devices is connected to pin 6. Failure to do so will cause a ground loop that may result in possible catastrophic damage to the device. In a laboratory environment we do recommend precise programmable power supply's as for example Keithley 2200 series for wavelength tuning and Keithley 2400 series as laser current sources.

## 3. Operation conditions.

Exceeding the operating conditions can result in a permanent damage of the device. Please do not exceed the maximum operation conditions given in the datasheet of the device. Especially do not exceed the maximum tuning voltage or the maximum operating current which can result in a permeant damage of the device.

## 4. Recommended equipment and connection to the device

Please ensure the first-time power on sequence in section 4.5 when you power up the device.

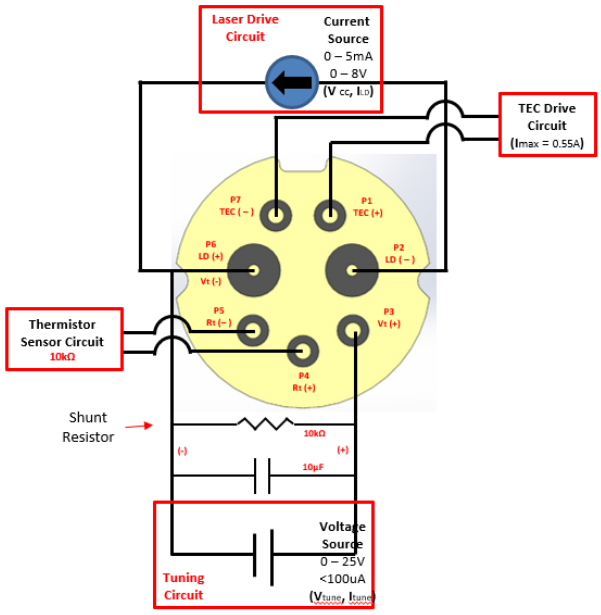


Figure 1: Electrical connection of the sweeping devices.

In Figure 1 the connection of the device is illustrated. In a laboratory environment we do recommend the equipment from the following manufacturers:

### 4.1. Best Performance Recommendations:

- Place the TO on a TO-Can mount or good thermal heat sink
- Clamp the TO down for best thermal contact
- The mount/heat sink fixed at or near typical room temperature

### 4.2. Driving the laser:

- **IMPORTANT:** The laser and tuning circuits should both be driven with floating sources.
- **DO NOT USE SOURCES WITH EARTH GROUND if possible!**
- If sources with earth ground cannot be avoided, please ensure that only one of the sources has earth ground or else that the earth ground of both devices is connected to pin 6. Failure to do so will cause a ground loop that may result in possible catastrophic damage to the device.
- Should be a precision current source for best stability
- (ideally with <10 µA noise)
- **NOTE:** Typical commercial laser driver current sources Do Not work well with VCSELs. (They are typically designed for Edge Emitters and the VCSEL differential resistance often trips the driver's protection circuitry.
- We recommend using a standard current source that is NOT DESIGNED FOR LASERS.

### 4.3. Tuning the Laser wavelength:

- As noted on previous page and shown on diagram below, the tuning bias voltage should be applied between the tuning pin (P3 / Vt+) and the laser drive pin (P6 / LD+).
- The voltage source should not exceed 25V (unless otherwise noted in the test sheet)
- The compliance current should not exceed 100 µA
- Notice that the wavelength tuning is approximately quadratic with voltage, so we recommend a 10 µF capacitor and 10 kΩ resistor in parallel with the tuning voltage source to reduce noise and guard against any transients. (see Figure 1)

### 4.4. The TEC and Thermistor:

- The TEC has an Imax of 0.55A
- P1 and P7 can connect to a standard TEC driving current
- P4 and P5 is connected to the thermistor which is a 10 kΩ sensor

### 4.5. First Time Setup Sequence:

Please follow the steps in order, do not proceed to a next step without completing a previous step.

1. Hook up all testing equipment, laser power source, tuning source and the TEC controller. Lots of supplies have transient pulse from the supply when first turn-on. We highly recommend to short the supply before opening to the diode.

2. Power up the equipment. Ensure that all outputs are disabled.

3. Connect all cables to the testing equipment.

4. Using ESD protection load the TO to mount or heat sink and clamp it down if possible.

5. Connect each testing equipment to the TO, starting with the Laser source, then the Tuning source, and finally the TEC/Thermistor controller.

6. If properly connected, the TEC controller should have a readout of the TEC's current temperature, which should be at the room temperature.

7. If TEC's required parameters are properly set and the controller is showing a room temperature readout, then set the controller to 25°C and turn it on.

8. For TO-can devices use collimating lenses in front of the fiber or bring the fiber very close to the output of the TO can and optimize the x-y-z axis to avoid excitations of the side peaks. Connect the collimator fiber output to an isolator and connect to a power meter or an optical spectrum analyzer or both using a fiber splitter

9. Once the TEC Controller shows the TO is stable at 25°C, it's ok to apply a 5mA bias current to the laser. At which time the TEC controller will show a jump in the TO temperature, this is normal and allow it to stabilize back to the 25°C set point.

10. Check the Laser source meter readouts to verify that,
    a. the voltage is within the expected range as noted on the Data Sheet
    b. the output power is at the expected power level for 5mA @25°C
    c. if there is a spectrometer connected, turn it on to see the wavelength of the TO at these set conditions

11. Double check the TEC controller is still holding the temperature at the set point.

12. Finally, turn on the tuning circuit source meter, starting at 0V, then slowly increase the voltage to max 6V to verify the device is properly connected and tuning.

13. Double check the TEC controller is still holding the temperature at the setpoint.

14. Now, apply various tuning voltages, not to exceed the limits found on the data sheet, to test out the changes in wavelength to get a good understanding of what the TO will tune to, (keeping a 100 µA compliance)

15. Now you have completed the initial setup sequence and the testing system and TO are ready for standard testing procedures as you need.

16. If one or more of these steps fail and several attempts to start over from the beginning continue to result in failure of a working and tunable laser or controlled temperature, then notify you BW10 contact for further support.

## 5. Optical spectrum as a function of voltage tuning

Once the devices are property setup you should be able to measure the optical output signal with a standard optical power meter operating around the lasing frequency of 10x0 nm. By applying a voltage of up to 25V you can see the wavelength sweeping on an optical spectrum analyzer. Figure 2 shows the typical characteristics of a typical device. Please note that the start and stop wavelength differs from device to device.

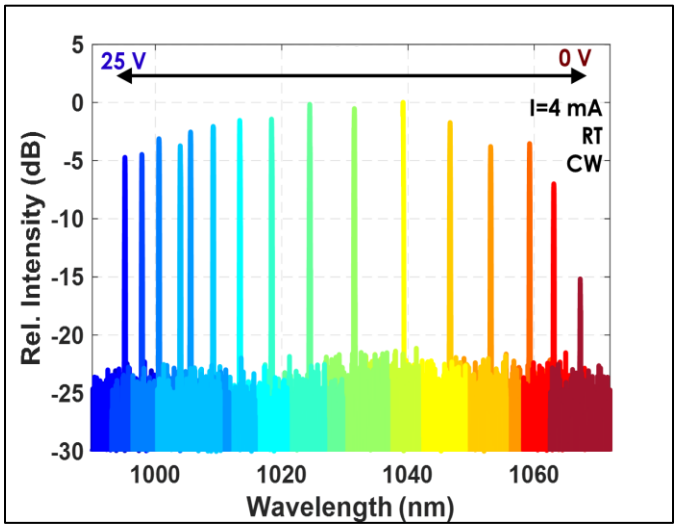


Figure 2: Optical Spectrum as a function of Tuning Voltage

## 6. TEC Parameters and Response

| Typical Performance under Controlled Conditions | | | | |
|---|---|---|---|---|
| | ΔTmax (K) | Qmax (W) | Imax (A) | Umax (V) |
| @ 27C | 0.71 | 0.30 | 0.55 | 1.0 |
| @ 75C | 0.89 | 0.40 | 0.55 | 1.3 |

**Typical Gain PID Settings**

P = 0.005

I = 0.0001

D = 0.01

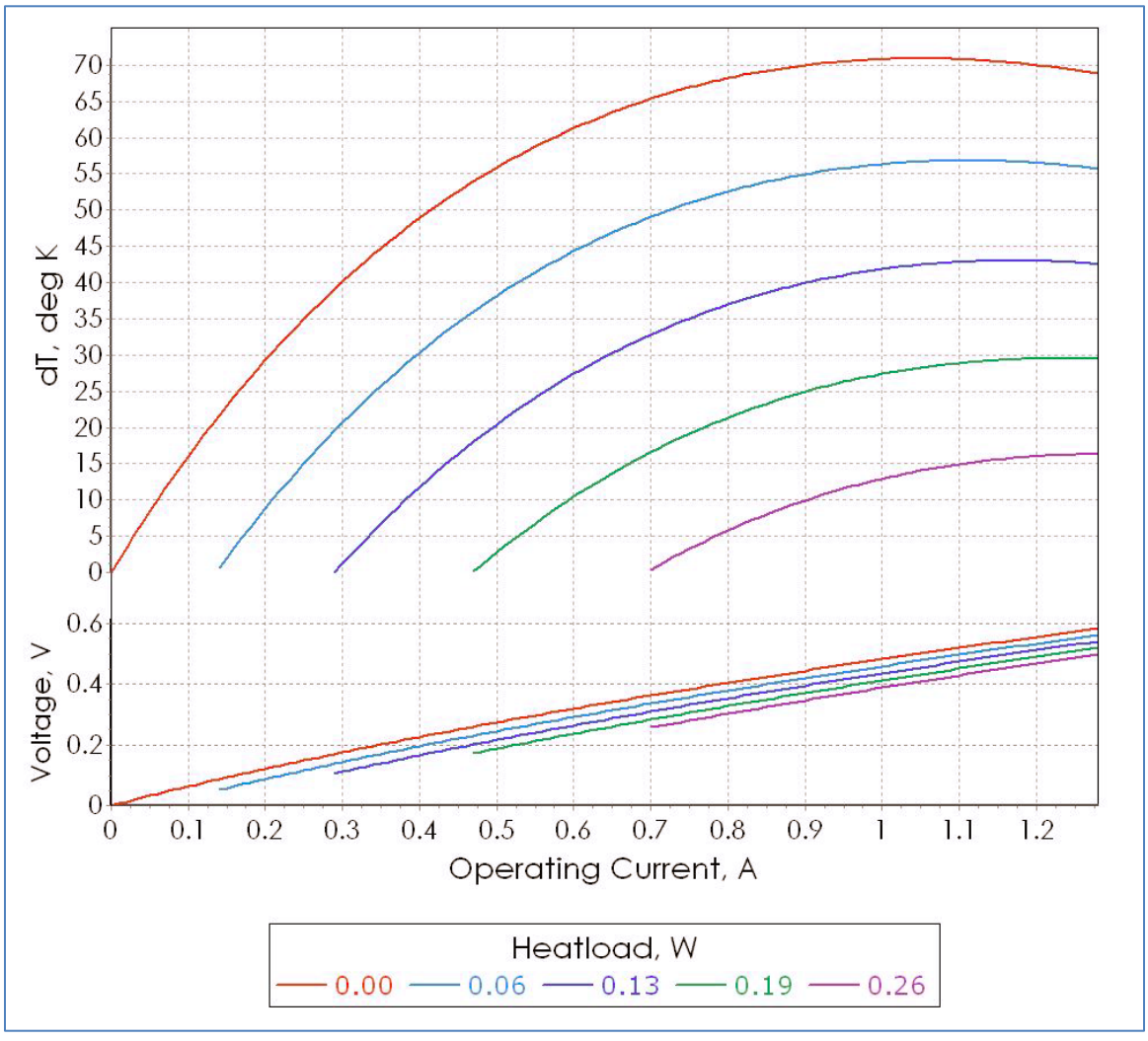


Figure 3 Typical TEC Performance under Lab Controlled Conditions, 10^-5 TORR Vacuum

## 7. Thermistor Performance Table

The thermistor is a standard 10kΩ thermistor. A table showing thermistor resistance over thermistor resistance at 25º C is shown below.

| °C | $R_t/R_{25}$ | °C | $R_t/R_{25}$ | °C | $R_t/R_{25}$ | °C | $R_t/R_{25v}$ | °C | $R_t/R_{25}$ |
|---|---|---|---|---|---|---|---|---|---|
| -50 | 67.0115 | -9 | 5.24025 | 32 | 0.74025 | 73 | 0.15816 | 114 | 0.045755 |
| -49 | 62.4122 | -8 | 4.96529 | 33 | 0.70983 | 74 | 0.15295 | 115 | 0.044531 |
| -48 | 58.1579 | -7 | 4.70621 | 34 | 0.68082 | 75 | 0.14793 | 116 | 0.043345 |
| -47 | 54.2210 | -6 | 4.46231 | 35 | 0.65314 | 76 | 0.14311 | 117 | 0.042196 |
| -46 | 50.5749 | -5 | 4.23247 | 36 | 0.62675 | 77 | 0.13846 | 118 | 0.041083 |
| -45 | 47.1985 | -4 | 4.01573 | 37 | 0.60157 | 78 | 0.13399 | 119 | 0.040004 |
| -44 | 44.0682 | -3 | 3.81144 | 38 | 0.57752 | 79 | 0.12969 | 120 | 0.038958 |
| -43 | 41.1655 | -2 | 3.61858 | 39 | 0.55456 | 80 | 0.12554 | 121 | 0.037945 |
| -42 | 38.4725 | -1 | 3.43675 | 40 | 0.53266 | 81 | 0.12155 | 122 | 0.036962 |
| -41 | 35.9716 | 0 | 3.26505 | 41 | 0.51172 | 82 | 0.11771 | 123 | 0.036009 |
| -40 | 33.6499 | 1 | 3.10302 | 42 | 0.49172 | 83 | 0.11400 | 124 | 0.035086 |
| -39 | 31.4920 | 2 | 2.94995 | 43 | 0.47262 | 84 | 0.11044 | 125 | 0.034190 |
| -38 | 29.4867 | 3 | 2.80530 | 44 | 0.45435 | 85 | 0.10700 | 126 | 0.033321 |
| -37 | 27.6208 | 4 | 2.66858 | 45 | 0.43689 | 86 | 0.10368 | 127 | 0.032478 |
| -36 | 25.8853 | 5 | 2.53931 | 46 | 0.42019 | 87 | 0.100484 | 128 | 0.031660 |
| -35 | 24.2694 | 6 | 2.41710 | 47 | 0.40422 | 88 | 0.097402 | 129 | 0.030867 |
| -34 | 22.7642 | 7 | 2.30140 | 48 | 0.38893 | 89 | 0.094430 | 130 | 0.030096 |
| -33 | 21.3619 | 8 | 2.19191 | 49 | 0.37431 | 90 | 0.091563 | 131 | 0.029349 |
| -32 | 20.0546 | 9 | 2.08829 | 50 | 0.36031 | 91 | 0.088797 | 132 | 0.028623 |
| -31 | 18.8354 | 10 | 1.99013 | 51 | 0.34687 | 92 | 0.086127 | 133 | 0.027919 |
| -30 | 17.6977 | 11 | 1.89719 | 52 | 0.33401 | 93 | 0.083552 | 134 | 0.027234 |
| -29 | 16.6360 | 12 | 1.80903 | 53 | 0.32168 | 94 | 0.081064 | 135 | 0.026570 |
| -28 | 15.6440 | 13 | 1.72553 | 54 | 0.30988 | 95 | 0.078666 | 136 | 0.025925 |
| -27 | 14.7176 | 14 | 1.64633 | 55 | 0.29857 | 96 | 0.076348 | 137 | 0.025299 |
| -26 | 13.8515 | 15 | 1.57121 | 56 | 0.28773 | 97 | 0.074109 | 138 | 0.024690 |
| -25 | 13.0418 | 16 | 1.49991 | 57 | 0.27735 | 98 | 0.071948 | 139 | 0.024099 |
| -24 | 12.2842 | 17 | 1.43235 | 58 | 0.26739 | 99 | 0.069860 | 140 | 0.023524 |
| -23 | 11.5754 | 18 | 1.36814 | 59 | 0.25784 | 100 | 0.067842 | 141 | 0.022966 |
| -22 | 10.9116 | 19 | 1.30718 | 60 | 0.24869 | 101 | 0.065901 | 142 | 0.022423 |
| -21 | 10.2899 | 20 | 1.24927 | 61 | 0.23990 | 102 | 0.064023 | 143 | 0.021895 |
| -20 | 9.70741 | 21 | 1.19424 | 62 | 0.23147 | 103 | 0.062208 | 144 | 0.021383 |
| -19 | 9.16150 | 22 | 1.14195 | 63 | 0.22338 | 104 | 0.060453 | 145 | 0.020884 |
| -18 | 8.64951 | 23 | 1.09223 | 64 | 0.21562 | 105 | 0.058757 | 146 | 0.020399 |
| -17 | 8.16902 | 24 | 1.04497 | 65 | 0.20816 | 106 | 0.057117 | 147 | 0.019928 |
| -16 | 7.71837 | 25 | 1.00000 | 66 | 0.20101 | 107 | 0.055527 | 148 | 0.019470 |
| -15 | 7.29500 | 26 | 0.95721 | 67 | 0.19413 | 108 | 0.053991 | 149 | 0.019024 |
| -14 | 6.89749 | 27 | 0.91649 | 68 | 0.18753 | 109 | 0.052505 | 150 | 0.018590 |
| -13 | 6.52404 | 28 | 0.87774 | 69 | 0.18118 | 110 | 0.051066 | | |
| -12 | 6.17302 | 29 | 0.84083 | 70 | 0.17508 | 111 | 0.049673 | | |
| -11 | 5.84286 | 30 | 0.80567 | 71 | 0.16922 | 112 | 0.048325 | | |
| -10 | 5.53247 | 31 | 0.77217 | 72 | 0.16358 | 113 | 0.047019 | | |

Figure 4: Thermistor table