

Layer 1222 can improve thermal coupling between microfluidic cartridge 1216 and thermal stage 1224. Optical detector elements 1220 can be directed at the top surface of microfluidic cartridge 1216.

[0290] FIGS. 45C and 45D show further cross-sectional views.

Example 6

Exemplary Optics Board

[0291] An exemplary optics board is shown schematically in FIG. 46, and is used to collect and amplify the fluorescent signature of a successful chemical reaction on a micro-fluidic cartridge, and control the intensity of LED's using pulse-width modulation (PWM) to illuminate the cartridge sample over up to four channels, each with two color options. Additionally, it receives instructions and sends results data back over an LVDS (low-voltage differential signaling) SPI (serial peripheral interface). In some embodiments there is a separate instance of this circuitry for each PCR channel that is monitored.

[0292] The power board systems include: a +12V input; and +3.3V, +3.6V, +5V, and -5V outputs, configured as follows: the +3.3V output contains a linear regulator, is used to power the LVDS interface, should maintain a +1-5% accuracy, and supply an output current of 0.35 A; the +3.6V output contains a linear regulator, is used to power the MSP430, should maintain a +/-5% accuracy, and supply an output current of 0.35 A; the +5V output contains a linear regulator, is used to power the plus rail for op-amps, should maintain a +1-5% accuracy, and supply an output current of 0.35 A; the -5V output receives its power from the +5V supply, has a mV reference, is used to power the minus rail for op-amps and for the photo-detector bias, should maintain a +/-1% voltage accuracy, and supply an output current of 6.25 mA +/-10%. Additionally, the power board has an 80 ohm source resistance, and the main board software can enable/disable the regulator outputs.

[0293] The main board interface uses a single channel of the LVDS standard to communicate between boards. This takes place using SPI signaling over the LVDS interface which is connected to the main SPI port of the control processor. The interface also contains a serial port for in-system programming.

[0294] The optical detection system of FIG. 46 comprises a control processor, LED drivers, and a photo-detection system. In the exemplary embodiment, the control processor is a TI MSP430F1611 consisting of a dual SPI (one for main board interface, and one for ADC interface) and extended SRAM for data storage. It has the functions of power monitoring, PWM LED control, and SPI linking to the ADC and main board. The LED drivers contain NPN transistor switches, are connected to the PWM outputs of the control processor, can sink 10 mA (12V per LED (80 mA total), and are single channel with 2 LEDs (one of each color) connected to each. The photo-detection system has two channels and consists of a photo-detector, high-sensitivity photo-diode detector, high gain current to voltage converter, unity gain voltage inverting amplifier, and an ADC. Additionally it contains a 16 channel Sigma-delta (only utilizing the first 8 channels) which is connected to the second SPI port of the control processor.

[0295] During assembly of the various components on to the PC board, such as may occur on a production line, there are the following considerations. The extremely high impedance of the photo-detection circuit means that a rigorous cleaning procedure must be employed. Such a procedure may

include, for example: After surface mount components are installed, the boards are washed on a Weskleen and blow dried upon exiting conveyor. The belt speed can be set at 20-30. The boards are soaked in an alcohol bath for approximately 3 minutes, then their entire top and bottom surfaces are scrubbed using a clean, soft bristle brush. The boards are baked in a 105° F. (40° C.) oven for 30 minutes to dry out all components.

[0296] After all the components are installed: the soldered areas of the boards can be hand wash using deionized water and a soft bristle brush. The same soldered areas can be hand washed using alcohol and a soft bristle brush. The boards are allowed to air dry. Once the board is cleaned, the optical circuitry must be conformal coated to keep contaminants out.

[0297] The foregoing description is intended to illustrate various aspects of the present technology. It is not intended that the examples presented herein limit the scope of the present technology. The technology now being fully described, it will be apparent to one of ordinary skill in the art that many changes and modifications can be made thereto without departing from the spirit or scope of the appended claims.

What is claimed:

1. An apparatus, comprising:
 - a receiving bay configured to receive a microfluidic cartridge;
 - at least one heat source thermally coupled to the cartridge and configured to carry out PCR on a microdroplet of polynucleotide-containing sample, in the cartridge;
 - a detector configured to detect presence of one or more polynucleotides in the sample; and
 - a processor coupled to the detector and the heat source, configured to control heating of one or more regions of the microfluidic cartridge.
2. The apparatus of claim 2, further comprising a registration member that is complementary to the microfluidic cartridge, whereby the receiving bay receives the microfluidic cartridge in a single orientation.
3. The apparatus of claim 1, wherein the processor is programmable to operate the detector to detect a polynucleotide or a probe thereof in a microfluidic cartridge located in the receiving bay.
4. The apparatus of claim 3, wherein the detector is an optical detector.
5. The apparatus of claim 4, wherein the optical detector comprises a light source that selectively emits light in an absorption band of a fluorescent dye and a light detector that selectively detects light in an emission band of the fluorescent dye, wherein the fluorescent dye corresponds to a fluorescent polynucleotide probe or a fragment thereof.
6. The apparatus of claim 5, wherein the optical detector comprises a bandpass-filtered diode that selectively emits light in the absorption band of the fluorescent dye and a bandpass filtered photodiode that selectively detects light in the emission band of the fluorescent dye.
7. The apparatus of claim 6, wherein the optical detector is configured to independently detect a plurality of fluorescent dyes having different fluorescent emission spectra, wherein each fluorescent dye corresponds to a fluorescent polynucleotide probe or a fragment thereof.
8. The apparatus of claim 6, wherein the optical detector is configured to independently detect a plurality of fluorescent dyes at a plurality of different locations, wherein each fluorescent dye corresponds to a fluorescent polynucleotide probe or a fragment thereof.