TABLE I

Logical input-output relationship for PD multiplexers

Control Bit 1	Control Bit 2	Control Bit 3	OE_NOT	Output
0	0	0	0	In1
0	0	0	1	HighZ
1	0	0	0	In2
1	0	0	1	HighZ
0	1	0	0	In3
0	1	0	1	HighZ
1	1	0	0	In4
1	1	0	1	HighZ
0	0	1	0	In5
0	0	1	1	HighZ
1	0	1	0	In6
1	0	1	1	HighZ
0	1	1	0	In7
0	1	1	1	HighZ
1	1	1	0	In8
1	1	1	1	HighZ

[0125] It will be appreciated by those skilled in the art that the first and second configurations, with and without optimal multiplexers **171**, are based on providing PD_ROW and PD_COL signals, each signal corresponding to a signal-generating circuit, or to a plurality of signal-generating circuits.

[0126] In accordance with the second configuration, separate current integrator cells are assigned to subgroups of column PDs and to subgroups of row PDs. E.g., one current integrator may be assigned to eight PDs. In this embodiment, multiple inputs to controller **150** are provided, one input for each subgroup. Controller **150**, as shown in FIG. **7**, may be used this way to accommodate 64 PDs grouped into eight subgroups, via eight input signals to controller **150**. Specifically, the eight inputs are PD_ROW__1, PD_ROW__2, PD_ROW__3, PD_ROW__4, PD_COL__1, PD_COL__2, TOUCH_SIGNAL and TOUCH_SIGNAL__2, where TOUCH_SIGNAL and TOUCH_SIGNAL__2 are used as PD_COL__3 and PD_COL__4, respectively.

[0127] vii. PD Current Integrator **180**

[0128] With regard to the type of integrator circuit used to bias and sample PD current as it enters controller **150**, several alternative configurations and methods of operation are provided.

[0129] According to a first configuration, each of the PD_ROW and the PD_COL signals entering controller **150** is coupled to a biasing resistor that sets the linear amplification, and to a capacitor that integrates the PD current over time. In this regard reference is now made to FIG. **18**A, which is a diagram of a resistor-based current integrator **180** used in conjunction with PD receivers **140** in a touch screen **100**, in accordance with an embodiment of the present invention. The dotted line shown in FIG. **18**A separates components internal to controller **150**, which are shown to the right of the dotted line, from components external to controller **150**, which appear to the left of the dotted line.

[0130] According to a second configuration, the biasing resistor is removed, and a transistor is used to set a voltage amplitude range.

[0131] In this regard, reference is now made to FIG. **18**B, which is a diagram of a transistor-based current integrator **180** used in conjunction with PD receivers **140** in a touch screen **100**, in accordance with an embodiment of the present invention. The dotted line shown in FIG. **18**B separates components internal to controller **150**, which are shown to the right of the dotted line, from components external to controller **150**, which appear to the left of the dotted line. A transistor T1 is located within controller **150**, and is used to efficiently control current sampled by a selected PD. In alternative embodiments of the present invention, components external to controller **150** are used to control the current.

[0132] When transistor T1 is open, capacitor C charges, and integrates the current, i, flowing through the photodiode. The voltage over C is given by

$$V=\int C\cdot i\,dt$$

When transistor T1 is closed, capacitor C discharges, and the voltage over C is reduced to 0 volts. In order to obtain a precise measure of the current, the sample and hold (S/H) element in FIG. **18**B is discharged before sample integration begins, and S/H is open through sample integration time. In this embodiment, the analog to digital converter ADC in FIG. **18**B is not active during integration time.

[0133] In an alternative embodiment, S/H is configured to sample at the end of the integration period, without previously having discharged the S/H internal capacitors. In this embodiment, there may be a voltage differential between the capacitor associated with S/H and the integrator circuit.

[0134] As indicated hereinabove with reference to controller **150**, elements illustrated in the figures as being external to controller **150** may, in other implementations, reside internal to controller **150**.

[0135] Reference is now made to FIG. **19**, which illustrates current integration over time, in accordance with an embodiment of the present invention. As shown in FIG. **19**, when transistor T1 is turned on, the current in capacitor C is reset to zero. When transistor T1 is turned off, capacitor C begins integrating current over time. The measurement used is the current value at the end of the sample window.

[0136] The transistor-based circuit offers several advantages over the use of resistors for setting the linear amplification of the PD signal. The resistors have a higher bias to low frequency noise, such as ambient light and, as such, the ambient light is amplified more than the light pulse. Moreover, the system measures the ambient light sensed by a designated PD prior to issuing a light pulse from a selected LED, in order to establish a baseline value. Thus resistor bias to low frequency ambient light amplifies the ambient light measurement more than the light pulse measurement. By eliminating these resistors, the system registers similar levels of bias for both ambient light measurements and light pulse measurements.

[0137] Another advantage of the transistor-based circuit is that the resistors in the resistor configurations require longer time to completely discharge between measurements, than transistor T1. In turn, this enables use of shorter intervals between measurements of successive PDs, as well as between successive measurements of the same PD. In particular, in cases in which a successive PD senses less ambient light, or other such noise, than a previous PD, a relatively long discharge interval is required to fully discharge the circuit below the ambient level of the previous PD with the resistor configurations. This problem is overcome in the transistor-based circuit, in which the resistors are eliminated. Since the current measurement is linearly integrated over time, with little residual current present in the measuring circuit, the transistor-based circuit requires uniform measuring intervals. As such, this configuration requires precise timing to ensure that the measurement be integrated over the same amount of time. In distinction, when resistors are used, because they are inher-