SensComp)))

The Electrostatic
Ultrasonic Sensor Experts.

6500 Ranging Module
Extended Inputs and Outputs

6500 Ranging Module Operation – Inputs and outputs

The 6500 Sonar Ranging Module contains 3 inputs (INIT, BINH, and BLNK) and two outputs (ECHO and OSC). The discussion below applies to the ranging module when connected to SensComp's Series 600 and Series 7000 Electrostatic Transducers.

Normal Operation (distances from 0.4 to 10.7 meters)

Of these inputs and outputs, only two are required for normal ultrasonic measurements of 0.4 to 10.7 meters (1.33 feet to 35 feet): INIT to initialize a cycle, and ECHO to report that a reflected sound wave has been received. In this case BINH and BLNK are not used and should not be connected.
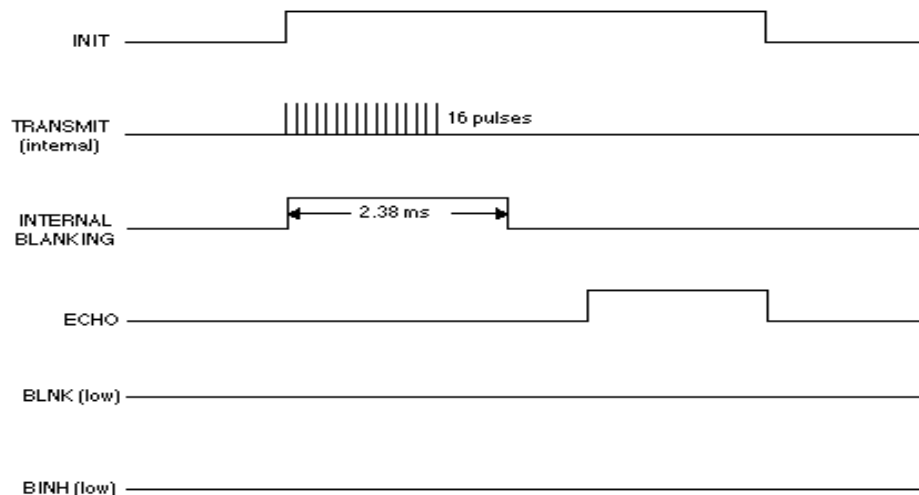
1. The 6500 ranging module transmits 16 ultrasonic pulses out to the transducer
2. The 6500 module has internal blanking for 2.38 ms before it internally switches to the receiving mode (to compensate for transmitting and transducer ringing)
3. The transducer receives the returning echo into the 6500 ranging module, generating ECHO.

INIT – (Initialize Input) – TTL Logic Input: When you (the user) assert this input signal (by a low level to a high-level transition), a write, then read, cycle is initiated. Note: the INIT signal must remain high until after receiving the returning signal for the returning ECHO signal to be detected.

ECHO – (Echo Return Output): – A received echo is detected by the 6500 Ranging Module, which then outputs a returning ECHO TTL level signal (by a low level to a high-level transition).

For the above normal operation, BLNK and BINH inputs can be left un-connected, or be connected to a logic LOW (ground return).

Using the time between INIT and ECHO, you can then calculate the distance between the sensor and the target as follows:

$$\textbf{D} \text{ (distance)} = \frac{\textbf{T} \text{ (time: INIT to ECHO)} \textbf{ X V} \text{ (speed of sound)}}{\textbf{2} \text{ (sensor to target and back to sensor)}}$$

Note: There is a slight acquisition time within the 6500 Ranging Module for the received echo signal of approximately 0.5 ms, which should be added to "T" above. This acquisition time will vary with the signal strength of the returning echo signal.

The speed of sound will also be affected by the temperature (and to a much less effect by the humidity) of the environment. The speed of sound in dry air is:

$$\upsilon_{\text{speed of sound}} \approx \left(331.4 + 0.6 T_C\right) \text{ m/s} \qquad T_C = \text{ Temperature in Celsius (from } 0° \text{ C)}$$

Close Range Operation using BINH (distances from 0.15 to 10.7 meters)

Normally the internal blanking of the ranging module prevents readings closer than 0.4 meters, due to the internal 2.38 ms blanking period. However, this blanking period can be manipulated with the signal BINH. The internal blanking time ceases at the moment when BINH switches from a TTL level logic 0 (low) to a logic 1 (high).

If this low to high transition occurs at 0.88 milliseconds, then the ranging module can receive an echo from an object as close as 0.15 meters (6 inches). BINH cannot be set to switch at a time of less than 0.88 milliseconds. A shorter time would result in the transmitting pulses and the initial ringing to create a false echo return. Due to the ringing characteristics of ultrasonic transducers, 6 inches is the minimum distance that can be measured.
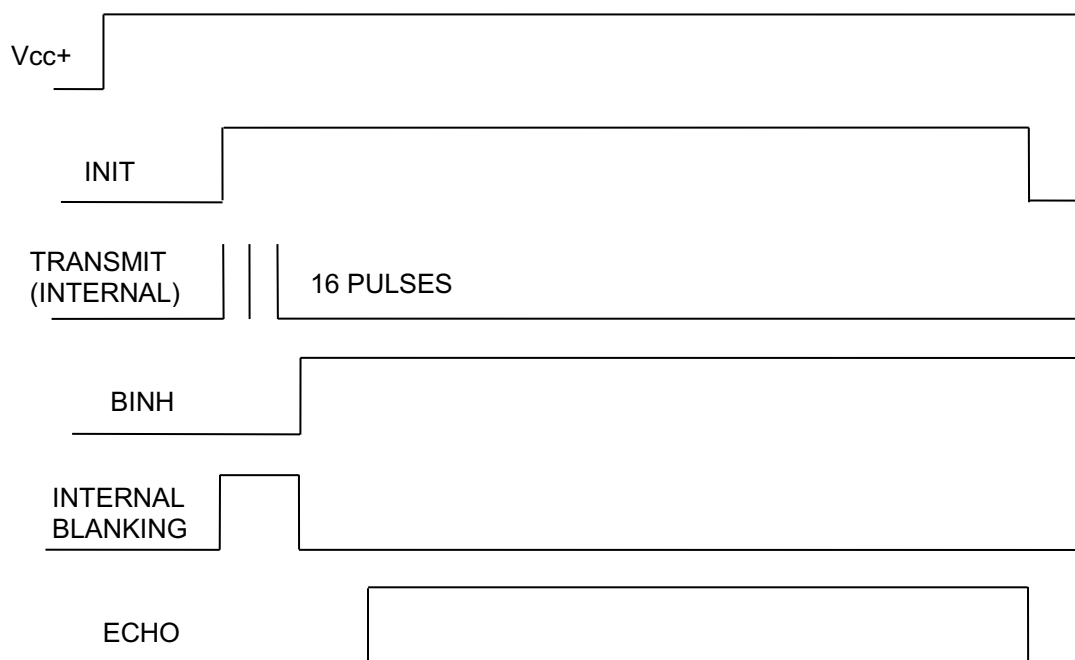
Multiple Echo Detection using BLNK

Normally the BLNK signal is not used. However, if you desire to receive multiple reflected signals and generate an ECHO output for each, then BLNK can perform this function.   Each time the BLNK transitions from a TTL level logic 0 (low) to a logic 1 (high), the ranging module's ECHO output is reset back to a logic 0 (low) and waits to receive another returning echo. This feature may be useful for ignoring the first echo returned, and then using the second for calculating the time between transmitting and receiving the ultrasonic sound wave.

The BLNK blanking signal must be at least 0.44 milliseconds in duration to account for all 16 returning pulses from the most distant target and to allow for internal ranging module circuit to reset.

Vcc+

INIT

TRANSMIT
(INTERNAL)   16 PULSES

INTERNAL
BLANKING

ECHO

BLNK
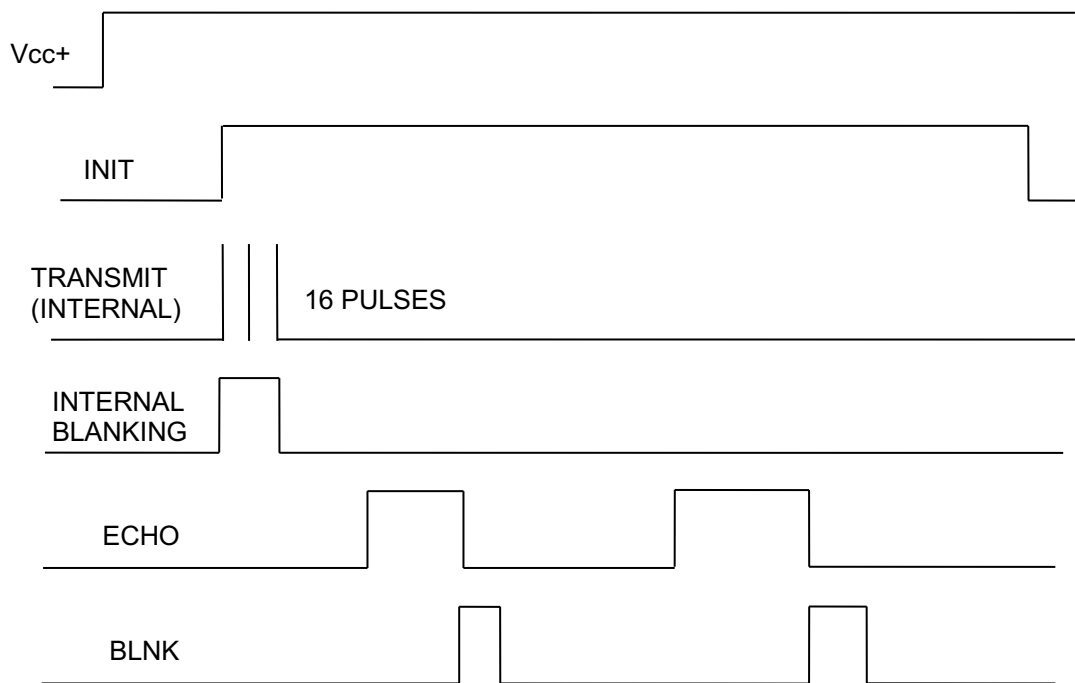
OSC - Oscillator Output: The Oscillator output provide an accurate timing signal that can be used for external controls and timing purposes. During transmit, the OSC output is 49.4 kHz, and during receive it is 93.3 kHz. When INIT is low, the OSC output is off. One such use may be a counter to calculate the time between INIT and ECHO.
Note: If the OSC output is utilized, it must be separated from the other ranging module inputs and outputs to prevent cross-coupling of the signals which could result in unpredictable results.

Pull-up Resistors: The #615078 and 615080 Ranging Module will require an external 4.7K ohm pull-up resistor on the ECHO output (and the OSC output if used). The 6500 Enhanced module (#615079) and the Smart Sensors contain internal 4.7K ohm pull-up resistors for both ECHO and OSC outputs.