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SMT Series 9000 Ranging Modules

SensComp's Ranging Modules provide the drive electronics for SensComp Series 9000 Ultrasonic Sensors

Features

- Accurate Sonar Ranging from 12 inches to 18 feet
- Drives a 45 kHz Series 9000 Piezoelectric Ultrasonic sensor Without an Additional Interface
- Operates from a Single Power Supply Source
- Accurate Clock Output Provided for External Use
- Selective Echo Exclusion
- TTL Compatible
- Multiple Measurement Capability
- Integrated Ultrasonic sensor Cable
- Variable Gain Control Potentiometer

Part No.

- PID# 615085 – SMT Series 9000 Ranging Module
- *PID# 615086 – SMT Series 9000E Ranging Module, Enhanced (Includes Pull-up Resistors and a Cycle Oscillator for Repetitive Operation)
- PID# 615087 – SMT Series 9000NC Ranging Module without Connector (J1)
- *RoHS Compliant

Description

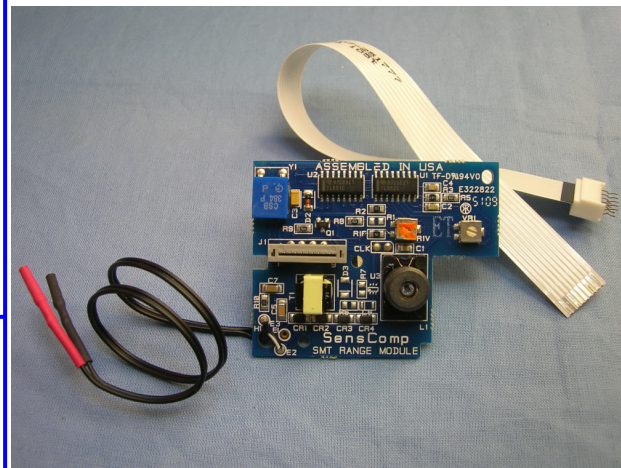
The SMT Series 9000 is an economical sonar ranging module that can drive SensComp's Series 9000 Piezoelectric Ultrasonic sensor. This module, with a simple interface, is able to measure distances from 12 inches to 18 feet. The typical accuracy is $\pm 1\%$ of the reading over the entire range.

This module has an external blanking input that allows selective echo exclusion for operation on a multiple-echo mode. The module is able to differentiate echoes from objects that are only three inches apart. The digitally controlled gain and variable bandwidth amplifier minimizes noise and side-lobe detection in sonar applications.

The module has an accurate ceramic resonator controlled 384 kHz time base generator. An output based on the 384 kHz time base is provided for external use. The sonar transmit output is 16 cycles at a frequency of 45 kHz.

The Series 9000 module operates over a DC power supply range from 4.5 volts to 6.8 volts (5 volts nominal) and is characterized for operation from 0° C to 70° C.

Specifications



PID#615085 Shown

Absolute Maximum Ratings over Operating Free-Air Temperature Range

Voltage from any pin to ground (see Note 1)	7 VDC
Voltage from any pin except XDGR to V_{CC} (see Note 1)	-7 VDC to 0.5 VDC
Operating free-air temperature range	0° C to 70° C
Storage temperature range	-40° C to 85° C

NOTE 1: The XDGR pin may be driven from -1 volt to 400 volts typical with respect to ground.

Recommended Operating Conditions

	MIN	MAX	UNIT
Supply Voltage, V_{CC}	4.5	6.8	V
High-level Input Voltage, V_{IH}	BLNK, BINH, INIT	2.1	V
Low-level Input Voltage, V_{IL}	BLNK, BINH, INIT	0.6	V
ECHO and OSC Output Voltage		6.8	V
Delay Time, Power Up to INIT High	5		ms
Recycle Period	80		ms
Operating Free-Air Temperature, T_A	0	70	°C

Electrical Characteristics over Recommended Ranges of Supply Voltage and Operating Free-Air Temperature

PARAMETER	TEST COND.	MIN	TYP	MAX	UNIT
Input Current	BLNK, BINH, INIT			1	mA
High-level Output Current, I_{OH}	ECHO, OSC			100	μ A
Low-level Output Voltage, V_{OL}	ECHO, OSC			0.4	V
Ultrasonic sensor Output Voltage (peak to peak)	$T_A = 25^\circ$ C		120		V
No. of Cycles for XDGR Output to Reach 120V	C = 500 pF			7	
Internal Blanking Interval			2.38†		ms
XMIT Drive Signal Duration			1.1†		ms
Frequency During 16-Pulse	OSC Output		45†		kHz
Transmit Period	XMIT Output		45†		kHz
Frequency After 16-Pulse	OSC Output		83.3†		kHz
Transmit Period	XMIT Output		0		kHz
Supply Current, I_{CC}	During Transmit Period			2000	mA
	After Transmit Period			100	mA

† These typical values apply for a 384 kHz ceramic resonator

Operation With SensComp Series 9000 Ultrasonic Sensors

There are two basic modes of operation for the Series 9000 Sonar Ranging Modules: Single-echo mode and multiple-echo mode. The application of power (V_{CC}), the application of the initiate (INIT) input, and the resulting transmit output, and the use of the Blanking Inhibit (BINH) input are basically the same for either mode of operation. After applying power (V_{CC}) a minimum of 5 milliseconds must elapse before the INIT signal can be taken high. During this time, all internal circuitry is reset and the internal oscillator stabilizes. When INIT is raised to a high level, drive to the ultrasonic sensor (XDGR) output occurs. Sixteen pulses at 45 kHz, with a 0 to 120 volts peak to peak amplitude, will excite the ultrasonic sensor as transmission occurs. At the end of the 16 transmitted pulses, the sonar ranging module switches to the receive mode.

In order to eliminate ringing of the ultrasonic sensor from being detected as a return signal, the Receive (REC) input of the ranging control IC is inhibited by internal blanking for 2.38 milliseconds after the initiate signal. If a reduced blanking time is desired, then the BINH input can be taken high to end the blanking of the Receive input any time prior to internal blanking. This may be desirable to detect objects closer than 1.33 feet (corresponding to 2.38 milliseconds) and may be done if ultrasonic sensor damping is sufficient so that ringing is not detected as a return signal.

In the single-echo mode of operation (Figure 1), all that must be done next is to wait for the return of the transmitted signal, traveling at approximately 0.9 milliseconds per foot out and back. The returning signal is amplified and appears as a high logic level echo output. The time between INIT going high and the Echo (ECHO) output going high is proportional to the distance of the target from the ultrasonic sensor. If desired, the cycle can now be repeated by returning INIT to a low logic level and then taking it high when the next transmission is desired.

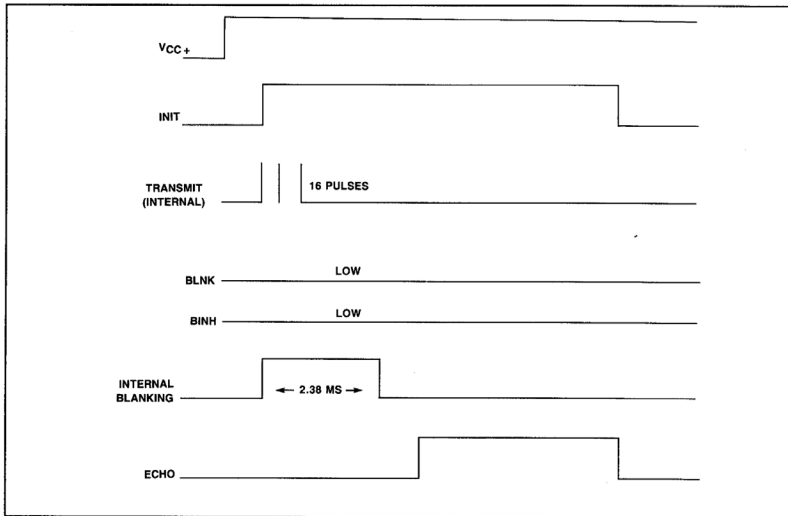


FIGURE 1: EXAMPLE OF A SINGLE-ECHO-MODE CYCLE WITHOUT BLANKING INPUT

If there is more than one target and a single transmission detects multiple echoes, then the cycle is slightly different (Figure 2). After receiving the first return signal which causes the ECHO output to go high, the Blanking (BLNK) input must be taken high then back low to reset the ECHO output for the next return signal. The blanking signal must be at least 0.44 milliseconds in duration to account for all 16 returning pulses from the first target and allow for internal delay times. This corresponds to the two targets being 3 inches apart.

During a cycle starting with INIT going high, the receiver amplifier gain is increased at discrete times (Figure 3) since the transmitted signal is attenuated with distance. At approximately 38 milliseconds, the maximum gain is attained. Although gain can be increased by varying R1 (see Component Layout), there is a limit to which the gain can be increased for reliable module operation. This will vary from application to application. The modules are “kitted” prior to their final test during manufacture. This is necessary because the desired gain distribution is much narrower than the module gain distribution if all were kitted with one value resistor. As kitted, these modules will perform satisfactorily in most applications. As a rule of thumb, the gain can be increased up to a factor of 4, if required, by increasing R1 correspondingly. Gain is directly proportional to R1.

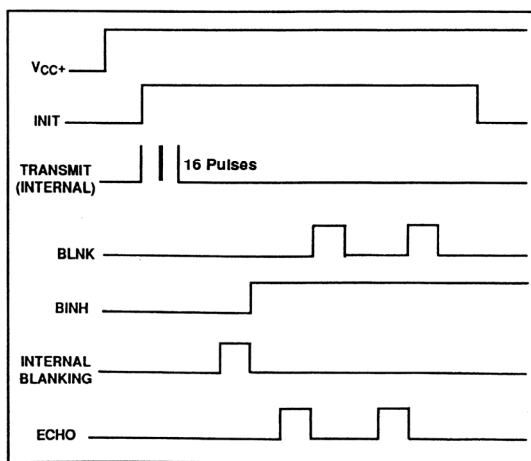


FIGURE 2: EXAMPLE OF A MULTIPLE-ECHO-MODE CYCLE WITH BLANKING INPUT

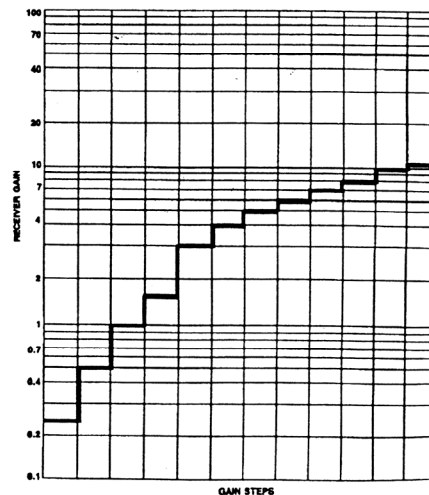


FIGURE 3: RECEIVER GAIN VS GAINSTEP NUMBERS

Input/Output Schematic Notes:

The ECHO and OSC outputs are open collector NPN transistor outputs (Figure 4) requiring 4.7K ohm pull-up resistors between V_{CC} and the output.

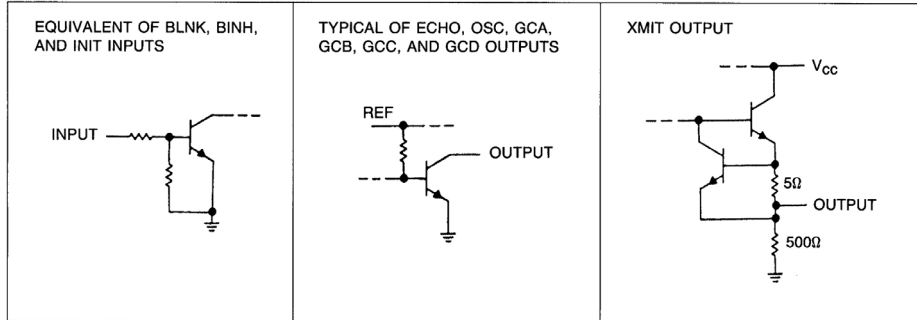
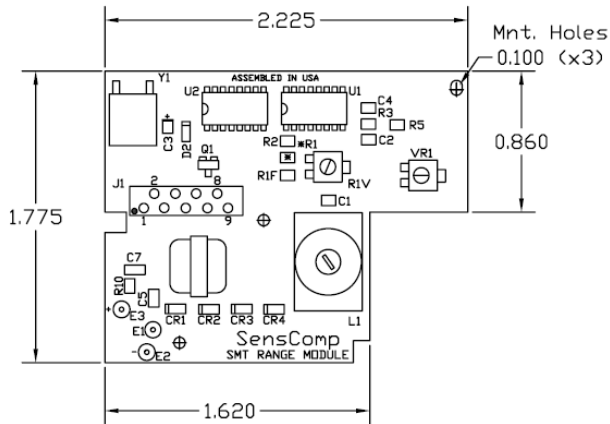
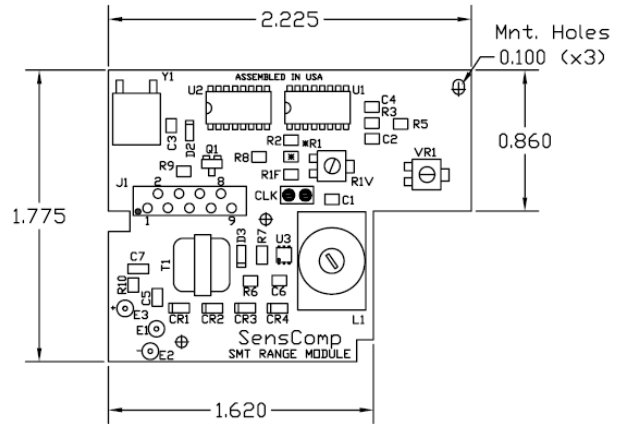


FIGURE 4: SCHEMATIC EQUIVALENT CIRCUITS OF BOARD INPUTS/OUTPUTS

Component Layouts

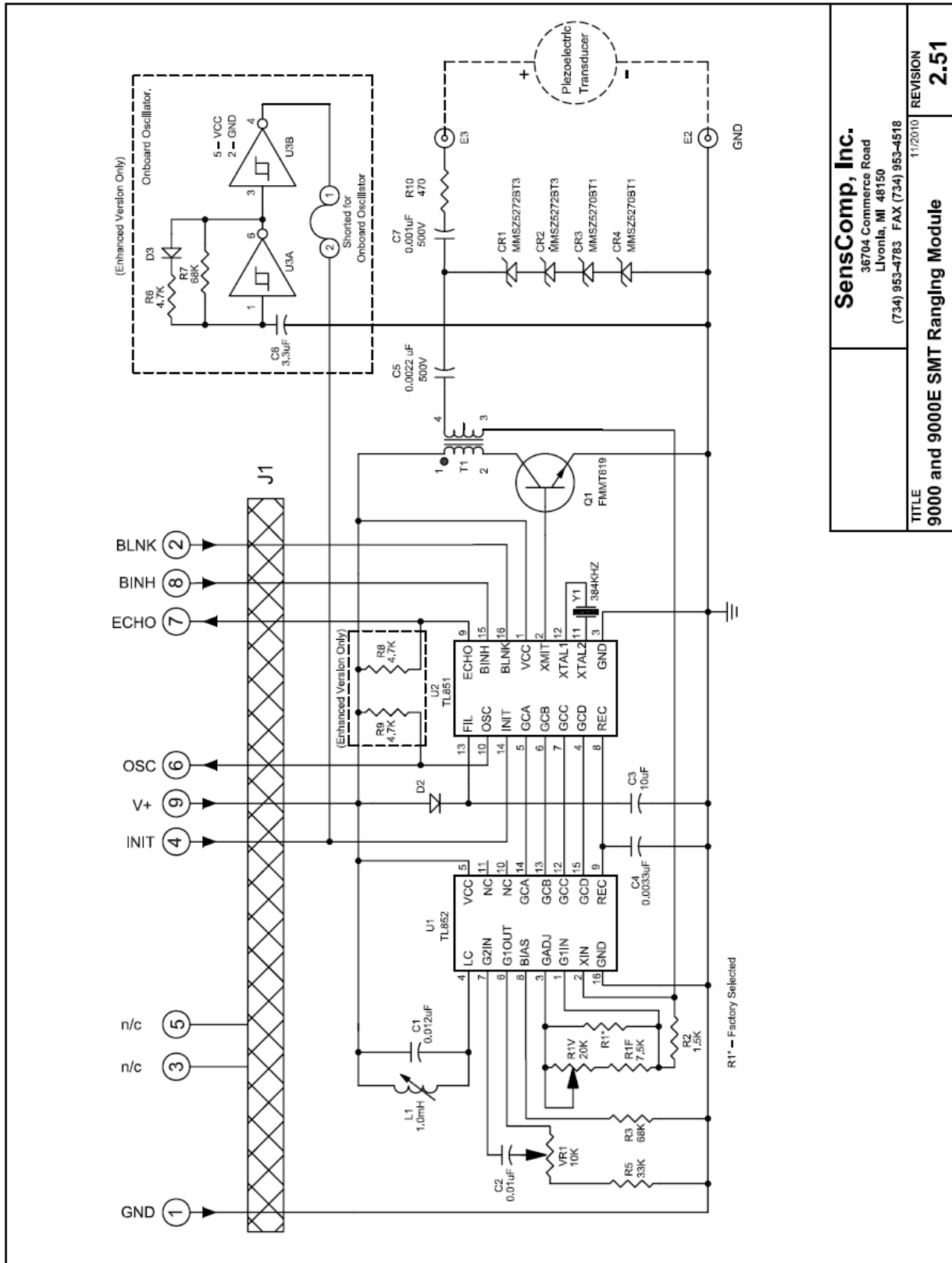


SMT Series 9000 Ranging Module (PID#615085)



SMT Series 9000E Ranging Module (PID#615068)

Schematic – 9000(E) SMT Ranging Module



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TITLE 9000 and 9000E SMT Ranging Module	REVISION 11/2010 2.51

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