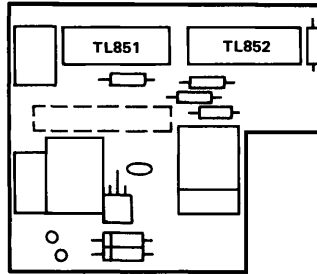


SN28827 SONAR RANGING MODULE

D2780, OCTOBER 1983—REVISED MARCH 1988

- Accurate Sonar Ranging from 6 Inches to 35 Feet
- Drives 50-kHz Electrostatic Transducer with No Additional Interface
- Operates from Single Supply
- Accurate Clock Output Provided for External Use
- Selective Echo Exclusion
- TTL-Compatible
- Multiple Measurement Capability
- Uses TL851 and TL852 Sonar Ranging Integrated Circuits



See schematic, Figure 4, for terminal assignments.

description

The SN28827 is an economical sonar ranging module that can drive a 50-kHz, 300-V electrostatic transducer with no additional interface. This module, with a simple interface, is able to measure distances of from 6 inches to 35 feet. The typical absolute accuracy is $\pm 2\%$ at one foot or greater.

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

The module has an accurate ceramic-resonator-controlled 420-kHz time-base generator. An output based on the 420-kHz time base is provided for external use. The sonar transmit output is 16 pulses at a frequency of 49.4 kHz.

The SN28827 operates over a supply voltage range of from 4.5 V to 6.8 V and is characterized for operation from 0°C to 40°C.

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

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

NOTE 1: The XDCR pin may be driven from -1 V to 300 V typical with respect to ground.

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Special Functions

PRODUCTION DATA documents contain information current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

TEXAS
INSTRUMENTS

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SN28827 SONAR RANGING MODULE

recommended operating conditions

	MIN	MAX	UNIT
Supply voltage, V_{CC}	4.5	6.8	V
High-level input voltage, V_{IH}	BLNK, BINH, INIT		V
Low-level input voltage, V_{IL}	BLNK, BINH, INIT		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	40	°C

electrical characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP [†]	MAX	UNIT
Input current	BLNK, BINH, INIT	$V_I = 2.1$ V			1	mA
High-level output current, I_{OH}	ECHO, OSC	$V_{OH} = 5.5$ V			100	μ A
Low-level output voltage, V_{OL}	ECHO, OSC	$I_{OL} = 1.6$ mA			0.4	V
Transducer bias voltage				150		V
Transducer output voltage (peak-to-peak)				300		V
Number of cycles for XDCR output to reach 300 V		$C = 500$ pF			7	
Internal blanking interval		See Note 2		2.38		ms
Frequency during 16-pulse transmit period	OSC output	See Note 2		49.4		kHz
	XMIT output			49.4		
Frequency after 16-pulse transmit period	OSC output	See Note 2		93.3		kHz
	XMIT output			0		
Supply current, I_{CC}	During transmit period				2000	mA
	After transmit period				100	

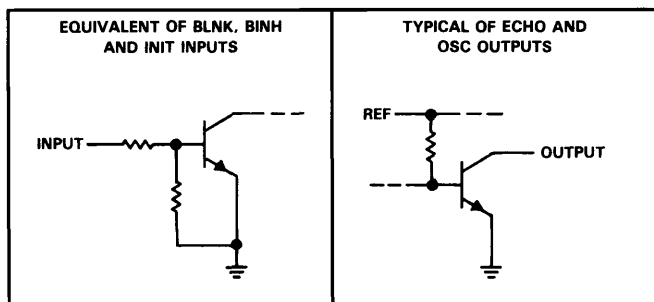
[†]All typical values are at $V_{CC} = 5$ V and $T_A = 25$ °C.

NOTE 2: These typical values apply for a 420-kHz ceramic resonator.

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Special Functions

schematics of inputs and outputs



operation with Polaroid electrostatic transducer

There are two basic modes of operation for the SN28827 Sonar ranging module: single-echo mode and multiple-echo mode. The application of power (V_{CC}), the activation 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 ms must elapse before the INIT input can be taken high. During this time, all internal circuitry is reset and the internal oscillator stabilizes. When INIT is taken high, drive to the Transducer (XDCR) output occurs. Sixteen pulses at 49.4 kHz with 300-V amplitude will excite the transducer as transmission occurs. At the end of the 16 transmit pulses, a dc bias of 150 V will remain on the transducer as recommended for optimum operation by the transducer manufacturer.

In order to eliminate ringing of the transducer from being detected as a return signal, the receive (REC) input of the ranging control IC is inhibited by internal blanking for 2.38 ms 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 anytime prior to internal blanking. This may be desired to detect objects closer than 1.33 feet corresponding to 2.38 ms and may be done if transducer damping is sufficient 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 ms 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 transducer. 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.

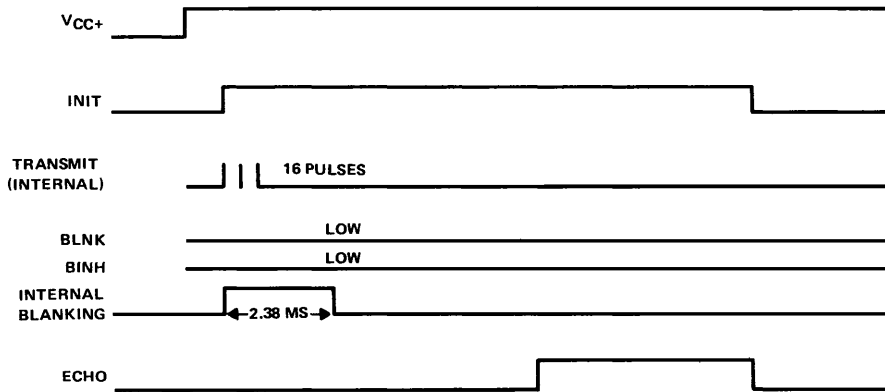


FIGURE 1. EXAMPLE OF A SINGLE-ECHO-MODE CYCLE WITHOUT BLANKING INPUT

If there is more than one target and multiple echos are to be detected from a single transmission, 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 ms 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.

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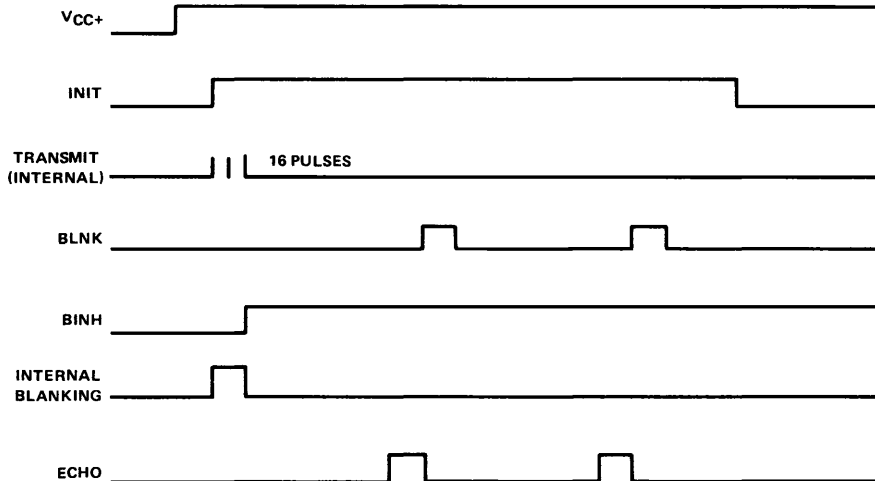


FIGURE 2. EXAMPLE OF A MULTIPLE-ECHO-MODE CYCLE WITH BLANKING INPUT

During a cycle starting with INIT going high, the receiver amplifier gain is incremented higher at discrete times (Figure 3) since the transmitted signal is attenuated with distance. At approximately 38 ms, the maximum gain is attained. For this reason, sufficient gain may not be available for objects greater than

RECEIVER GAIN
vs
GAINSTEP NUMBERS

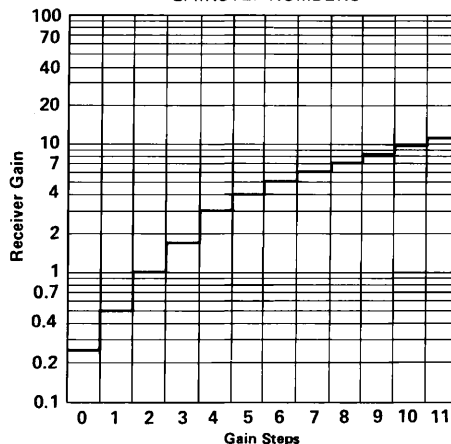


FIGURE 3

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Special Functions

35 feet away. Although gain can be increased by varying R1 (Figure 4), 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 by up to a factor of 4, if required, by increasing R1 correspondingly. Gain is directly proportional to R1.

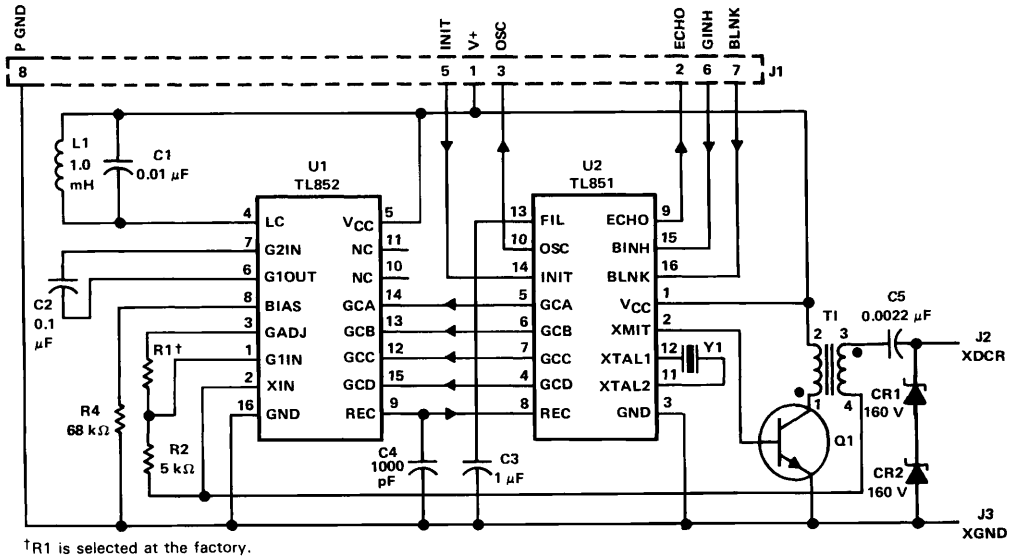
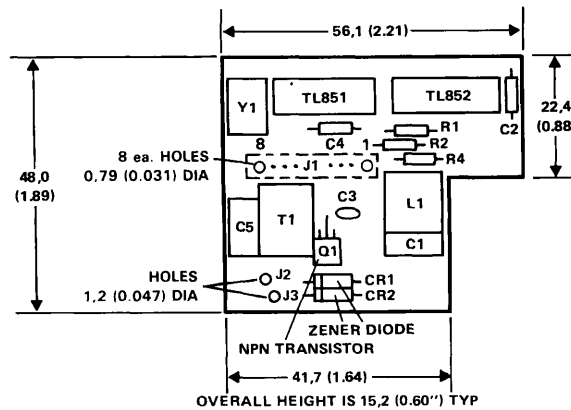


FIGURE 4. SCHEMATIC



NOTE: All dimensions are in millimeters and parenthetically in inches.

FIGURE 5. COMPONENT LAYOUT AND DIMENSIONS OF MODULE