Signetics

SAA3004
Infrared Transmitter

Product Specification

Linear Products

DESCRIPTION

The SAA3004 transmitter IC is designed for infrared remote control systems. It has a total of 448 commands which are divided into 7 subsystem groups with 64 commands each. The subsystem code may be selected by a press button, a slider switch or hard wired.

The SAA3004 generates the pattern for driving the output stage. These patterns are pulse distance coded. The pulses are infrared flashes or modulated. The transmission mode is defined in conjunction with the subsystem address. Modulated pulses allow receivers with narrow-band preamplifiers for improved noise rejection to be used. Flashed pulses require a wide-band preamplifier within the receiver.

FEATURES

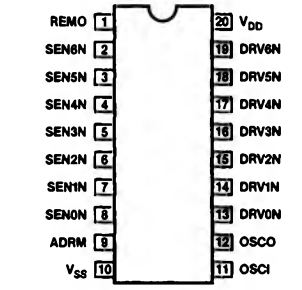
- **Flashed or modulated transmission**
- **7 subsystem addresses**
- **Up to 64 commands per subsystem address**
- **High-current remote output at V_{DD} = 6V ($-I_{OH}$ = 40mA)**
- **Low number of additional components**
- **Key release detection by toggle bits**
- **Very low standby current ($< 2\mu A$)**
- **Operational current < 2mA at 6V supply**
- **Wide supply voltage range (4 to 11V)**
- **Ceramic resonator controlled frequency (typ. 450kHz)**
- **Encapsulation: 20-lead plastic DIP or 20-lead plastic mini-pack (SO-20)**

APPLICATIONS

- **TV**
- **Audio**

PIN CONFIGURATION

N, D Packages



TOP VIEW

CD12000S

PIN NO.	SYMBOL	DESCRIPTION
1	REMO	Remote data output
2	SEN6N	Key matrix sense inputs
3	SEN5N	
4	SEN4N	
5	SEN3N	
6	SEN2N	
7	SEN1N	
8	SEN0N	
9	ADRM	Address mode control input
10	V_{SS}	Ground
11	OSCI	Oscillator input
12	OSCO	Oscillator output
13	DRV0N	Key matrix drive outputs
14	DRV1N	
15	DRV2N	
16	DRV3N	
17	DRV4N	
18	DRV5N	
19	DRV6N	
20	V_{DD}	Positive supply

ORDERING INFORMATION

DESCRIPTION	TEMPERATURE RANGE	ORDER CODE
20-Pin Plastic DIP (SOT-146C1)	−20°C to +70°C	SAA3004PN
20-Pin Plastic SOL (SOT-163AC3)	−20°C to +70°C	SAA3004TD

ABSOLUTE MAXIMUM RATINGS

SYMBOL	PARAMETER	RATING	UNIT
V_{DD}	Supply voltage range	−0.5 to +15	V
V_I	Input voltage range	−0.5 to V_{DD} + 0.5	V
V_O	Output voltage range	−0.5 to V_{DD} + 0.5	V
$\pm I$	DC current into any input or output	10	mA
$-I_{(REMO)M}$	Peak REMO output current during 10μs; duty factor = 1%	300	mA
P_{TOT}	Power dissipation per package for T_A = −20 to +70°C	200	mW
T_{STG}	Storage temperature range	−65 to +150	°C
T_A	Operating ambient temperature range	−20 to +70	°C

DC ELECTRICAL CHARACTERISTICS V_{SS} = 0V; T_A=25°C, unless otherwise specified.

SYMBOL	PARAMETER	V_{DD} (V)	LIMITS			UNIT
			Min	Typ	Max	
V_{DD}	Supply voltage T_A = 0 to +70°C		4		11	V
I_{DD} I_{DD}	Supply current; active f_{OSC} = 455kHz; REMO output unloaded	 6 9		 1 3		 mA mA
I_{DD} I_{DD}	Supply current; inactive (stand-by mode) T_A = 25°C	 6 9			 2 2	 µA µA
f_{OSC}	Oscillator frequency (ceramic resonator)	4 to 11	400		500	kHz
Keyboard matrix						
	Inputs SEN0N to SEN6N					
V_{IL}	Input voltage LOW	4 to 11			0.2 × V_{DD}	V
V_{IH}	Input voltage HIGH	4 to 11	0.8 × V_{DD}			V
$-I_I$ $-I_I$	Input current V_I = 0V	 4 11	 10 30		 100 300	 µA µA
I_I	Input leakage current V_I = V_{DD}	 11			 1	 µA
	Outputs DRV0N to DRV6N					
V_{OL} V_{OL}	Output voltage "ON" I_O = 0.1mA I_O = 1.0mA	 4 11			 0.3 0.5	 V V
I_O	Output current "OFF" V_O = 11V	 11			 10	 µA
Control input ADRM						
V_{IL}	Input voltage LOW				0.8 × V_{DD}	V
V_{IH}	Input voltage HIGH		0.2 × V_{DD}			V
	Input current (switched P-and N-channel pull-up/pull-down)					
I_{IL} I_{IL}	Pull-up active standby voltage: 0V	4 11	10 30		100 300	µA µA
I_{IH} I_{IH}	Pull-down active standby voltage: V_{DD}	4 11	10 30		100 300	µA µA
Data output REMO						
V_{OH} V_{OH}	Output voltage HIGH $-I_{OH}$ = 40mA	6 9	3 6			V V
V_{OL} V_{OL}	Output voltage LOW I_{OL} = 0.3mA	6 9			0.2 0.1	V V
Oscillator						
I_I	Input current OSCI at V_{DD}	6	0.8		2.7	µA
V_{OH}	Output voltage HIGH $-I_{OL}$ = 0.1mA	6			V_{DD} - 0.6	V
V_{OL}	Output voltage LOW I_{OH} = 0.1mA	6			0.6	V

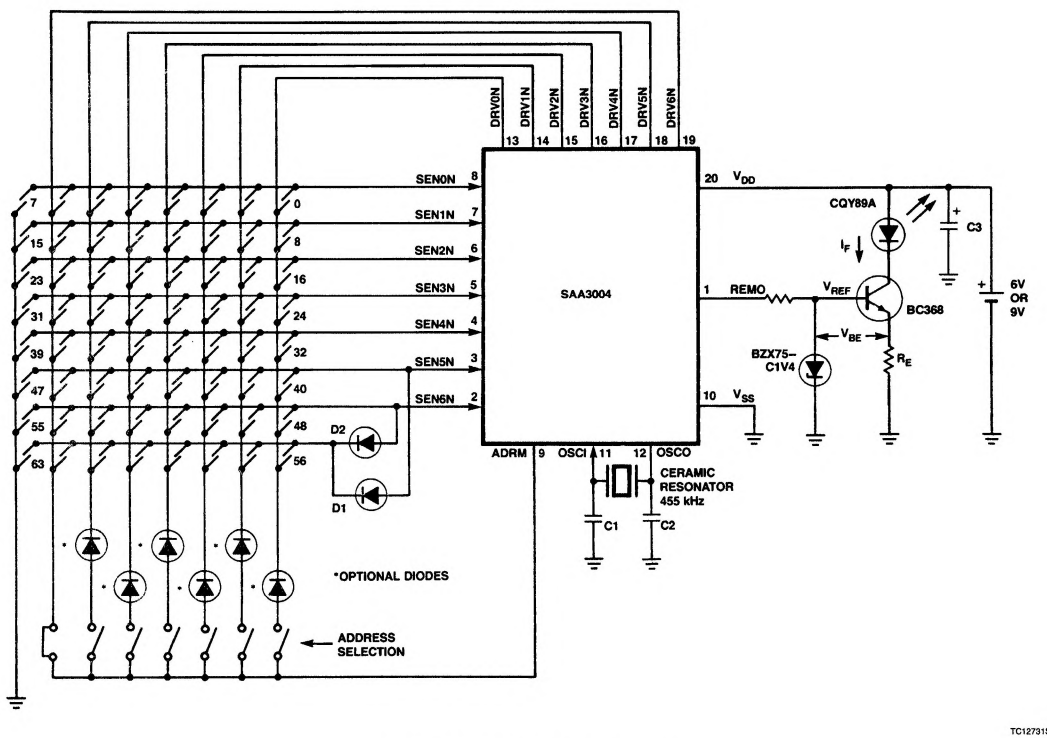


Figure 1. Transmitter With SAA3004

INPUTS AND OUTPUTS

Key Matrix Inputs and Outputs (DRV0N to DRV6N and SEN0N to SEN6N)

The transmitter keyboard is arranged as a scanned matrix. The matrix consists of 7 driver outputs and 7 sense inputs as shown in Figure 1. The driver outputs DRV0N to DRV6N are open-drain N-channel transistors and they are conductive in the stand-by mode. The 7 sense inputs (SEN0N to SEN6N) enable the generation of 56 command codes. With 2 external diodes all 64 commands are addressable. The sense inputs have P-channel pull-up transistors, so that they are HIGH until they are pulled LOW by connecting them to an output via a key depression to initiate a code transmission.

Address Mode Input (ADRM)

The subsystem address and the transmission mode are defined by connecting the ADRM input to one or more driver outputs (DRV0N to DRV6N) of the key matrix. If more than one driver is connected to ADRM, they must be decoupled by a diode. This allows the definition of seven subsystem addresses as shown in Table 3. If driver DRV6N is connected to ADRM the data output format of REMO is modulated or if not connected, flashed.

The ADRM input has switched pull-up and pull-down loads. In the stand-by mode only the pull-down device is active. Whether ADRM is open (subsystem address 0, flashed mode) or connected to the driver outputs, this input is LOW and will not cause unwanted dissipation. When the transmitter becomes active by pressing a key, the pull-down device is switched off and the pull-up device is switched on, so that the applied driver signals are sensed for the decoding of the subsystem address and the mode of transmission.

The arrangement of the subsystem address coding is such that only the driver DRVnN with the highest number (n) defines the subsystem address, e.g., if driver DRV2N and DRV4N are connected to ADRM, only DRVN4N will define the subsystem address. This option can be used in transmitters for more than one subsystem address. The transmitter may be hard-wired for subsystem address 2 by connecting DRV1N to ADRM. If now DRV3N is added to ADRM by a key or a switch, the transmitted subsystem address changes to 4.

A change of the subsystem address will not start a transmission.

Remote Control Signal Output (REMO)

The REMO signal output stage is a push-pull type. In the HIGH state a bipolar emitter-follower allows a high output current. The timing of the data output format is listed in Tables 1 and 2.

The information is defined by the distance t_b between the leading edges of the flashed pulses or the first edge of the modulated pulses (see Figure 3).

The format of the output data is given in Figures 2 and 3. In the flashed transmission mode, the data word starts with two toggle bits, T1 and T0, followed by three bits for defining the subsystem address S2, S1 and S0, and six bits F, E, D, C, B and A, which are defined by the selected key.

In the modulated transmission mode the first toggle bit, T1, is replaced by a constant reference time bit (REF). This can be used as a reference time for the decoding sequence.

The toggle bits function as an indication for the decoder that the next instruction has to be considered as a new command.

The codes for the subsystem address and the selected key are given in Tables 3 and 4.

Oscillator Input/Output (OSCI and OSCO)

The external components must be connected to these pins when using an oscillator with a ceramic resonator. The oscillator frequency may vary between 400kHz and 500kHz as defined by the resonator.

FUNCTIONAL DESCRIPTION

Keyboard Operation

In the standby mode all drivers (DRV0N to DRV6N) are on. Whenever a key is pressed, one or more of the sense inputs (SENnN) are tied to ground. This will start the power-up sequence. First the oscillator is activated and after the debounce time t_{DB} (see Figure 4) the output drivers (DRV0N to DRV6N) become active successively.

Within the first scan cycle the transmission mode, the applied subsystem address and the selected command code are sensed and loaded into an internal data latch. In contradiction to the command code the subsystem address is sensed only within the first scan cycle. If the applied subsystem address is changed while the command key is pressed, the transmitted subsystem address is not altered.

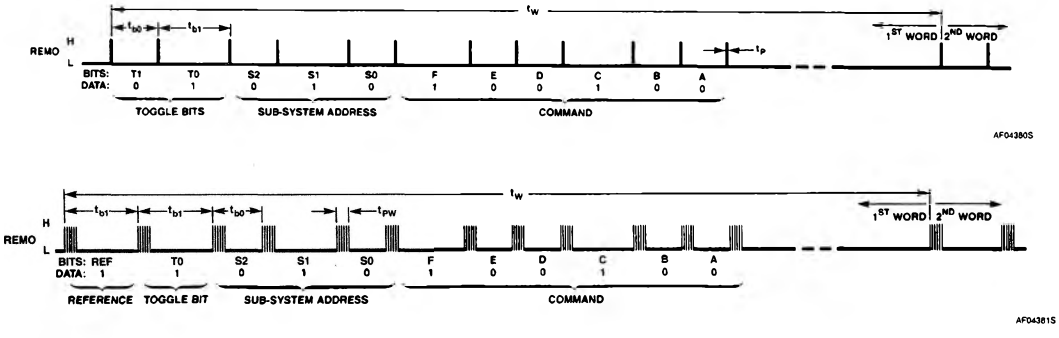
In a multiple keystroke sequence (see Figure 5), the command code is always altered in accordance with the sensed key.

Multiple Keystroke Protection

The keyboard is protected against multiple keystrokes. If more than one key is pressed at the same time, the circuit will not generate a new output at REMO (see Figure 5). In case of a multiple keystroke the scan repetition rate is increased to detect the release of a key as soon as possible.

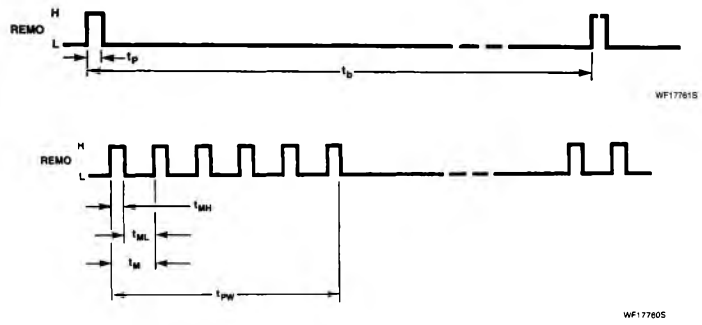
There are two restrictions caused by the special structure of the keyboard matrix:

- The keys switching to ground (code numbers 7, 15, 23, 31, 39, 47, 55 and 63) and the keys connected to SEN5N and SEN6N are not covered completely by the multiple key protection. If one sense input is switched to ground, further keys on the same sense line are ignored.
- SEN5N and SEN6N are not protected against multiple keystroke on the same driver line, because this condition has been used for the definition of additional codes (code numbers 56 to 63).



NOTES:
a. Flashed mode: transmission with 2 toggle bits and 3 address bits, followed by 6 command bits (pulses are flashed).
b. Modulated mode: transmission with reference time, toggle bit and 3 address bits, followed by 6 command bits (pulses are modulated).

Figure 2. Data Format of REMO Output; REF = Reference Time; T0 and T1 = Toggle Bits; S0, S1 and S2 = System Address; A, B, C, D, E, and F = Command Bits



NOTES:
1. Flashed pulse.
2. Modulated pulse ($t_{PW} = (5 \times t_M) + t_{MH}$).

Figure 3. REMO Output Waveform

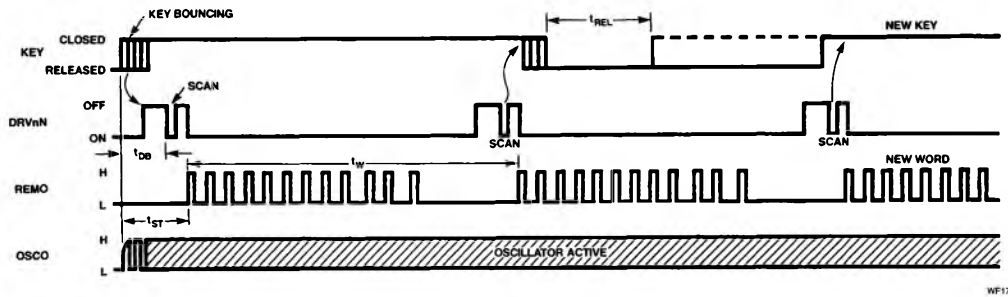
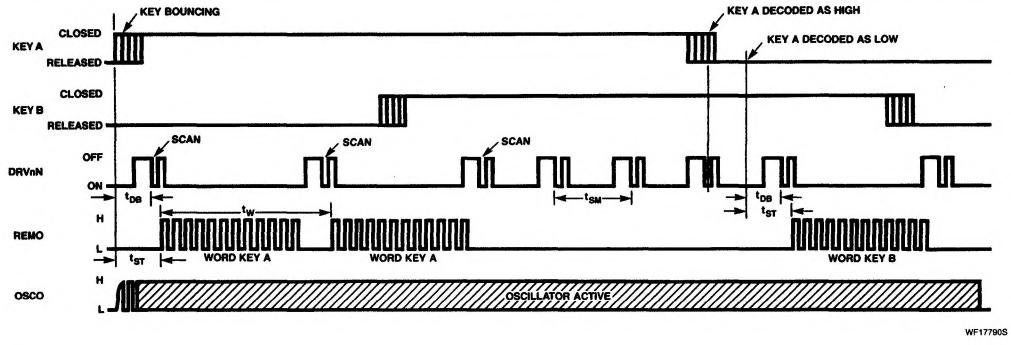


Figure 4. Single Key-Stroke Sequence

Output Sequence (Data Format)

The output operation will start when the selected code is found. A burst of pulses, including the latched address and command codes, is generated at the output REMO as long as a key is pressed. The format of the output pulse train is given in Figures 2 and 3. The operation is terminated by releasing the key or if more than one key is pressed at the same time. Once a sequence is started, the transmitted words will always be completed after the key is released.

The toggle bits T0 and T1 are incremented if the key is released for a minimum time t_{REL} (see Figure 4). The toggle bits remain unchanged within a multiple keystroke sequence.



NOTES:
1. Scan rate multiple key-stroke: $t_{SM} = 6$ to $10 \times t_O$.
2. For t_{DB}, t_{ST} and t_W see Figure 4.

Figure 5. Multiple Key-Stroke Sequence

Table 1. Pulse Train Timing

MODE	t_O (ms)	t_P (μs)	t_M (μs)	t_{ML} (μs)	t_{MH} (μs)	t_W (ms)
Flashed	2.53	8.8				121
Modulated	2.53		26.4	17.6	8.8	121

NOTES:

f_{OSC}	455kHz	$t_{OSC} = 2.2\mu s$
t_P	$4 \times t_{OSC}$	Flashed pulse width
t_M	$12 \times t_{OSC}$	Modulation period
t_{ML}	$8 \times t_{OSC}$	Modulation period LOW
t_{MH}	$4 \times t_{OSC}$	Modulation period HIGH
t_O	$1152 \times t_{OSC}$	Basic unit of pulse distance
t_W	$55\ 296 \times t_{OSC}$	Word distance

Table 2. Pulse Train Separation (t_B)

CODE	t_B
Logic "0"	$2 \times t_O$
Logic "1"	$3 \times t_O$
Reference time	$3 \times t_O$
Toggle bit time	$2 \times t_O$ or $3 \times t_O$

Table 3. Transmission Mode and Subsystem Address Election

MODE	SUBSYSTEM ADDRESS				DRIVER DRVnN FOR n =						
	#	S2	S1	S0	0	1	2	3	4	5	6
F	0	1	1	1							
L	1	0	0	0	o						
A	2	0	0	1	X	o					
S	3	0	1	0	X	X	o				
H	4	0	1	1	X	X	X	o			
E	5	1	0	0	X	X	X	X	o		
D	6	1	0	1	X	X	X	X	X	o	
M											
O	0	1	1	1							o
D	1	0	0	0	o						o
U	2	0	0	1	X	o					o
L	3	0	1	0	X	X	o				o
A	4	0	1	1	X	X	X	o			o
T	5	1	0	0	X	X	X	X	o		o
E	6	1	0	1	X	X	X	X	X	o	o
D											

NOTES:
o = Connected to ADRM
Blank = Not connected to ADRM
X = Don't care

Table 4. Key Codes

MATRIX DRIVE	MATRIX SENSE	CODE						MATRIX POSITION
		F	E	D	C	B	A	
DRV0N	SEN0N	0	0	0	0	0	0	0
DRV1N	SEN0N	0	0	0	0	0	1	1
DRV2N	SEN0N	0	0	0	0	1	0	2
DRV3N	SEN0N	0	0	0	0	1	1	3
DRV4N	SEN0N	0	0	0	1	0	0	4
DRV5N	SEN0N	0	0	0	1	0	1	5
DRV6N	SEN0N	0	0	0	1	1	0	6
V_{SS}	SEN0N	0	0	0	1	1	1	7
1	SEN1N	0	0	1		2		8 to 15
1	SEN2N	0	1	0		2		16 to 23
1	SEN3N	0	1	1		2		24 to 31
1	SEN4N	1	0	0		2		32 to 39
1	SEN5N	1	0	1		2		40 to 47
1	SEN6N	1	1	0		2		48 to 55
1	SEN5N and SEN6N	1	1	1		2		56 to 63

NOTES:
1. The complete matrix drive as shown above for SEN0N is also applicable for the matrix sense inputs SEN1N to SEN6N and the combined SEN5N/SEN6N.
2. The C, B and A codes are identical to SEN0N as given above.

The subsystem address and the transmission modes are defined by connecting the ADRM input to one or more driver outputs (DRV0N to DRV6N) of the key matrix. If more than one driver is connected to ADRM, they must be decoupled by a diode.