

LH1208 PBX Switch Set

Features

- Inputs
 - On/off ring switches
 - On/off message switch
 - All switches on
 - All switches off
 - Device reset
 - Off-hook detection
 - Strobe address
- Outputs
 - Ring trip/off-hook status
 - Auxiliary latch
- Relay functions
 - Break switches
 - Ring-access switches
 - Message capability
 - Break-before-make switching of all switch functions
 - Clean, bounce-free switching
 - Monolithic reliability
- Control functions
 - Ring trip detection
 - Zero cross insertion and removal of ring signal

Description

The LH1208 PBX Switch Set combines analog and digital circuitry with high-voltage switches to produce a very powerful and versatile PBX switching function. The LH1208 device packs five high-voltage switches, ring trip circuitry, zero cross circuitry, comprehensive logic, and an auxiliary latch into a single highly reliable, monolithic integrated circuit. To save space, the IC is mounted into surface-mount packages.

The LH1208 device performs the break and access switch functions between the PBX line feed and the telephone loop. Two 10 Ω bidirectional break switches, two 45 Ω bidirectional ring-access switches, and a 40 Ω unidirectional message switch are provided. Comprehensive logic features (all switches on, all switches off, device reset, and off-hook detection) control inputs. The logic provides break-before-make operation that is governed by internal circuitry. Onboard ring trip circuitry is also provided. This circuitry detects ring trip states and, upon detection, automatically opens the break switches.

Other features of the LH1208 Switch Set are ring trip/off-hook status, ring signal insertion at zero voltage and removal at zero current, and an auxiliary latch for latching data for the battery feed or other subscriber line interface circuit (SLIC) components. The LH1208 device can be addressed by using the strobe input.

The LH1208 Switch Set replaces electromechanical relays, relay drivers, and discrete control circuitry normally associated with telephone loop switching in PBX applications. To operate, the LH1208 requires +5 V, +12 V, and -12 V power supplies. The LH1208 PBX Switch Set is packaged in a 28-pin SOG (LH1208AAJ).

Description (continued)

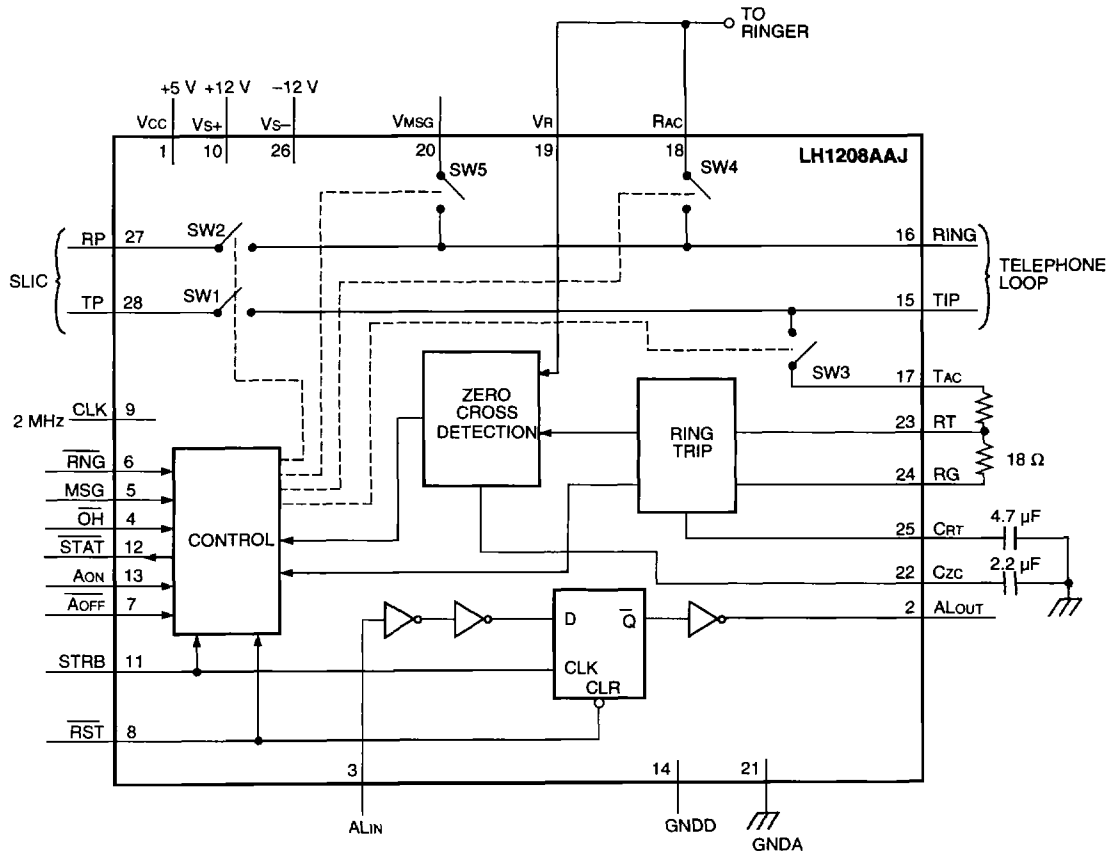


Figure 1. Functional Diagram

Pin Information

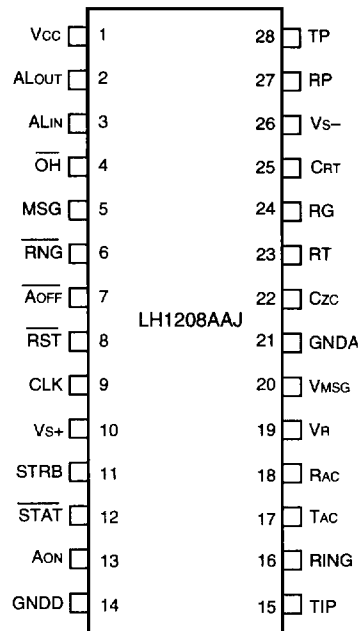


Figure 2. 28-Pin SOG, Diagram

Pin Information (continued)

Table 1. Pin Descriptions

Pin	Symbol	Name/Function
1	V _{CC}	+5 V Supply.
2	AL _{OUT}	Auxiliary Latch Output. Uncommitted D-type flip-flop that latches after STROBE occurs. Can be used to latch data for other SLIC components.
3	AL _{IN}	Auxiliary Latch Input. Uncommitted D-type flip-flop input. Can be used to latch data for other SLIC components.
4	$\overline{\text{OH}}$	Off-Hook Detection Input (Active-Low). When a logic low is applied to this pin, the device closes both break relays on the subsequent strobe signal.
5	MSG	Message Switch Control Line. Dependent on $\overline{\text{RNG}}$ switch control line (see Table 2). Closes message switch when MSG is high and $\overline{\text{RNG}}$ is low. When $\overline{\text{RNG}}$ is low, ring switch 3 is closed, thereby completing the return path for the message switch.
6	$\overline{\text{RNG}}$	Switch Control Line (Active-Low). Actuates break and ring switches (see Table 2).
7	$\overline{\text{AOFF}}$	Control Line for All Switches (Active-Low). A low turns all switches off after a strobe. This pin must be high for normal switch operation.
8	$\overline{\text{RST}}$	Reset (Active-Low). Resets all internal latches. Immediately turns all switches off independent of strobe input.
9	CLK	2 MHz Clock Input. This clock is required for ring switch operation.
10	V _{S+}	+12 V Supply.
11	STRB	Strobe Clock. Clocks in AL _{IN} , $\overline{\text{RNG}}$, MSG, $\overline{\text{AOFF}}$, and $\overline{\text{STAT}}$ control signals. An 8 kHz strobe frequency is suggested.
12	$\overline{\text{STAT}}$	Status (Active-Low). Provides a digital indication of off-hook/ring trip status. A logic-low indicates that off-hook or ring trip has been detected.
13	A _{ON}	Control Line for All Switches. A high turns all switches on. For normal switch operation, tie this pin low or leave it floating.
14	GNDD	Digital Ground.
15	TIP	To be wired to the TIP lead of the telephone loop.*
16	RING	To be wired to the RING lead of the telephone loop.*
17	T _{AC}	Ring Access to TIP.
18	R _{AC}	Ring Access to RING.
19	V _R	Ringer voltage should be applied directly to this pin.
20	V _{MSG}	Message signal bias should be applied to this pin.

* This device is susceptible to damage if subjected to lightning or power-cross transients. Depending on the application, external protection may be required.

Pin Information (continued)**Table 1. Pin Descriptions** (continued)

Pin	Symbol	Name/Function
21	GNDA	Analog Signal Ground.
22	Czc	Zero Cross Capacitor. A capacitor for filtering out the ring signal from the zero cross circuitry should be applied to this pin. A nonpolarized 2.2 μ F, 15 V capacitor is suggested.
23	RT	Input to Ring Trip Circuitry.
24	RG	The ringer return lead should be applied to this pin.
25	CRT	Ring Trip Capacitor. A capacitor for filtering out the ring signal from the ring trip circuitry should be applied to this pin. A nonpolarized 4.7 μ F, 15 V capacitor is suggested.
26	Vs-	-12 V Supply.
27	RP	RING Prime. To be wired to the RING lead input of the SLIC circuitry.
28	TP	TIP Prime. To be wired to the TIP lead input of the SLIC circuitry.

Functional Description**Table 2. Switch Control Truth Table**

X = don't care

RST	$\overline{\text{A OFF}}$	AON	RNG	MSG	Break Switches 1 and 2	Ring Switches		Message Switch 5
						3	4	
1	1	0	1	X	ON	OFF	OFF	OFF
1	1	0	0	0	OFF	ON	ON	OFF
1	1	0	0	1	OFF	ON	OFF	ON
0	X	X	X	X	OFF	OFF	OFF	OFF
1	0	0	X	X	OFF	OFF	OFF	OFF
1	X	1	X	X	ON	ON	ON	ON

Table 3. Status Truth Table

X = don't care

OH	Internal Ring Trip	STAT*
0	X	0
1	NO	1
1	YES	0

* Condition of $\overline{\text{STAT}}$ during STRB.

Absolute Maximum Ratings

$T_A = 0\text{ }^{\circ}\text{C}$ to $70\text{ }^{\circ}\text{C}$

Stresses in excess of the Absolute Maximum Ratings can cause permanent damage to the device. These are absolute stress ratings only. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operational sections of the data sheet. Exposure to Absolute Maximum Ratings for extended periods of time can adversely affect device reliability.

Table 4. Control Ratings

Parameter	Symbol	Conditions	Min	Max	Unit
Operating Temperature	T_A	—	-10	80	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	—	-55	125	$^{\circ}\text{C}$
Supply with Respect to GND_D	V_{CC}	—	-0.3	7	V
Supply with Respect to GND_A	V_{S+}	—	-0.3	15	V
Supply with Respect to GND_A	V_{S-}	—	-15	-0.3	V
GND_D Supply with Respect to GND_A	V_{DA}	—	± 0.3	—	V
Input Voltage: $\overline{\text{OH}}$, MSG , $\overline{\text{AOFF}}$, $\overline{\text{ALIN}}$, $\overline{\text{RST}}$, $\overline{\text{RNG}}$, STRB , and CLK	V_{IN}	—	$\text{VGND}_D - 0.3$	$V_{CC} + 0.3$	V
For RT and RG		RT, RG	$V_{S-} - 0.3$	$V_{CC} + 0.3$	V
Output Voltage — $\overline{\text{STAT}}$ and ALout	V_{OUT}	—	$\text{VGND}_D - 0.3$	$V_{CC} - 0.3$	V
Output Current: ALout	I_{OUT}	—	-250	+250	μA
$\overline{\text{STAT}}$		—	—	25	mA
Power Dissipation	P_{DISS}	$T_A = 25\text{ }^{\circ}\text{C}$	—	500	mW

Table 5. Switch Ratings

Parameter	Symbol	Conditions	Min	Max	Unit	
Breakdown Voltage	V_{MAX}	RING to R_{AC} , V_{MSG} , RP , TIP to T_{AC} , TP , $I_L = 50\text{ }\mu\text{A}$ (See Figure 6.)	-300	+300	V	
		RING, TIP, RP , TP , R_{AC} , T_{AC} , V_{MSG} , to GND (See Figure 6.)	-300	+300	V	
Load Current:* $\text{SW1}, \text{SW2}$	I_L	Constant	—	70	mA	
		$\text{SW3}, \text{SW4}$	0.2 s, 20 Hz	—	75 dc + 180 ac peak	mA
		SW5	Constant	—	35	mArms
			0.2 s	—	60	mA
	Constant	—	10	ma		

* These are recommended ratings.

Electrical Characteristics

Table 6. dc Characteristics
 $T_A = 0\text{ }^{\circ}\text{C to }70\text{ }^{\circ}\text{C}$, $V_{CC} = +5\text{ V} \pm 10\%$, $GND_D = 0\text{ V}$

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Input Voltage: High: \overline{RNG} , \overline{MSG} , $\overline{A_{OFF}}$, \overline{ALIN} , \overline{RST} , and \overline{OH} \overline{STRB} and \overline{CLK}	V_{IH}	—	3.5	—	—	V
		—	2.0	—	—	V
	Low	V_{IL}	—	—	0.8	V
Output Voltage: High — $\overline{AL_{OUT}}$	—	$I_{OH} = 100\text{ }\mu\text{A}$	4.0	—	—	V
		$I_{OL} = 10\text{ mA}$	—	—	0.4	—
		$I_{OL} = 100\text{ }\mu\text{A}$	—	—	0.4	—
Input Current: Low-level	I_{IL}	$GND_D \leq V_{IN} \leq I_{IL}$	—	—	10	μA
		High-level	$V_{IH} \leq V_{IN} \leq V_{CC}$	—	—	10
Leakage Current — \overline{STAT}	I_{LEAK}	—	—	<1	10	μA
Capacitance: Output	C_{OUT}	Switch outputs to GND_A	—	8	—	pF
		Input	C_{IN}	—	5	—

Table 7. Operating Power Supply
 $T_A = 0\text{ }^{\circ}\text{C to }70\text{ }^{\circ}\text{C}$, clock = 2.048 MHz; SW1, SW2 on; outputs unloaded

Parameter	Symbol	Min	Typ	Max	Unit
V_{CC} Operating Current	I_{CC}	—	—	2.5	mA
V_{S+} Operating Current	I_{S+}	—	—	0.5	mA
V_{S-} Operating Current	I_{S-}	—	—	3.0	mA
+5 Vdc Supply	V_{CC}	4.5	5.0	5.5	V
+12 Vdc Supply	V_{S+}	10	12	14	V
-12 Vdc Supply	V_{S-}	-10	-12	-14	V
Ringer Voltage	V_{RING}	40	90	110	V_{rms}
-48 Vdc Supply	V_{BB}	-56	-48	—	V

Electrical Characteristics (continued)

Table 8. Switch Characteristics

For all switches unless otherwise noted: $T_A = 0\text{ }^\circ\text{C}$ to $70\text{ }^\circ\text{C}$, $V_{CC} = +5\text{ V} \pm 10\%$, $V_{S+} = +12\text{ V} \pm 15\%$, $V_{S-} = -12\text{ V}$.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
ON-resistance — Battery Feed Voltage (-4 V to -56 V ; RP, TP); SW1, SW2	R_{ON}	$I_L = 20\text{ mA}$ to 50 mA	—	10	20	Ω
		$I_L = 10\text{ mA}$	—	45	96	Ω
		$I_L = 20\text{ mA}$ to 50 mA	—	40	110	Ω
ON-resistance — Balance: TP = -4 V , RP = -48 V ; $I_L = 20\text{ mA}$ to 50 mA	ΔR_{ON}	$R_{ON}(\text{SW1}) - R_{ON}(\text{SW2})$	—	—	2	Ω
		$R_{ON}(\text{SW1}) - R_{ON}(\text{SW2})$	—	—	2	Ω
Switch Feedthrough Capacitance: SW1, SW2, SW5	C_o	10 Vdc, 1 MHz	—	30	—	pF
		10 Vdc, 1 MHz	—	15	—	pF
ON Time Delay	t_{ON}	See Figures 4 and 7.	—	—	1.0	ms
OFF Time Delay	t_{OFF}	See Figures 4 and 7.	—	—	1.0	ms
Break-to-make Time	t_{BM}	STRB = 8 kHz (See Figures 4a, 4b, and 7.)	—	500	—	μs
dV/dT Transient Current ($I_T - I_{STRAV}$)	$I \frac{dV}{dT}$	200 V _{pp} @ 100 V/ μs (See Figure 8.)	—	—	2.5	mA
ON-state Forward Voltage: SW1, SW2 Battery Feed Voltage (-4 V to -46 V ; RP, TP)	V_F	$I_L \pm 30\text{ mA}$	—	—	1.4	V
		$I_L = +60\text{ mA}$	—	2.7	4.4	V
		$I_L = -50\text{ mA}$	—	1.9	3.0	V
OFF-state Leakage Current	I_{LEAK}	250 V	—	0.1	10	μA
Offset Current — SW1, SW2, SW5	I_g	—	—	10	25	μA
I_{GBT} Cutoff Current — SW1, SW2	I_{CO}	SW1, SW2 on	70	130	—	mA

Electrical Characteristics (continued)

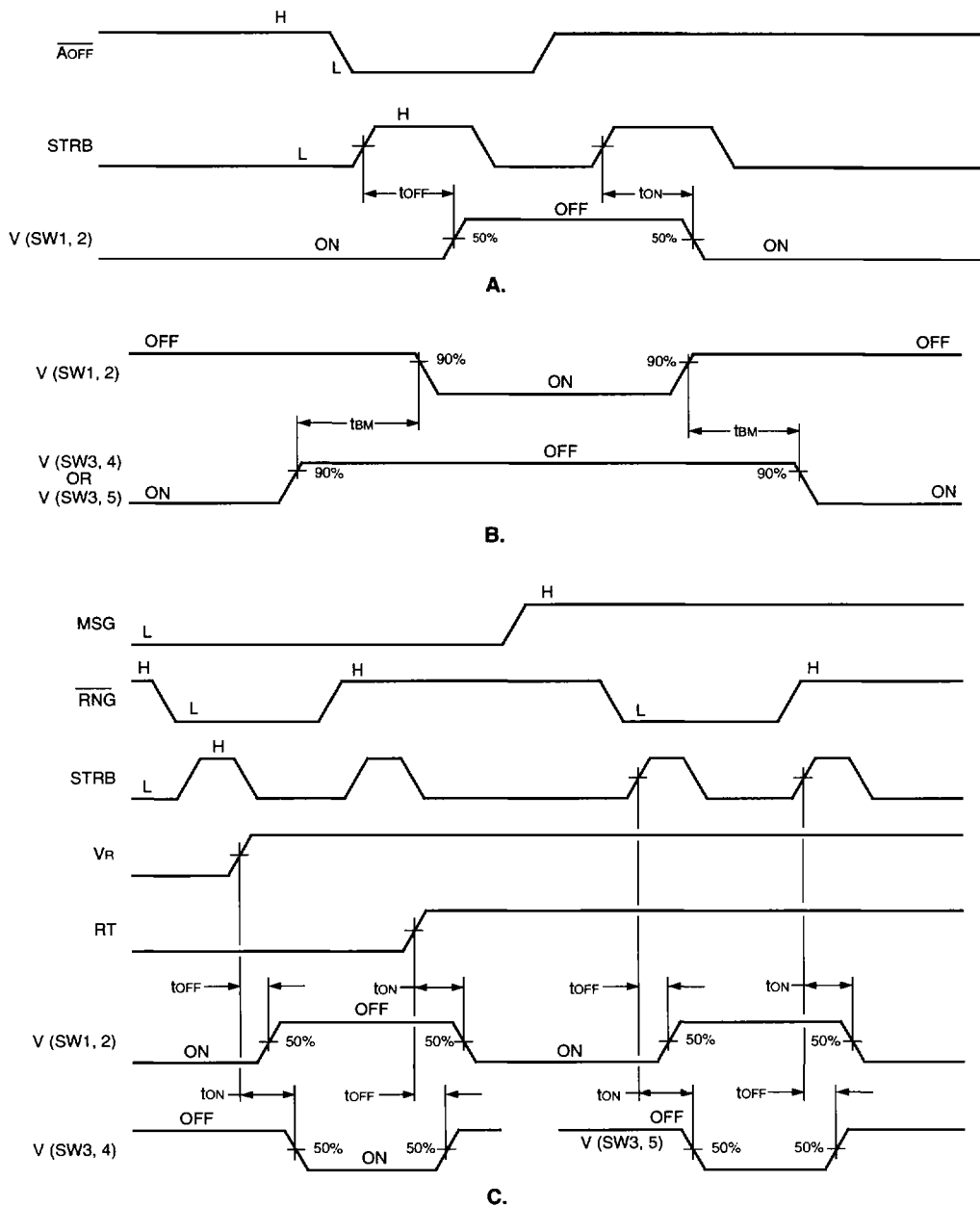


Figure 3. Output Leakage Current

Electrical Characteristics (continued)

Table 9. Ring Trip Characteristics

$T_A = 0\text{ }^\circ\text{C to }70\text{ }^\circ\text{C}$, $V_{CC} = +5\text{ V} \pm 10\%$, $V_{S+} = +12\text{ V} \pm 15\%$, $V_{S-} = -12\text{ V}$, $R_4 = 18\ \Omega \pm 10\%$

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Ring Trip Detection Current	I_{RT}	dc (See Figure 9.)	10	12.5	15	mA
		ac $\leq 150\text{ mA peak}$, 1 kHz sine wave (See Figure 9.)	5	—	20	mA
Detection Delay	t_D	$I_{LOOP} = 0\text{ mA to }-30\text{ mA}$ (See Figures 5 and 9.)	—	—	100	ms
Detection Current Pulse Width — Input RT	t_{WD}	$I_{LOOP} = 0\text{ mA to }-75\text{ mA}$ to 0 mA, $C = 4.7\ \mu\text{F}$ (See Figures 5 and 9.)	11	—	—	ms
Detection Pulse Hold Time — Output STAT	t_H	$f_r = 20\text{ Hz}$ (See Figures 5 and 9.)	50	—	—	ms
Voltage Zero Cross Detection Sensitivity	V_Z	—	—	2	4	V
Current Zero Cross Detection Capture Level	I_Z	$I_{LOOP} \geq 3.5\text{ mA (pulse)}$ (duty 50%)	—	—	± 3.5	mA

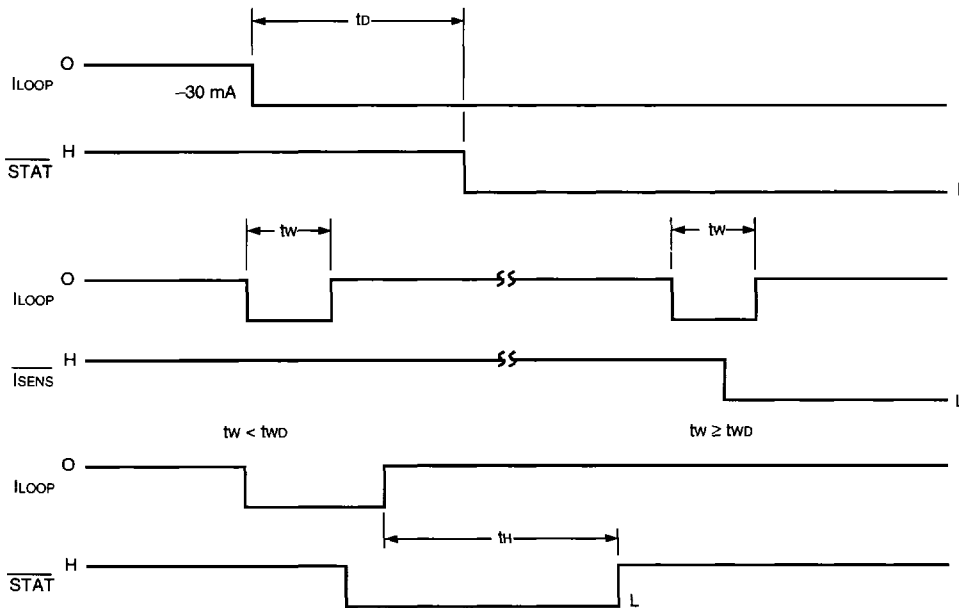


Figure 4. Ring Trip Timing Characteristics

Electrical Characteristics (continued)

Test Circuits

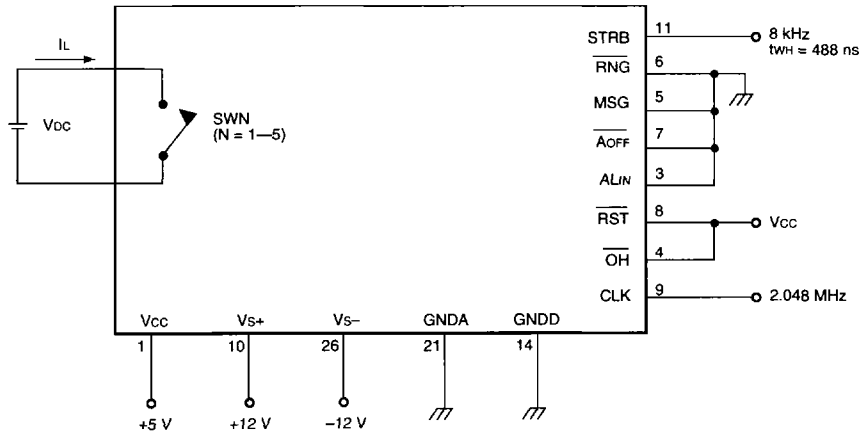


Figure 5. Switch Breakdown Voltage Test Circuit

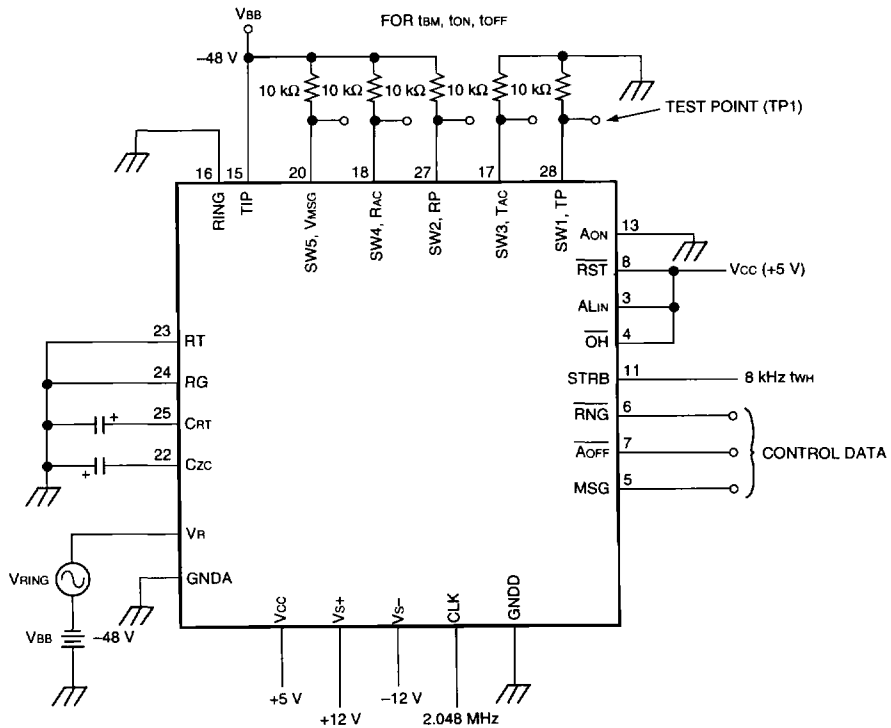


Figure 6. Switch Characteristics Test Circuit

Electrical Characteristics (continued)

Test Circuits (continued)

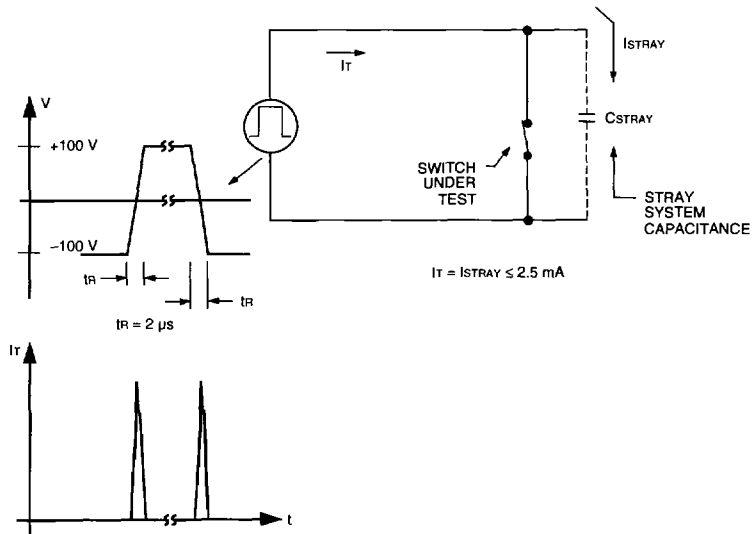


Figure 7. dV/dT Test Circuit

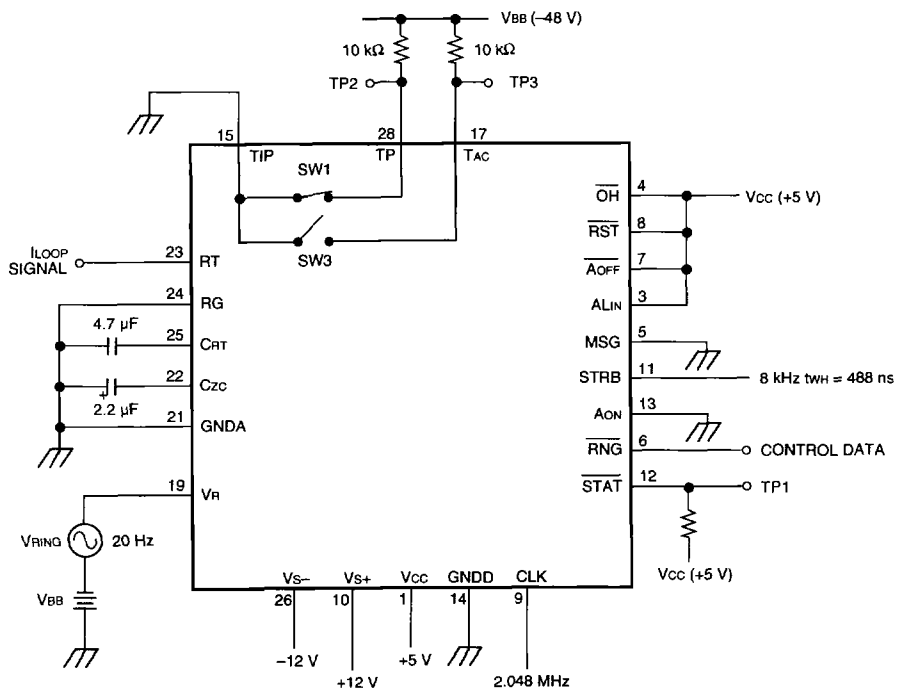


Figure 8. Ring Trip Test Circuit

Characteristic Curves

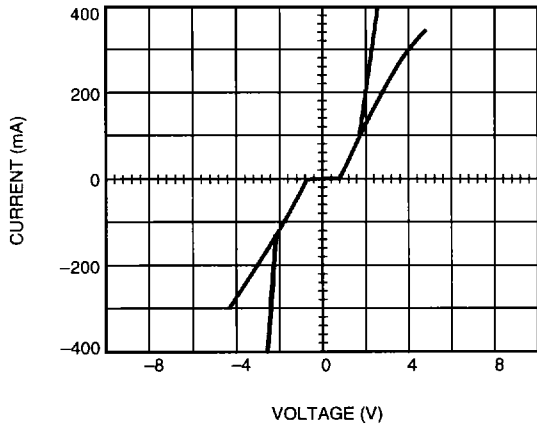


Figure 9. Break Switch (SW1 or SW2)

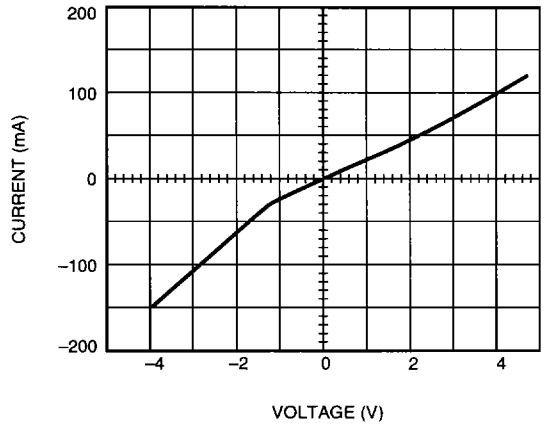


Figure 11. Ring-Access Switch (SW3)

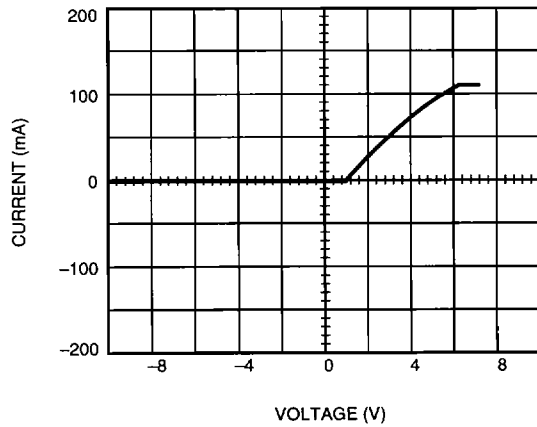


Figure 10. Message Switch (SW5)

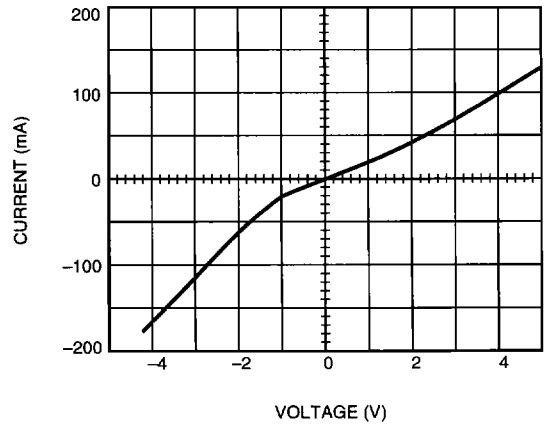


Figure 12. Ring-Access Switch (SW4)

Timing Characteristics

Table 10. Timing Characteristics

$T_A = 0\text{ }^\circ\text{C}$ to $70\text{ }^\circ\text{C}$, $V_{CC} = +5\text{ V} \pm 10\%$, $GND_D = 0\text{ V}$; typical readings are at $T_A = 25\text{ }^\circ\text{C}$.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Strobe Pulse Width (STRB)*	tWH	See Figure 14.	400	—	—	ns
Minimum Setup Time* — \overline{RNG} , MSG, $\overline{A_{OFF}}$, and A_{LIN}	tSET	See Figure 14.	—	—	400	ns
Minimum Hold Time* — \overline{RNG} , MSG, $\overline{A_{OFF}}$, and A_{LIN}	tHOLD	See Figure 14.	400	—	—	ns
Output Enable Time	tOE	$R_L = 1\text{ k}\Omega$, $C_L = 50\text{ pF}$ (See Figure 14.)	—	35	200	ns
Output Disable Time	tOD	$R_L = 1\text{ k}\Omega$, $C_L = 50\text{ pF}$ (See Figure 14.)	—	0.2	1	μs
Delay from \overline{OH} to \overline{STAT} , STRB to A_{Lout} *	tPD	See Figure 14.	—	—	500	ns
Reset Pulse Width (\overline{RST})*	tRST	—	—	—	500	ns

*These are recommended ratings.

Timing Characteristics (continued)

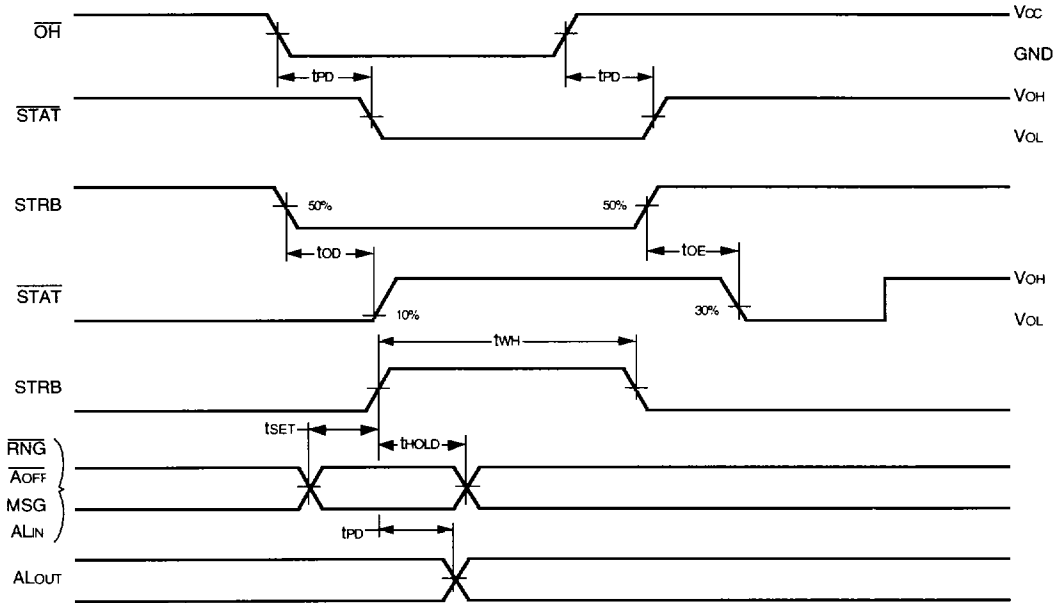


Figure 13. Timing Characteristics

Application

Figure 14 portrays the LH1208AAJ in a typical PBX application. The PBX switch set provides the ring relay, message switch, and break switch functions for the battery feed. Via its data bus, the system microprocessor controls the switch status. STRB selects each specific channel and can be controlled through the address bus and a decoder. A 1 MHz to 2 MHz clock signal is required. For a 2 MHz clock signal, a channel can be strobed every 1 μs. ALout is an uncommitted flip-flop which can supply latched data to the battery feed. The battery feed detects off-hook and notifies the PBX switch set through the $\overline{\text{OH}}$ input.

With the break switches open, ringing is applied through SW3 and SW4.

Ring trip can be adjusted by varying R4. Typical trip current is dictated by the equation $R4 = 0.225/I_{TRIP}$.

For the ring trip currents specified in this data sheet, make R4 an 18 Ω ± 10% resistor.

CRT and Czc filter the ring signal out of the device to allow flawless zero cross and ring trip detection. For maximum performance, use the capacitor values recommended in the Pin Information section.

A message light can be illuminated through the use of a high-voltage power supply and a zener diode. The message light remains off during normal operating conditions. With the break switches open, SW5 and SW3 can be closed, allowing the high-voltage power supply to break down the zener diode to allow conduction through the LED. The LED can be illuminated continuously or toggled through microprocessor control.

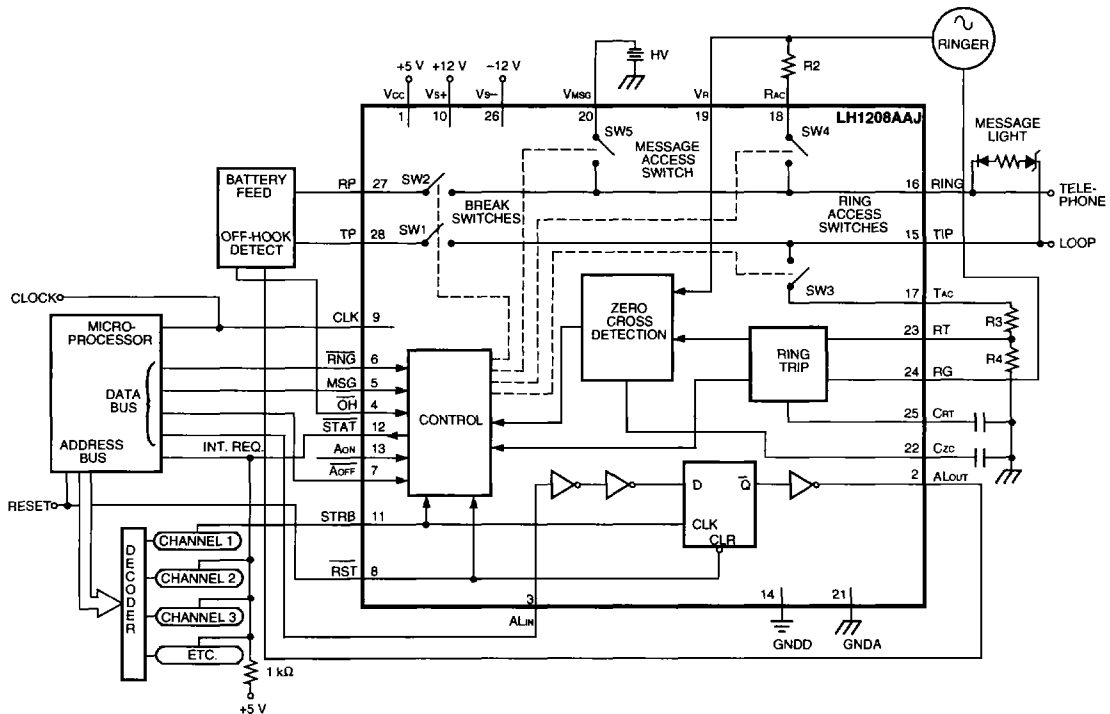


Figure 14. Typical PBX Application

Outline Drawings

28-Pin SOG (LH1208AAJ)

Dimensions are in inches.

