Using Ring Sync with HC-5502A and HC-5504 SLICs

Introduction

The ring synchronization (sync) input pin is a TTL compatible clock input in both the HC-5502A and HC-5504 SLICs. It's purpose is to insure that the ring relay is activated or deactivated only when the instantaneous AC ring voltage, which may be as high as 150V peak, is at or near AC zero crossing.

If ring sync is not used, it must be tied high to insure proper ring trip. When used, it is important to consider at which zero crossing of the AC ring voltage, positive or negative, the ring sync signal must be synchronized with. Subsequent illustrations and equations highlight this consideration.

For detailed description of the ring trip sequence of events, refer to Application Note 549 by P. G. Phillips. Excerpts from the pertinent section are included below.

Ring Trip Sequence

The Ring Command ($\overline{RC}$) input is taken low during ringing. This activates the ring relay driver ($\overline{RD}$) output providing the telephone is not off-hook or the line is not in a power denial state. The ring relay connects the ring generator to the subscriber loop. The ring generator output is usually an $80V_{RMS}$, 20Hz signal. For use with the Intersil SLIC, the ring signal should not exceed 150V peak. Since the telephone ringer is AC coupled, only ring current will flow. For the HC-5502A SLIC, the ring current is sunk by the ring feed amplifier output stage whereas for the HC-5504 the ring path flows directly into V_{B}- via a set of relay contacts. The high impedance terminal RFS exists on the HC-5504 so that the low impedance RF node can be isolated from the hot end of the ring path in the battery referenced ring scheme.

The AC ring current flowing in the subscriber circuit will be sensed across RB4, and will give rise to an AC voltage at the output of the longitudinal amplifier. R19 and C4 attenuate this signal before it reaches the ring trip detector to prevent false ring trip. C4 is nominally set at $0.47\mu F$ but can be increased towards $1\mu F$ for short lines or if several telephones are connected in parallel across the line in order to prevent false or intermittent ring trip.

When the subscriber goes off-hook, a DC path is established between the output winding of the ring generator and the battery ground or V_{B}- terminal. A DC longitudinal imbalance is established since no tip feed current is flowing through the tip feed resistors. The longitudinal amplifier output is driven negative. Once it exceeds the ring trip threshold of the ring trip detector, the logic circuitry is driven by GK to trip the ring relay establishing an off-hook condition such that SHD will become active as loop metallic current starts to flow.

Figure 1 illustrates the sequence of events during ring trip with ring synchronization. Note, that owing to the 90° phase shift introduced by the low pass filter (R19, C4) the RS pulse will occur at the most negative point of the attenuated ring signal that is fed into the ring trip detector. Hence, when DC conditions are established for RTD, the AC component actually assists ring trip taking place. If ring synchronization is not used, then the RS pin should be held permanently to a logic high of 5V nominally: ring trip will occur asynchronously with respect to the ring voltage. Ring trip is guaranteed to take place within three ring cycles after the telephone going off-hook.
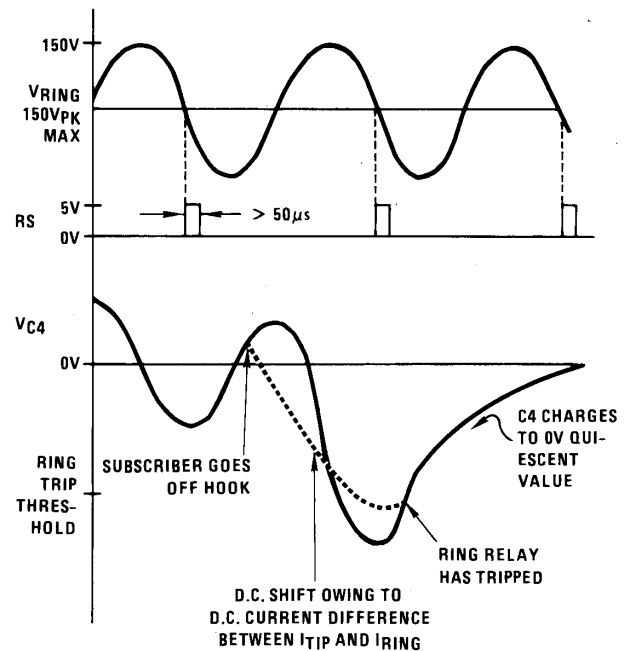

FIGURE 1. RING TRIP SEQUENCE

Case 1: HC-5502A Tip Injected Ringing

$V_{LA} = (I_{RING} - I_{TIP})$ (RB4) (K)

(During Ringing $I_{TIP} = 0$)

$V_{LA} = (I_{RING})$ (RB4) (K)

$I_{RING} = (V_{RF} - V_{RING})/RB4$

$V_{LA} = (V_{RF} - V_{RING})$ K

FIGURE 2.

FIGURE 3.

Case 2: HC-5504 Ring Injected Ringing

$V_{LA} = (I_{RING} - I_{TIP})$ (RB4) (K)

(During Ringing $I_{TIP} = 0$)

$V_{LA} = (I_{RING})$(RB4) (K)

$I_{RING} = (V_{RFS} - V_{RING})/RB4$

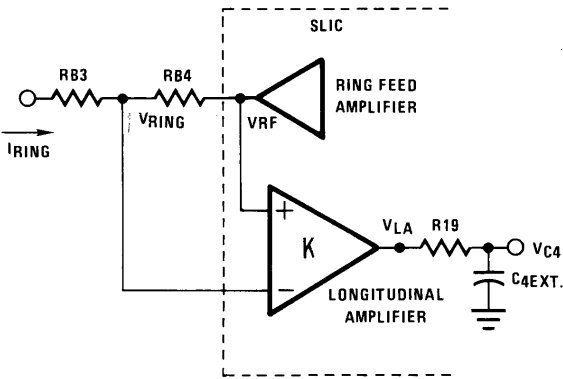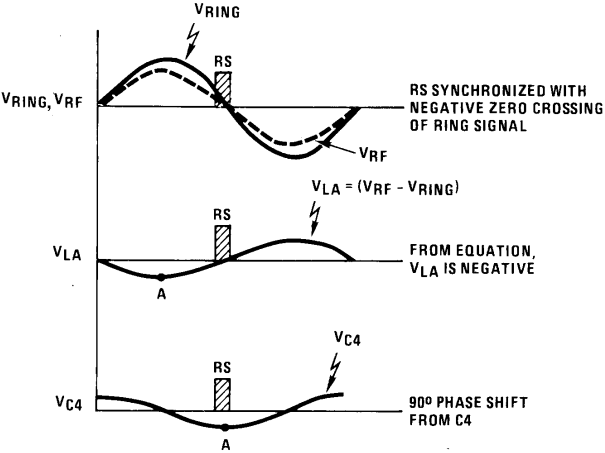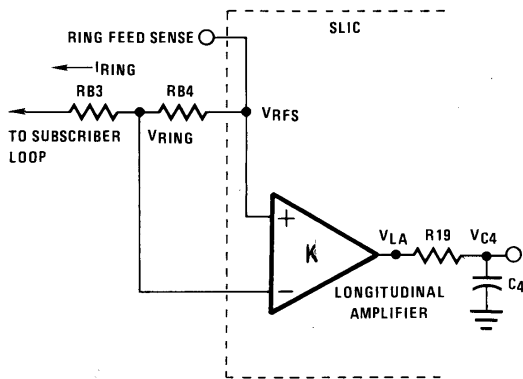$V_{LA} = (V_{RFS} - V_{RING})$ K

FIGURE 4.

FIGURE 5.

For Case 1, refer to Figures 2 and 3. In this situation the desired result is obtained, namely, that ring sync occurs during the negative peak of V_{C4}. This helps achieve ring trip faster because, once a subscriber goes off-hook, a negative DC shift is observed at V_{C4}. This shift approaches a comparator threshold in the ring trip detection circuit. If the negative peak of V_{C4}(AC) precedes the negative going DC shift at V_{C4}, one can achieve ring trip in a shorter time frame. Also this configuration allows ring trip to occur for long lines, in the order of 3000Ω. At these line lengths, the DC negative shift will never reach the threshold because there is not enough DC current through the sense resistor, RB4. However, the negative peak of V_{C4} (AC) will cross the ring trip detector comparator threshold and ring trip will occur.

Conclusion 1: For this case make sure ring sync is synchronized with the negative zero crossing of V_{RING} as it appears on the line.
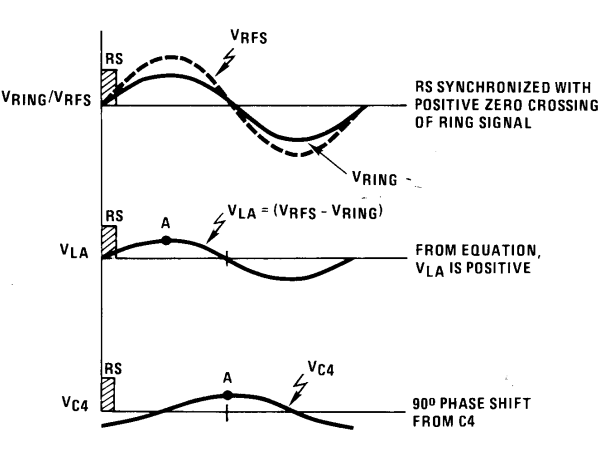
For Case 2 refer to Figures 4 and 5. Here ring sync must be synchronized with the positive zero crossing of V_{RING} (AC) as it appears on the line so as to coincide with the negative peak of V_{C4} (AC), as in the previous case. One can see from Figure 5 that ring sync on the negative zero crossing would coincide with the positive peak of V_{C4}, inhibiting ring trip for loops greater than approximately 800Ω.

Conclusion 2: For this case make sure ring sync is synchronized with the positive zero crossing of V_{RING} (AC.).

For all other ring configurations, namely, tip injected and balanced ringing for the HC-5504, if ring sync is used, it must be synchronized with the negative zero crossing of V_{RING}(AC).

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Renesas Electronics America Inc.
1001 Murphy Ranch Road, Milpitas, CA 95035, U.S.A.
Tel: +1-408-432-8888, Fax: +1-408-434-5351

Renesas Electronics Canada Limited
9251 Yonge Street, Suite 8309 Richmond Hill, Ontario Canada L4C 9T3
Tel: +1-905-237-2004

Renesas Electronics Europe Limited
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K
Tel: +44-1628-651-700, Fax: +44-1628-651-804

Renesas Electronics Europe GmbH
Arcadiastrasse 10, 40472 Düsseldorf, Germany
Tel: +49-211-6503-0, Fax: +49-211-6503-1327

Renesas Electronics (China) Co., Ltd.
Room 1709 Quantum Plaza, No.27 ZhichunLu, Haidian District, Beijing, 100191 P. R. China
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

Renesas Electronics (Shanghai) Co., Ltd.
Unit 301, Tower A, Central Towers, 555 Langao Road, Putuo District, Shanghai, 200333 P. R. China
Tel: +86-21-2226-0888, Fax: +86-21-2226-0999

Renesas Electronics Hong Kong Limited
Unit 1601-1611, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong
Tel: +852-2265-6688, Fax: +852 2886-9022

Renesas Electronics Taiwan Co., Ltd.
13F, No. 363, Fu Shing North Road, Taipei 10543, Taiwan
Tel: +886-2-8175-9600, Fax: +886 2-8175-9670

Renesas Electronics Singapore Pte. Ltd.
80 Bendemeer Road, Unit #06-02 Hyflux Innovation Centre, Singapore 339949
Tel: +65-6213-0200, Fax: +65-6213-0300

Renesas Electronics Malaysia Sdn.Bhd.
Unit 1207, Block B, Menara Amcorp, Amcorp Trade Centre, No. 18, Jln Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: +60-3-7955-9390, Fax: +60-3-7955-9510

Renesas Electronics India Pvt. Ltd.
No.777C, 100 Feet Road, HAL 2nd Stage, Indiranagar, Bangalore 560 038, India
Tel: +91-80-67208700, Fax: +91-80-67208777

Renesas Electronics Korea Co., Ltd.
17F, KAMCO Yangjae Tower, 262, Gangnam-daero, Gangnam-gu, Seoul, 06265 Korea
Tel: +82-2-558-3737, Fax: +82-2-558-5338