A800-SIM Modified Fast CTCSS Keying

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General

This Application Note details the setup of the A800-SIM and associated radio equipment for a modified Fast CTCSS Keying operation.

Note: This application note assumes the technician has a sound working knowledge of the Tait A800-SIM, and Tait T800 modules. For more information on these products, refer to the relevant service manuals.

Background

Fast CTCSS Keying is used on links to avoid excessive cumulative delays in keying across an extended network where a number of link hops are required. These delays are particularly an issue where CTCSS tones need to be decoded a number of times across the system.

CTCSS tones can take typically 150ms to decode (up to 250ms dependent on tone frequency). For a system consisting of 6 cumulative links this equates to approximately 1 second delay from one end of the system to the other – not including transmitter rise time and gating delays (or mobile transceiver CTCSS decoders).

To avoid these delays where multiple link hops are required the Tait A800-SIM utilises a system whereby links are keyed prior to a CTCSS decode to establish the network. This means that the links are setup and operate on a carrier basis. CTCSS audio that is received at the link receivers is passed to the A800-SIM. This audio is called 'Live Tone' and is the RXAF_TONE line in the A800-SIM.

Once a link has been keyed up, but prior to CTCSS decoding on any of the other links, "live tone" is passed through the system to initiate CTCSS decoders throughout the system. Once CTCSS tones are decoded then the tone encoders within the A800-SIM take over and regenerate the CTCSS. Figure 1 depicts a simple system (or part of a system) which is in the 'Live Tone' phase of operation. Upon decoding of the CTCSS, the A800-SIM's would switch over to a regenerated CTCSS encode tone.

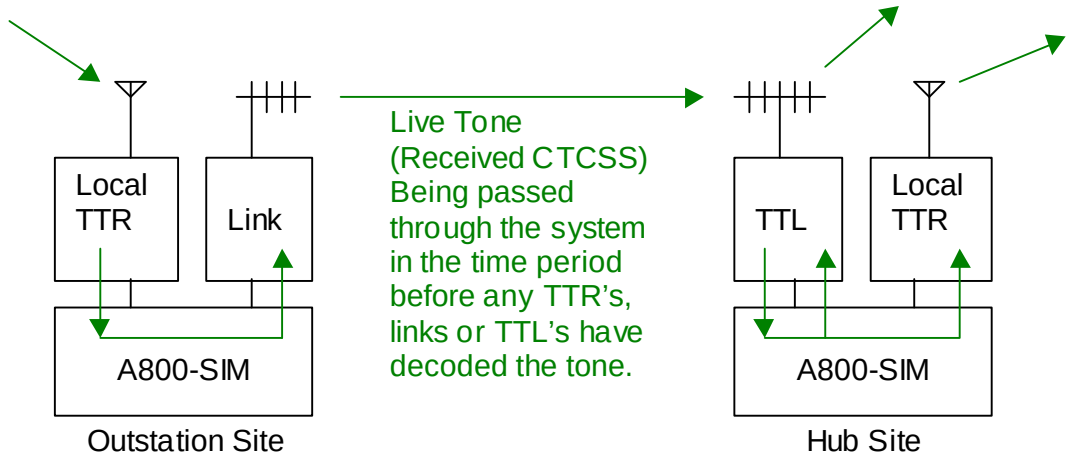

Figure 1

The advantage of a system setup like this is that all transmitters can key up within milliseconds of each other, almost regardless of the topography of the system. This is true for a system with up to as many as six or seven link hops. After this an additional CTCSS decode period can occur due to the degradation of the retransmitted 'Live Tone'. This however does not normally cause any problems to speech access times or to mobile voting system.

A disadvantage of a system setup like this is that a carrier being received by a link can key up the local repeaters, even without CTCSS tone. This would allow interference on links to key up the repeaters.

Purpose

This Application Note details a setup which does not let local repeaters key up until links get a valid decode on their received CTCSS audio.

The procedure used in this Application Note is only applicable for certain restricted system architectures as it effectively reduces the maximum number of ports available on the A800-SIM. This needs to be considered prior to implementation.

The main idea with this setup is that separate carrier gate and decode gate paths are setup in the A800-SIM for the local TTR and the link or TTL(Talk Through Link). This enables carrier gates and decode gates to be routed individually. Carrier gates are then setup to be routed only to links and TTL's, and decode gates are setup to be routed only to the local repeaters (TTR).

With this configuration, local TTR receivers are configured the same as links and TTL's. This means they are configured to pass (output) a carrier gate and a 'Live Tone' signal.

Using this setup, all repeaters in the system will transmit at virtually the same time, as long as the same CTCSS decode tone is used on all repeaters and links. If not, bases at different sites will not transmit at the same time, because of extra CTCSS decodes required between the first TTR and any remote links decoding.

Important - This application note assumes the connection of a single TTR and one link (or TTL). The TTR is connected to port 1 on the A800-SIM. The link is connected to port 3 or if the link is a TTL, for instance at a hub site, then it is connected to Port 2.

Ports 4, 5 and 6 are used for separate decode input signals parallel to Ports 1, 2 & 3 respectively, and should not be connected to external equipment. The A800-SIM ports 7 & 8 are still free and will be configured to operate as the voting pulse input ports on hub sites that require a voting pulse to be generated. Figure 2 shows the connection of a typical hub site with a single base and a TTL to a A800-SIM.

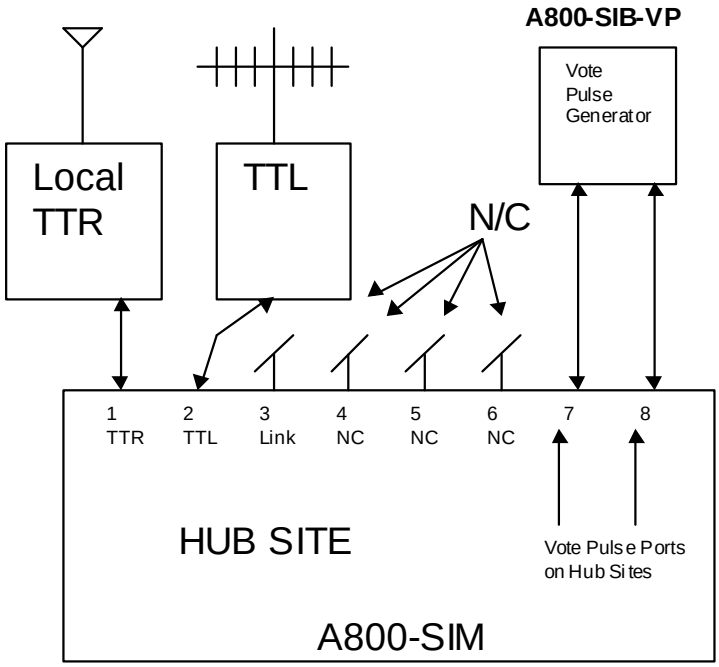

Figure 2

The other thing to consider when following this procedure is that of Hub Site generated vote pulses. Vote pulses generated from the A800-SIM at the Hub Site will have one CTCSS decode time period difference between the Hub Site TTR transmitting and any/all Outstation Site TTR's transmitting. This is because at the Hub Site the vote pulse is generated locally, so the local TTR will be keyed up instantly, but at Outstation Sites the link must achieve a CTCSS decode before keying the local TTR. This is not a problem as the Tait T2020 mobile operating in the system can have their Vote Lead In Delay programmed accordingly to handle the delay. A programmed time period of 150ms to 200ms should be adequate.

If other brands of mobile radios are being used in the system, and these radios voting system cannot deal with the delays that can happen in the system, a work around can be implemented. This work around is applied to the Hub Site A800-SIM to delay the key-up of the local TTR during a vote pulse. Basically it involves connecting an A800-SIB- VP Vote Pulse Generator (based on the A800-SIB board) to ports 7 and 8 of the Hub Site A800-SIM. Once connected, no other configuration is required inside the A800-SIM.

The A800-SIB-VP Vote Pulse Generator gives 2 independent outputs to use as TX Key lines. One output keys up the link transmitters only (not the TTR) with CTCSS which gives the outstation sites time to receive and decode the voting pulse, and then approx. 150mS later (1x CTCSS decode period) applies a 2nd key to the local TTR to key the TTR transmitter up with CTCSS on the voting pulse. In doing this, the limited operation & functionality of these mobiles can be overcome. For more information, please refer to the A800-SIB-VP documentation.

A800-SIB-VP Module

Parts

The parts required are as follows:

Part Number	Description	Supplier	Qty.
Misc.	Miscellaneous workshop consumables, e.g. solder, wire, etc.	N/A	1

Procedure

1. All T800 Receivers and Transmitters need to be modified as per Section 3.2 Basic Mods, in the A800-SIM Service Manual(AM8-SIM). Section 3.3 Optional Mods/Settings of the A800-SIM Service Manual also should be applied as follows :

   3.3.1 – Series II Programming & 2nd D Range - Optional to all modules but recommended.

   3.3.2 – Transmitter Fast Keying – Apply to all transmitters/exciters (except if they are to go on solar sites)

   3.3.3 – Receiver Fast Gating – Apply to all link receivers (not to repeater receivers).

   3.3.4 – Fast CTCSS Keying - Apply to all receivers (repeaters and links).

   3.3.5 – Link Receiver Mute Crash - Apply to all link receivers (not to repeater receivers).

   3.3.6 – CTCSS Encode Tone for Local Transmitter – Optional.

   The extra modification needed for the repeater receivers are to bring out the carrier gate line and the live tone audio. These are the signals on the A800-SIM ports RX1 to RX8 pin 11 RXGATE and pin 7 RXAF-TONE. Any other brand of radio equipment being used with the A800-SIM must also be configured to provide these signals. For more information on this, contact your local Tait representative.

2. Remove the A800-SIM top lid. Remove the A800-SIM3 PCB from its 2RU 19” rack enclosure. This is done by unplugging the 16 way ribbon cables from ports RX1 to RX8 and TX1 to TX8, and removing the figure 8 speaker cable from the two way PCB terminal block S2. Next remove the six M3 x 6mm Pan Pozi screws holding the PCB down.

3. On the bottom of the A800-SIM PCB, place wire links from RX1 pin 12 to RX4 pin 12, RX2 pin 12 to RX5 pin 12, RX3 pin 12 to RX6 pin 12. This routes the RXDEC signals from ports 1, 2 and 3 to ports 4, 5 and 6 respectively.

4. Refit the A800-SIM PCB to its 2RU 19”rack enclosure, in the reverse order as Step 2.

5. On the A800-SIM PCB, ensure that the 16 pin IDC header cable that connects to the RX D Range on Port 7 is plugged into the 16 pin IDC pin strip marked TARA. Also ensure that the 16 pin IDC header cable that connects to the RX D Range on Port 8 is plugged into the 16 pin IDC pin strip marked T802.

6. On the A800-SIM PCB, solder links LK71 to LK78 should be setup as per Table 1. This sets up ports 1, 2 and 3 for normal carrier operation, and sets ports 4, 5 and 6 for decode operation (i.e. routes port 4, 5 and 6 pin 12 input RXDEC to the Gate Matrix [via relays RL19, RL23, and RL22]). The links LK77 and LK78 are setup for decode operation so any external A800-SIB-VP Vote Pulse Generator will key up the A800-SIM with CTCSS Encode tones enabled.

Table 1.

Link	Setting
LK71	1-2
LK72	1-2
LK73	1-2
LK74	2-3
LK75	2-3
LK76	2-3
LK77	2-3
LK78	2-3

7. Configure the Audio matrix, Gate matrix, Receiver Primary Tone Inputs matrix, and the PTT Output (Tails) matrix as for either Hub or Outstation operation. Refer to the following sections Hub Site Setup or Outstation Site Setup.

   The sections Hub Site Setup and Outstation Site Setup are not a complete list of configuration requirement for the A800-SIM, but simply detail the particular link setting that are important for the Modified Fast Keying type of operation. Each A800-SIM will still need other configurations, dependant on the type of system being setup. For more information, please refer to the A800-SIM service manual (AM8-SIM.pdf).

8. For Outstation Sites, the Link on Port 3 will need to have RX Disable setup on it. Refer to Section 6.7 "RX Disable" in the A800-SIM Service Manual (AM8-SIM.pdf) for more information on receive disable. Note that KL Bases setup as End Site Links need their receive disable setup internally. Even though KL Bases have their receive disable setup internally, it is recommended that the A800-SIM port connected to the End Site Link be configured as per the A800-SIM Service Manual. The reason for this is for compatibility and flexibility. For more information on KL Bases used with A800-SIM's, refer to the Application Note AN002.

9. Refer to Section 5.5 Setup of the A800-SIM service manual (AM8-SIM.pdf) for information on setting up the A800-SIM levels, etc.

10. In addition to the TX Tail and Soft Off tail setup for a hub site, the Soft Off tail needs to be setup at all outstations as well. This is because the soft off from the hub does not get through from the link to the local repeater, because the link is tone guarded before the link will key the local repeater. The duration of all Soft Off tails at all site should be adjusted to be of the same time period.

11. On the rear of the A800-SIM, place labels to identify ports 1 to 3, as per Figure 3.

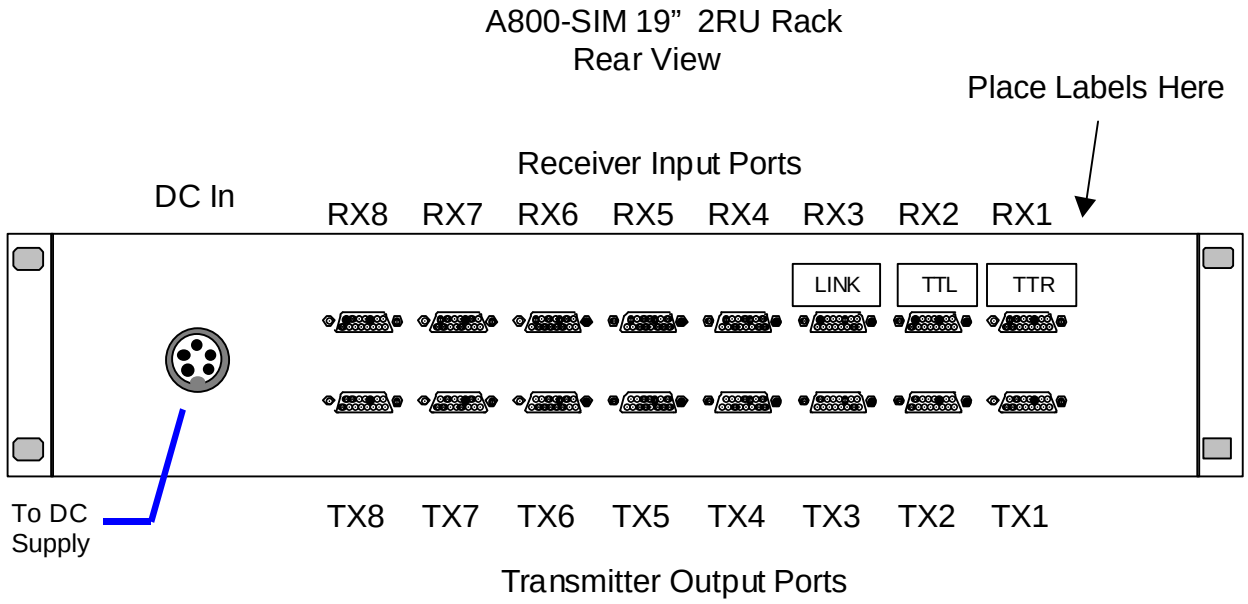

Figure 3

Hub Site Setup

The link settings detailed here assume a Hub Site configuration consisting of one TTR connected to port 1 and one TTL connected to port 2.

Audio Matrix

Receiver Inputs	Transmitter Outputs							
	TTR 1	TTL 2	Link 3	N/C 4	N/C 5	N/C 6	N/C 7	N/C 8
TTR – 1	X	X	X	X	X	X	X	X
TTL – 2	X	X	X	X	X	X	X	X
Link – 3	X	X	-	X	X	X	X	X
4	X	X	X	-	X	X	X	X
5	X	X	X	X	-	X	X	X
6	X	X	X	X	X	-	X	X
7	X	X	X	X	X	X	-	X
8	X	X	X	X	X	X	X	-
TT_AF*	X	X	X	X	X	X	X	X

X = Solder Link in place **- = No Solder Link**

The links that are important are highlighted in the table above. The setup of this matrix is the same as the default Hub Site shown in the A800-SIM service manual.

Gate Matrix

PTT Outputs	Receiver Gate Inputs							
	TTR Gate 1	TTL Gate 2	Link Gate 3	TTR Dec 4	TTL Dec 5	Link Dec 6	VP-I 7	VP-D 8
TTR - 1	-	-	-	X	X	X	-	X
TTL - 2	X	X	X	X	X	X	X	X
Link - 3	X	X	-	X	X	-	X	X
4	X	X	X	-	X	X	X	X
5	X	X	X	X	-	X	X	X
6	X	X	X	X	X	-	X	X
7	X	X	X	X	X	X	-	X
8	X	X	X	X	X	X	X	-

VP-I = Instant Voting Pulse Input **VP-D = Delayed Voting Pulse Input**

X = Solder Link in place **- = No Solder Link**

The links that are important are highlighted in the table above. With the links setup as shown in this matrix, you can see that RX GATE signals from the local TTR are set to go directly to the TTL, but RX DEC from the local TTR will go to both the TTR and the TTL. The TTL RX GATE is set to go to the TTL, but RX DEC from the TTL will go to both the TTR and the TTL. This means that RX GATE signals from anywhere will be routed to the TTL, but only an RX DEC from the TTR or TTL will key up the local TTR.

Hub Site Setup Cont.

Receiver Primary Tone Inputs

	1	2	3	4	5	6	7	8
Tail	X	X	X	X	X	X	-	-
No Tail	-	-	-	-	-	-	X	X

X = Solder Link in place **- = No Solder Link**

The links that are important are highlighted in the table above. The setup of this matrix is almost the same as the default Hub Site shown in the A800-SIM service manual.

PTT Outputs (Tail)

	1	2	3	4	5	6	7	8
Tail	X	X	X	X	X	X	X	X

X = Solder Link in place **- = No Solder Link**

The links that are important are highlighted in the table above. The setup of this matrix is the same as the default shown in the A800-SIM service manual.

Outstation Site Setup

The link settings detailed here assume a Outstation Site configuration consisting of one TTR connected to port 1 and one Link connected to port 3.

Audio Matrix

Receiver Inputs	Transmitter Outputs							
	TTR 1	TTL 2	Link 3	N/C 4	N/C 5	N/C 6	N/C 7	N/C 8
TTR - 1	X	X	X	X	X	X	X	X
TTL - 2	X	X	X	X	X	X	X	X
Link - 3	X	X	-	X	X	X	X	X
4	X	X	X	-	X	X	X	X
5	X	X	X	X	-	X	X	X
6	X	X	X	X	X	-	X	X
7	X	X	X	X	X	X	-	X
8	X	X	X	X	X	X	X	-
TT_AF*	X	X	X	X	X	X	X	X

X = Solder Link in place **- = No Solder Link**

The links that are important are highlighted in the table above. The setup of this matrix is the same as the default Hub Site shown in the A800-SIM service manual. In this configuration, the default Hub Site setup is also suitable for the Outstation Sites as well.

Gate Matrix

PTT Outputs	Receiver Gate Inputs							
	TTR Gate 1	TTL Gate 2	Link Gate 3	TTR Dec 4	TTL Dec 5	Link Dec 6	7	8
TTR – 1	-	-	-	X	X	X	-	X
TTL – 2	X	X	X	X	X	X	X	X
Link – 3	X	X	-	X	X	-	X	X
4	X	X	X	-	X	X	X	X
5	X	X	X	X	-	X	X	X
6	X	X	X	X	X	-	X	X
7	X	X	X	X	X	X	-	X
8	X	X	X	X	X	X	X	-

X = Solder Link in place **- = No Solder Link**

The links that are important are highlighted in the table above. With the links setup as shown in this matrix, you can see that RX GATE signals from the local TTR are set to go directly to Link, but RX DEC from the local TTR will go to both the TTR and the Link. The Link RX GATE is set to go nowhere, and RX DEC from the Link will go to the TTR. This means that RX GATE signals from the TTR will be routed to the Link, but only an RX DEC from the TTR or the Link will key up the local TTR.

Outstation Site Setup Cont.

Receiver Primary Tone Inputs

	1	2	3	4	5	6	7	8
Tail	-	-	-	-	-	-	-	-
No Tail	X	X	X	X	X	X	X	X

X = Solder Link in place - = No Solder Link

The links that are important are highlighted in the table above. The setup of this matrix is the same as the default Outstation Site described in the A800-SIM service manual.

PTT Outputs (Tail)

	1	2	3	4	5	6	7	8
Tail	X	X	-	X	X	X	X	X

X = Solder Link in place - = No Solder Link

The links that are important are highlighted in the table above. The setup of this matrix is similar to the Hub Site setup, except for link 3. Link 3 is not fitted because we don't want the locally generated Soft Off tails to be sent back down the link.

The PTT Output (Tail) links are normally only used at the hub to output the system tails out to all of the system. It also needs to be setup at all of the other sites so the local repeater can output the soft off tails, hence the link on 1. Link are left on 2, & 4 to 8 for compatibility with the Hub Site configuration.