Part C Circuit Description

This part describes the Change Over Module circuit operation. It contains the following information:

1 Introduction

Inside the Change Over Module a single Control PCB, flush-mounted against the front panel, interfaces to T800 base stations and other equipment via D Range connectors on the back panel. Power monitor cables connect via RCA sockets on the back panel. A four way terminal block connects to two coaxial relays, one for base selection and one for the standard RX/TX change over function in base station applications.

The unit either identifies a fault condition in the active repeater, or compares a measure on the active repeater and a measure on the standby repeater.

Fault condition trigger levels can be set on preset resistors on the front panel of the unit. After change over, the unit displays the error on the LEDs. A reset button on the front panel allows the module to return to the situation before change over. A selector switch allows the technician to define which T800 is active and which is on standby.

A change over relay internal to the Change Over Module provides the means to switch the antenna as required. The receiver signals are derived from a low loss power splitter. An external directional coupler provides the DC signals for forward and reverse powers.

Internal dip switches provide set up to select repeater function and provide alarm outputs. See Part G, **Setting, Calibration and Testing** for information.

The control board contains a 68HC705C8A microprocessor that controls the functions of the Change Over Module. Inputs and outputs to the microprocessor are as follows:

- Input comparators (PSU, FWD, RVS, RSSI)
- Direct logic inputs (Rx-Gate, TX -Key, Reset, Base Select, Remote Reset, Remote Select, Mode Select)
- Rx gate selection input - IRQ
- Switches (Rx, TX, RSSI, Tx Audio, Rx Audio, Tx Key, Rx Gate, RSSI and Coaxial Relay)
- Direct logic outputs (Alarm)
- Alarm outputs

The remaining circuitry consists of power regulators and an optional DC-DC converter.

2 Monitor Circuits

PSU and Battery

Forward Power

Reverse Power

RSSI

RX-Gate

Tx-Key

2.1 PSU and Battery Input Comparators

Relevant circuitry: IC109, IC110 & IC111

The MC34064 is an under voltage sensing device. It features a comparator with precise thresholds and built-in hysteresis to prevent erratic reset operation.

RV100, RV101 and RV102 are set to activate their alarms when the input to the circuit drops below 10.8V

When the input to IC109-2 drops below 4.59v the output will indicate an alarm (logic ‘0’). The output will not deactivate until the voltage rises above 4.61v.

2.2 Forward Power Input Comparators

Relevant ICs: IC201, IC202 for FWD-PWR-A and FWD-PWR-B

IC201 and 202 are comparator ICs with open collector output stages.

Adjustments: RV206 for Base A, RV205 for Base B

Base A component designators have been taken to describe the circuit in more detail.

Forward power alarms can be taken from an external power meter, or direct from the T800 power amplifier stage.

With T800 power meter signals, the FWD-PWR signal is high when the transmitter and antenna are operating efficiently and reduces when a fault condition occurs. When the FWD-PWR falls below the threshold voltage set by RV206 the comparator output is forced to 0v, indicating a FWD-PWR error.

The trigger level to generate an alarm is typically set at nominal power level -3dB

The power alarm can also be selected by the T800 power transmitters alarm outputs. These outputs are normally shorted to Gnd and go high impedance when activated. In this configuration, the T800 generated alarm output is connected via PL2-6 and pulls low the alarm input to the microprocessor.

Note: RV206 needs to be tuned to 0V to ensure that the output impedance of IC202-1 is high.

Note: When the power meter alarms are used SW201 needs to be closed.

The controller reads the alarm input only when the associated Tx-Key is active.

2.3 Reverse Power Input Comparators

Relevant ICs: IC201, IC202 for REV-PWR-A and REV-PWR-B

Adjustments: RV204 for Base A, RV203 for Base B

IC201 and 202 are comparators with open collector output stages.

Note: Base A components have been used to illustrate the circuit operation in more detail.

Note: Reverse power alarms can be taken from an external power meter, or direct from the T800 power amplifier stage.

With T800 power signals, the REV-PWR signal is low when the transmitter and antenna are operating efficiently and increases when a fault condition occurs. When the REV-PWR raises above the threshold voltage set by RV204 the comparator output is forced to +5V, indicating a REV-PWR error.

The alarm trigger level is typically set for 50% of power reflected back by terminating the transmitter antenna port with a 3dB open ended attenuator.

An alternative way for power alarm to be selected by using the T800 power transmitters' alarm outputs. These outputs are normally shorted to Gnd and go high impedance when activated. In this configuration the T800 generated alarm output is connected via PL2-8 and pulls the alarm input to the microprocessor high.

Note: When this type of alarm is selected, RV204 needs to be tuned to +5V to ensure that the output impedance of IC202-13 is high.

Note: When the power meter alarms are used SW201 needs to be open.

The controller only reads the alarm input when the associated Tx-Key is active.

2.4 RSSI Input Comparators

Relevant ICs: IC300 & IC301

Adjustments: RV300 for Base A and RV301 for Base B

Receiver performance is measured in two ways:

- both Rx-Gates must be unmuted.
- the RF level of the stand-by receiver must be within + or - 6dB of the active receiver.

The RF level is translated into the RSSI voltage (Receiver Signal Strength Indicator). For an UHF receiver the RSSI output is set to 2.0V for a RF input level of -110dBm.

Mute monitoring is detailed later in this document.

Four comparators determine whether an RSSI error has occurred. These produce output signals PA3, PA7 and PB7.

- PA3 is active low when RSSI-A is lower than a predetermined offset voltage below RSSI-B. LED D300 illuminates.
- PA7 is active low when RSSI-A is higher than a predetermined offset voltage above RSSI-B. LED D301 illuminates.
- PB7 is active low when either RSSI-A or RSSI-B is ***below*** a predetermined threshold.
- RSSI decoders are outside their linear operating range when both A and B are above the threshold. In this case no comparison is made and the system assumes operation of both receivers. LED D302 illuminates when RSSI of either A or B is ***below*** the threshold level.

RSSI signals are fed from a resistor divider network to non-inverting differential amplifier IC300 with a variable DC input offset provided by RV300 (RV13). The input stage gain is set by combining the resistor divider (approx 0.68) and the non-inverting amplifier (approx 2), giving a total input gain of approx 1.3.

RSSI-A is fed into a temperature-compensated current mirror network that provides a constant current through R331 and R332 and hence a constant voltage drop across R111 and R110. R111 and R110 have about 0.48V across them. (6dB difference in RF level creates about 0.48V.)

When the non-inverting input (RSSI-A + offset) is greater than RSSI-B, the PA3 comparator goes into positive saturation. When RSSI-A + offset is less than RSSI-B, the comparator goes into negative saturation and LED1 illuminates.

The same principles apply to the PA7 comparator. When RSSI-A + offset is greater than RSSI-B, the comparator goes into negative saturation and LED2 illuminates.

Two comparators,whose outputs are open collector, drive PB7. Therefore if either RSSI-A or RSSI-B are below the threshold voltage set by R177 and R178 then PB7 will be effectively connected to ground.

2.5 RX-Gate Selection

Relevant components: Q307, Q309, IC100 and IC203

Adjustments: none

Both RX-Gate signals are via inverting level translators connected directly to the processor inputs. A transient detector circuit ensures each gate change triggers the interrupt input of the processor for fast detection.

The RX-Gate Select circuit indicates which receiver should be selected based on which RX Gate opens first. If neither gate is open, the switch defaults to the last selected receiver.

The output of the RX Gate Select circuit can control the RX Audio and RX RSSI switches directly, or, in the event of a fault for example, allow the microprocessor to override RX selection.

The logic for this circuit is derived from the following.

Rx Mute A	Rx Mute B	
0	0	no change
0	1	1 (A opened first)
1	0	0 (B opened first)
1	1	Always defaults to Base A

2.6 TX-Key Inputs

Relevant circuitry: Q308, Q310, and Q106.

Tx-Key inputs are, like the Rx-Gate signals, connected to the microprocessor via level translating inverters. For simplicity, the Tx-Key signals are shorted to the Tx-Enable inputs of the Control PCB.

Remote Tx-Key input connects to the Tx-key of either Base A or Base B via the change over relay contacts. Remote Tx-Key signal directly drives the Rx/Tx change over relay in Base Station applications.

The circuitry is designed for the Remote Tx-Key input to be connected to an open collector or relay contact to Gnd.

2.7 Direct Logic Inputs

RX-Gate, TX-Key, Reset, Base Select, Mode Select, Alarm clear, Remote TX select

Q307, Q308, Q309 and Q310 invert Rx-Gate and TX-Key signals before being fed to the microprocessor. Diodes protect the input stages against excessive input levels. Rx-Gate and TX-Key lines also drive the front panel LEDs. Both signals are active low.

Switches in series with Tx-Key are for test purposes only.

Reset, Base Select and Mode Select input are driven from switches with pull-up resistors.

Remote Reset and Remote Select feed straight into the microprocessor by a diode protection and resistor pull-up arrangement.

Mode selection is controlled by SW6 8-way DIL switch as follows:

SW201-1	SW201-2	SW201-3	Mode
OFF	ON	OFF	Mode A
ON	OFF	OFF	Mode B

Note: If the mode setting is changed, the Change Over Module must be reset before it can assume its new configuration.

Note: Microprocessor pin 15 (PB2) is connected to SW201-3 but has a second function described in the section below.

2.8 Direct Logic Outputs (Alarm)

Relevant circuitry: Q200

Adjustments: none

There are two direct logic outputs

- RSSI Alarm
- Alarm Tone Burst

In Mode A and B RSSI Alarm is active low and triggers when the difference between the RSSI level of Base A and Base B is more than 6dB. In Mode B only, this alarm also triggers with the Mute alarm or RSSI on either Base.

The Alarm Tone Burst is generated by the microprocessor at PB2 (pin 15) when an alarm condition occurs. This output produces a tone burst at 3 second intervals when an alarm condition exists. The outputs need to be connected to either RX or TX Audio lines if necessary.

SW201-3 is always OFF. During power up, the microprocessor reads PB2 as an input. As SW201-3 is OFF it will not cause a conflict after power up when PB2 is set up as an output.

2.9 Alarm Outputs

Relevant circuitry: IC400, IC401, Q400 to Q414 and Q418 to Q432

Adjustments: none

Alarm outputs can be configured as either open collector or active low with a source resistor to +13.8V.

The All Alarm for Base A and Base B has closed contacts in the non-alarm state and can be configured as:

- Dry relay contact to Gnd - All2A switched to Gnd
- Closure of two dry relay contacts - All1A shorts to All2A
- With source resistor to +13.8V, hard wired to All1A

Alarm outputs available:

- All Alarm, activates when any of the standard alarm conditions are met
- Fwd Pwr, activates when the level stays below to minimum set.
- Rev. Pwr, activates when the level exceeds a maximum set
- Mute, activates when the other mute gets active and this one not
- RSSI, activates when this RSSI is more than 6dB below the other one
- PSU, activates when the level stays below minimum set, typically 10.8V

These alarms are open collector to Gnd with an optional 1k resistor to +13.8V

2.10 Battery Alarm

When the battery drops below its preset alarm trigger level both ALL relays - RL400 and RL 401 - start a continuous on-off cycle of 600/600mS. If a power supply then drops below the trigger level the cycle changes to continuous alarm on the relay of the base with the faulty supply (contacts open when alarm raised).

Note: In the non-alarm state the ALL Alarm relays are normally powered up

2.11 Signal Polarity

Function	I/O	Comment
Rx Gate	Input	Active low
TX Key	Output	Active low
Rx Mute	Input	Active low
Fwd Pwr Alarm	Input	Active high
Rev Pwr Alarm	Input	Active high
Remote Select	Input	‘1’ – Base A; ‘0’ – Base B
Remote Reset	Input	Active low
RSSI alarm	Output	Active low
CO relay	Output	Active low
SR_ALL	Output	select: contact closure, short to Gnd, pull up to +
SR_individual	Output	active low, select: pull up to +

3 Change Over

3.1 Change-Over Switches

Relevant circuitry: IC100, IC101, RL100, RL101, RL 102, RL 103, IC102 and Q106

Adjustments: none

The following signals are changed over:

- 2 wire Rx Audio
- 2 wire Tx Audio
- Rx Gate (= Rx Mute)
- Tx-Key (= Tx-Enable)
- Select Base Coaxial Relay

Latching relays are used for all switching. If power disappears from the Change Over Module, the latched relay contacts ensure that all 4 wire plus E&M signalling remains connected to the selected base.

3.2 Change Over Control

Latching relays are driven by the microprocessor with two lines for direction (DIR_PC0 and DIR_PC2) and one line to control(CNTRL_PC1). To change over, the control line must be pulsed high for one polling cycle.

Direction	PC0 ⇑	PC2 ⇑
low	sel Base A: Rx Aud, Rx-Gate, RSSI	sel Base A Tx Aud, Tx-Key, Coax Relay
high	sel Base B: Rx Aud, Rx-Gate, RSSI	sel Base B Tx Aud, Tx-Key, Coax Relay

Rx/Tx Change-over Relay switches from the remote Tx-Key input

4 External Connections

4.1 PL1 and PL2 15 Way D Ranges (Base A and Base B)

Pin	Function	I/O	Comment
1	RX Audio +	Input	transparent
2	RX Audio -	Input	transparent
3	TX Audio +	Input	transparent
4	TX Audio -	Input	transparent
5	RX-Gate	Input	T800 RX Gate
6	Fwd Pwr Alarm	Input	Active High
7	TX Key	Output	Open collector 10mA sink impedance
8	Rev Pwr Alarm	Input	Active high
9			
10	Tx Enable	Input	Shorted to TX Key
11	Fwd Pwr level	Input	T800 Output
12	Rev Pwr level	Input	T800 Output
13	PSU	Input	PSU monitoring. Optionally to supply power to TA703-01-0000 module.
14	RSSI	Input	T800 RSSI
15	GND	Gnd	

4.2 PL3 15 Way D Range (4 Wire E&M)

This connector is the interface point between the Base Station system and the remote console. It is wired as follows:

Pin	Function	Description
1	Rx-Audio +	Transparent
2	Rx Audio -	Transparent
3	Tx Audio +	Transparent
4	Tx-Audio -	Transparent
5	Rx-Gate O/P	Active low upon receive of valid carrier
6	Rx-Gate (spare)	not used
7	Remote Tx-Key	Active low input to transmit
8	V+ Battery	Input to Battery Alarm Circuit
9	Combined Audio +	Balanced output to voice logger - future development
10	Combined Audio -	Balanced output to voice logger - future development
11	RSSI Active	Displays RSSI level of active base
12	Remote Reset (RAC)	Driven by open collector 10mA sink capability
13	RSSI Alarm	Open collector 10mA sink
14	TX Select	High = TX of Base A, Low = TX of Base B.
15	Gnd	

Note: An error on the TA703-01-0000 Control PCB means that PL3 pin 15 has not been connected to Gnd as intended.

4.3 PL4 15 Way D Range (Alarm Outputs)

Pin	Alarm	Comments
1	shorts to pin 2 on any alarm activated in Base A	refer to internal links for options on all alarm outputs
2	shorts to pin 1 on any alarm activated in Base A	
3	open coll. Active low when Fwd Pwr of Base A fails	
4	open coll. Active low when Rev Pwr of Base A fails	
5	open coll. Active low when Mute of Base A fails	
6	open coll. Active low when RSSI of Base A fails	
7	open coll. Active low when PSU of Base A fails	
8	Gnd	
9	shorts to pin 10 on any alarm activated in Base B	
10	shorts to pin 9 on any alarm activated in Base B	
11	open coll. Active low when Fwd Pwr of Base B fails	
12	open coll. Active low when Rev Pwr of Base B fails	
13	open coll. Active low when Mute of Base B r fails	
14	open coll. Active low when RSSI of Base B fails	
15	open coll. Active low when PSU of Base B fails	

4.4 PL5 25 Way D Range (Modem Interface)

This 25 way D Range socket provides an interface for external equipment, and as RS232 interface for Data Terminal Equipment.

Pin	Signal	Function
1	FRAME GND	Earth to Chassis
2	TD	Transmitted data - RS232
3	RD	Received data - RS232
4	N/C	
5	N/C	
6	N/C	
7	SG-GND	RS232 - Ground
8	N/C	
9	GND	
10	GND	
11	N/C	
12	V+ OUT	From optional DC-DC converter
13	V+ OUT	
14	REMOTE RX LINE +	600 Ohm balanced audio from receiver
15	REMOTE RX LINE -	
16	REMOTE TX LINE +	600 Ohm balanced audio to transmitter
17	REMOTE TX LINE -	
18	RX GATE OUT	Copy from active receiver gate O/P
19	REMOTE TX KEY	Active low input to key active transmitter
20	N/C	
21	RSSI O/P	Analog RSSI level from receiver
22	N/C	
23	TX SELECT	Forces change over to standby transmitter
24	V+ OUT	From optional DC-DC converter
25	V+ OUT	

Note: All terminals labelled N/C are unused RS232 signals.

