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Aerospace Systems Division

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ATM 849	

Resettable Solid State Timer and
Command Decoder Interface

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This unscheduled ATM is published to define the operation of the Resettable
Solid State Timer and its interface with the Delayed Command Sequencer
and Pulse Shaping Circuits of the Command Decoder.

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The Resettable Solid State Timer (RSST) is designed to replace the Central Station Timer manufactured by Bulova Watch Company for use on EASEP and ALSEP's 1 and 2. Notable changes in operation have been included in the RSST design, these are as follows:

1. One minute output, which changes from a high impedance to a low impedance path to ground for one second each minute.

2. 18 hour output, which changes from a high impedance to a low impedance path to ground for one second approximately each 18 hours coincidentally with a one minute output.

3. 18 hour telemetry point, which changes between a 0-0.5 VDC state and a 3.0-5.0 VDC state with the occurrence of an 18 hour pulse. This telemetry will occupy housekeeping channels 45 for Flight IV and 10 for Flight V A-2 array.

4. Two 1-1/2 month telemetry points from parallel redundant counters. These points are 0-0.5 VDC levels for the initial 1-1/2 month period and 3.0-5.0 VDC levels for the second 1-1/2 month period. 1-1/2 month T/M #1 will occupy housekeeping channels 74 for Flight IV and 11 for Flight V A-2 array. 1-1/2 month T/M #2 will occupy housekeeping channel 86 for both flights.

5. Parallel/series "Transmitter Off" relay driver with an integrated input driven by parallel redundant three month counters for fail safe operation.

6. Non-resettable "transmitter off" relay (resettable for test only).

7. Timer Reset Command capability which will extend transmitter operation for a three month period if applied prior to the three month turn off operation. Timer reset command will be Octal 150.

8. Count retention capability during 30 seconds of power loss.

9. Fast advance capability for test purposes.

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Figure 1 is a functional block diagram of the RSST. Essentially, an internally generated clock is divided down to drive two parallel 28 bit ripple counters at a one second rate. The count of one of these ripple dividers is decoded to electronically generate the one minute and 18 hour signals. The 23rd bit of both divider chains is used to generate the three month turn off signal, while ensuring that a premature turn off does not occur.

The Delayed Command Sequencer section of the Command Decoder uses the one minute and 18 hour switching functions of the RSST to generate a group of time sequenced commands which are independent of the MSFN (uplink commands). The commands have the same pulse shape and interface characteristics as the "normal" commands which are generated in response to command signals from the MSFN. In general, they can be classified as repetitive or non-repetitive.

Repetitive

1. Two commands starting about 18 hours after turn-on and repeating on an 18 hour cycle thereafter.

    (a) One of these commands is used as a "re-set" on the receiver circuit breaker.

    (b) The second command is routed to the PSE for short period calibration.

2. Two additional 18 hour repetitive commands are generated after a waiting period of 162 hours has elapsed. These are Command 131 at 162 hours + 1 minute and Command 52 at 162 hours + 7 minutes: repeating at 18 hour intervals thereafter.

Non-Repetitive

Seven one-time commands are generated at 144 + hours as follows:

Commands Octal 73, 105 and 113 at 144 hours + 2 minutes
Command   Octal 110 at 144 hours + 3 minutes
Commands Octal 107 and 122 at 144 hours + 4 minutes
Command Octal 110 at 144 hours + 5 minutes

All of the above commands are redundant with the uplink commands (as backup) except the receiver circuit breaker reset (1a) and the PSE short period calibrate (1b).
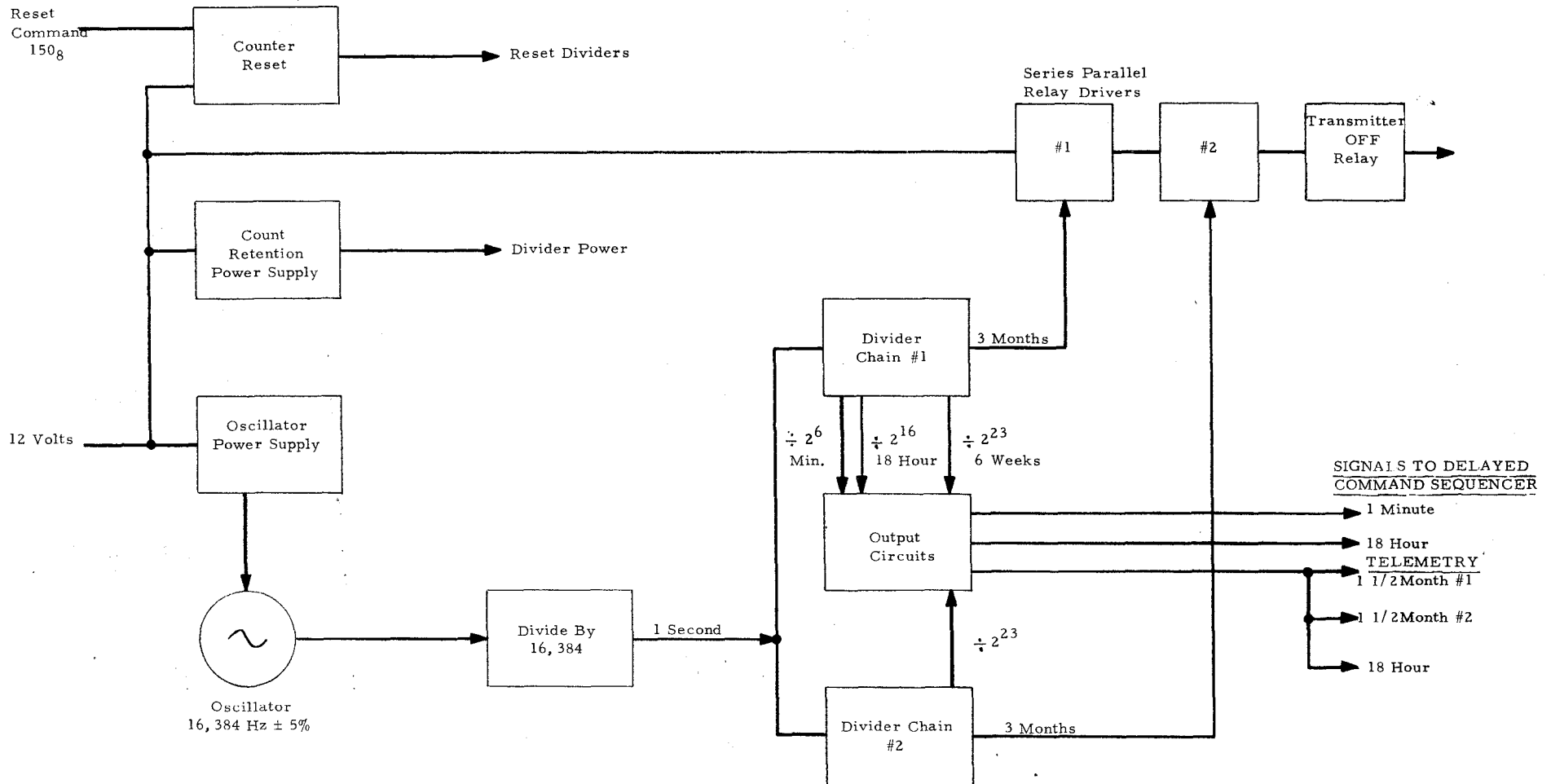
Reset
Command
150_8

Counter
Reset

Reset Dividers

Series Parallel
Relay Drivers

#1

#2

Transmitter
OFF
Relay

Count
Retention
Power Supply

Divider Power

Oscillator
Power Supply

12 Volts

Oscillator
16,384 Hz ± 5%

Divide By
16,384

1 Second

Divider
Chain #1

3 Months

$\div 2^6$
Min.

$\div 2^{16}$
18 Hour

$\div 2^{23}$
6 Weeks

Output
Circuits

SIGNALS TO DELAYED
COMMAND SEQUENCER

1 Minute

18 Hour
TELEMETRY
1 1/2 Month #1

1 1/2 Month #2

18 Hour

$\div 2^{23}$

Divider Chain
#2

3 Months

Figure 1. Block Functional Diagram - Solid State Timer

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They are all time-sequenced by the 18 hour and one minute strobes, produced by suitably shaping the RSST 18 hour and one minute pulses as shown in Figure 2. The time sequence of command generation is shown in Figure 3. It should be noted that the Short Period Calibrate Command (1b) is or'ed with Command 065 within the PSE to provide redundant short period calibration commands.

Commandable control over the RSST output is provided, as it was with the Bulova timer. This feature is shown in Figure 2. On power application or in response to Command Octal 032, the level on G5 (Pin 8) goes high and puts gates 1A and 1B in the Timer accept state. On reception of Command Octal 033, the state of the flip-flop is changed, that is, its output (Pin 8) goes low and gates 1A and 1B are inhibited from responding to the RSST pulses.

Transmission of Command 033 is flagged as CRITICAL: it was intended for use only to prevent random commands from a Timer operating in an erratic manner (timer failure). Use of Command 033 is permissible if one is willing to accept the consequences. These are:

1. Loss of the automatic receiver circuit breaker reset command.

2. The issuance of an "unscheduled 18 hour" command.

The "power on reset" shown in Figure 2 ensures that the Timer interface circuits are in the "Timer Accept" mode when power is applied. This may also occur on switchover from power conditioner no. 1 to power conditioner no. 2 (or no. 2 to no. 1), in the power conditioning unit. Therefore, this power on reset has special significance since:

1. Should power reset be activated the Central Station counters will be initialized and will restart the 144 hour count.

2. The Timer interface circuits will be in the "Accept Mode" even though command 033 has previously been transmitted.

The RSST itself will retain its count during approximately 30 seconds of power loss; it will not reset during PCU switching. It also generates its own reset upon initial power application. Therefore, it does not use the "power on reset" function.
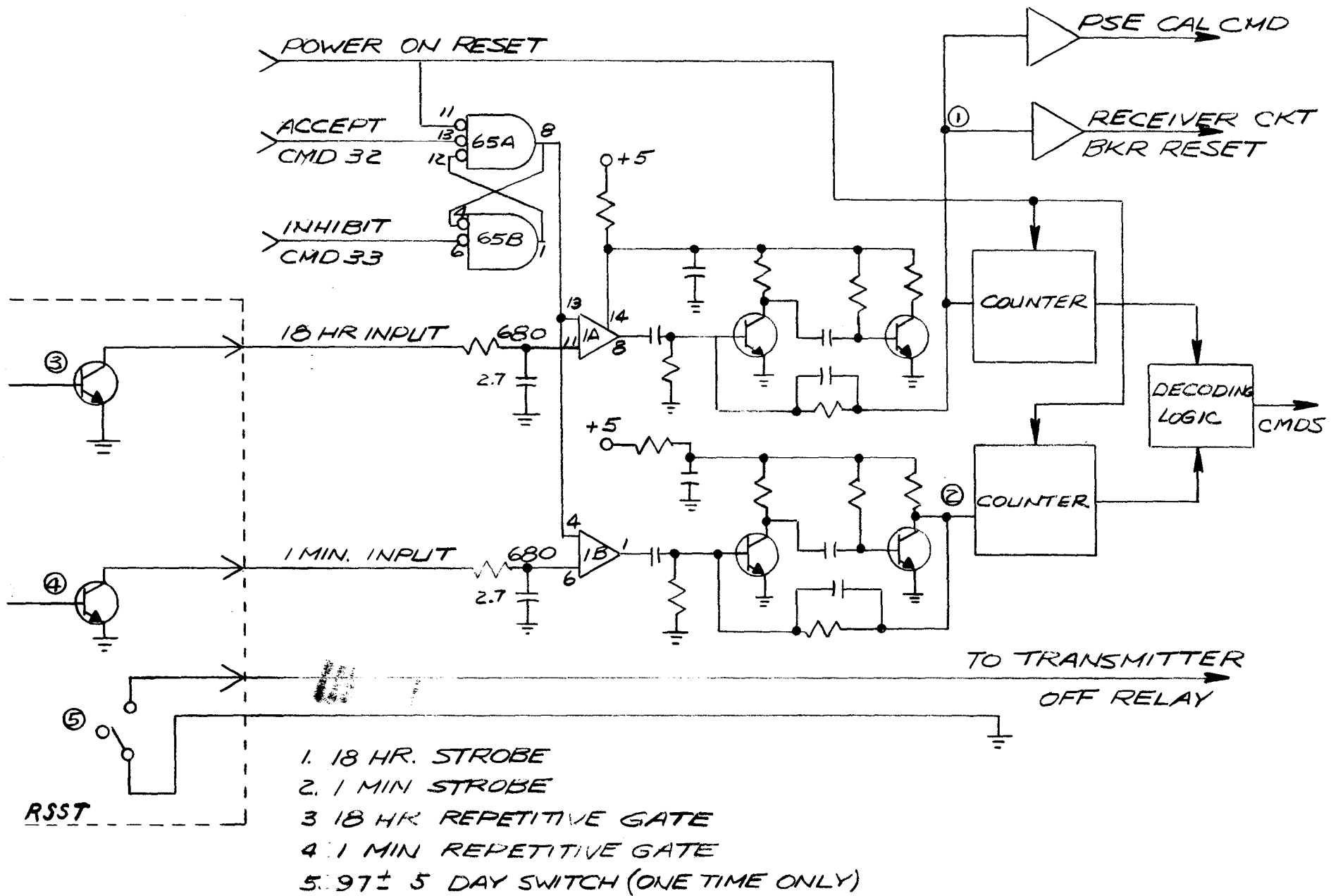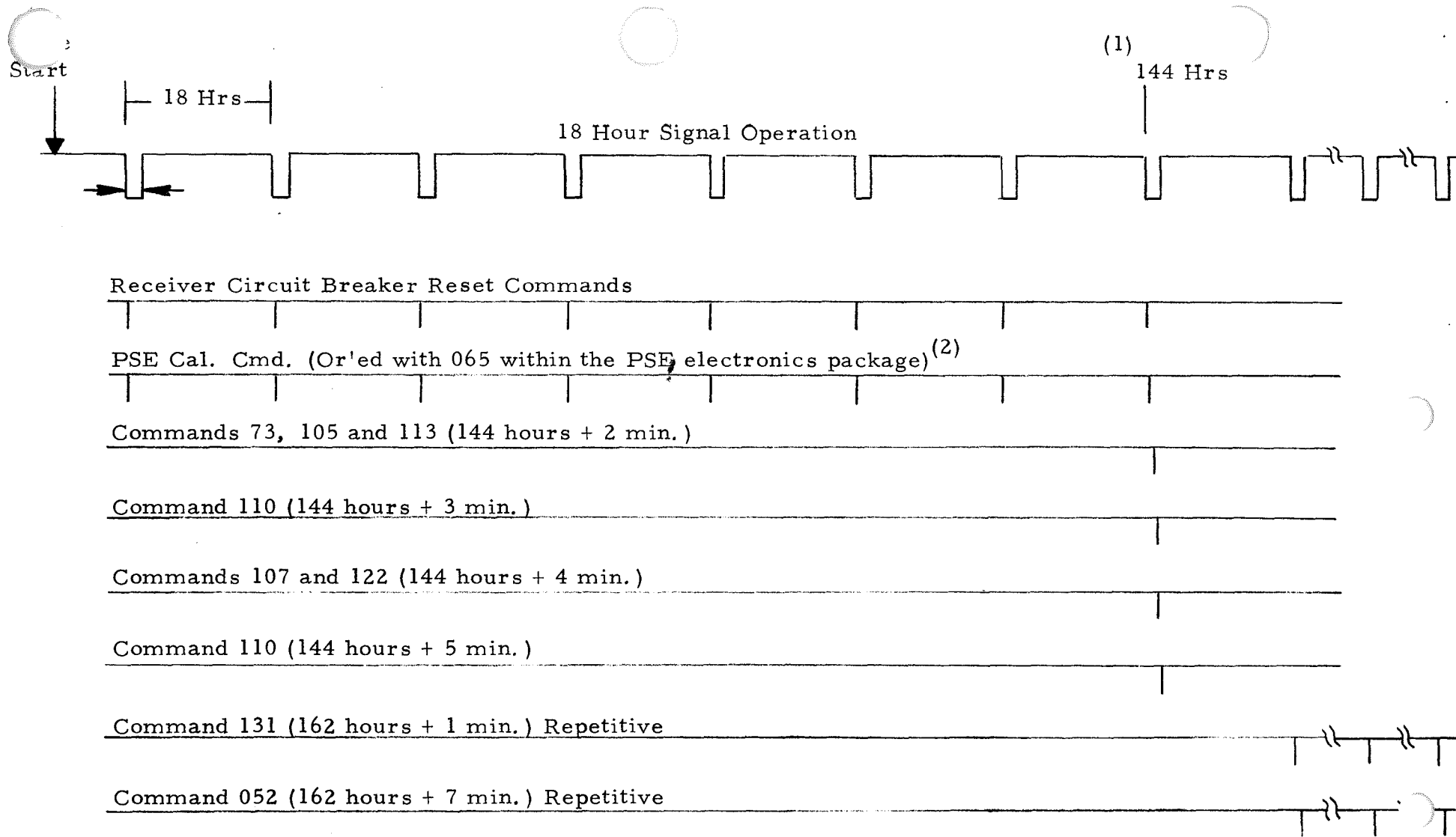
Figure 2

Start

18 Hrs

(1)
144 Hrs

18 Hour Signal Operation

Receiver Circuit Breaker Reset Commands

PSE Cal. Cmd. (Or'ed with 065 within the PSE electronics package)(2)

Commands 73, 105 and 113 (144 hours + 2 min.)

Command 110 (144 hours + 3 min.)

Commands 107 and 122 (144 hours + 4 min.)

Command 110 (144 hours + 5 min.)

Command 131 (162 hours + 1 min.) Repetitive

Command 052 (162 hours + 7 min.) Repetitive

NOTES: (1) 144 hour point ≈ 145 hours
              Max. ≈ 153 hours
              Min. ≈ 137 hours
       (2) In PSE Central Station Electronics, subsequent to Qual Model, this command is also or'ed with Command 073.
       (3) All delayed commands will be repeated in 144 hours following each activation of the Power Reset circuit.
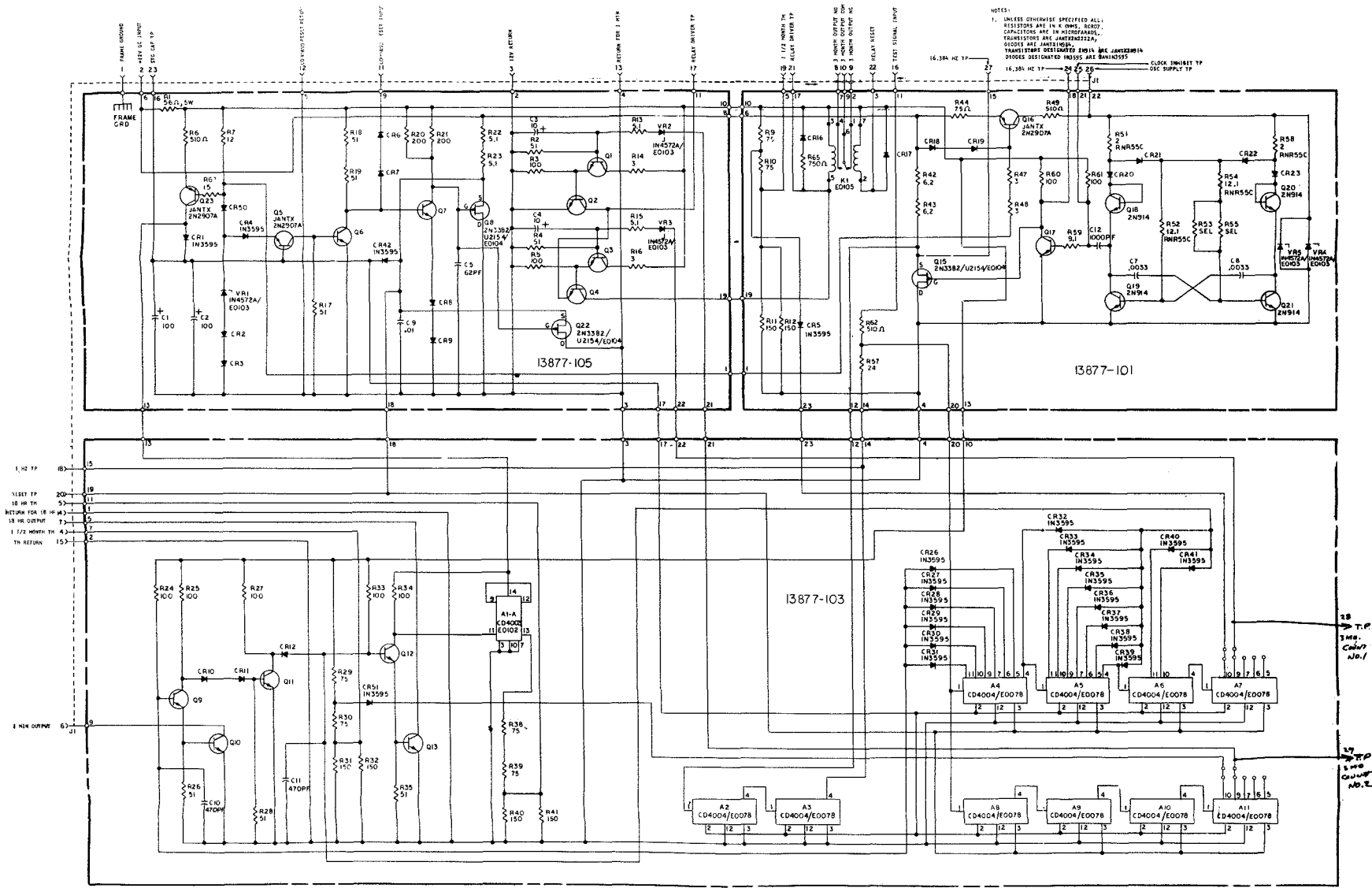
Figure 3.   Command Time Sequence

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The RSST is designed to terminate ALSEP transmission after 3 months of operation or within 3 months after the loss of command capability.

A normally open relay contact on the RSST is provided as shown in Figure 2. This switch provides a ground signal which is applied to the transmitter off relay in 97 ± 5 days after Central Station "power turn on" on the lunar surface. THERE IS NO PROVISION TO RESET THIS RELAY AFTER OPERATION, WHEN DEPLOYED ON THE LUNAR SURFACE. THEREFORE, TRANSMITTER TURN OFF IS IRREVOCABLE DURING A MISSION. The TIMER RESET Command, however, will reset the timer to 0 and will inhibit this relay's operation for a 3 month period with each application. It MUST be transmitted within each 3 month period if Central Station Operation is to continue.

RSST SCHEMATIC