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Digital Development Memo #260, Revision B

To: Eldon Hall
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Subject: Block II AGC Alarm Indications
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A. AGC FAULT DETECTION CIRCUITS

1. LOGIC

a. Parity Fail

Occurs if any accessed word in fixed or erasable memory whose address is octal 10 or greater contains an even number of ones. Causes restart. Buffer to test connector (MPAL/).

b. Rupt Lock

Occurs if interrupt is either too long or too infrequent. The criterion for "too long" is phase dependent, varying from 140ms to 300ms. Likewise the criterion for "too infrequent" varies from 140ms to 300 ms. Causes restart. Buffer to test connector (MRPTAL/).

c. TC Trap

Occurs if too many consecutive TC or TCF instructions are run or are too infrequent. The criterion for "too many" varies from 5ms to 15ms duration. The criterion for "too infrequent" varies from 5ms to 15ms absence. Causes restart. Buffer to test connector (MTCAL/).

d. Night Watchman

Occurs if the computer should fail to access address 67 within a period whose duration varies from .64 sec to 1.92 sec. Causes restart. Buffer to test connector (MWATCH/).

e. Counter Fail

Occurs if counter increments happen too frequently or else fail to happen following an increment request. "Too frequently" means continuous counter requests and/or incrementing for from .625ms to 1.87ms. Does not cause restart, but can cause AGC warning. Buffer to test counter (MCTRAL/).

f. PIPA Fail

Occurs if no pulses arrive from a PIPA during a 312.5 μsec period, or else if both plus and minus pulses occur, or else if a "long time" elapses without at least one plus pulse and at least one minus pulse arriving. By "long time" is meant a period of between 1.28 sec and 3.84 sec. Does not cause restart, but appears as inverted inbit 33-13. AGC program will use it to govern setting of ISS WARNING and PROGRAM CAUTION relays. Buffer to test connector (MPIPAL/).

g. Uplink Too Fast

A trap circuit prevents inlink data pulses from reaching the counter priority chain for 156 microseconds following each pulse. If a second pulse arrives during this "dead" time it sets inverted inbit 33-11. This flip-flop can be reset by any of the channel write instructions, Write, Wor, or Wand, acting on channel 33.

h. Downlink Too Fast

A trap circuit prevents downlink end pulses from causing interrupt and from terminating commutation for 10 milliseconds following each end pulse. If a second pulse arrives during this "dead" time it sets inverted inbit 33-12.

2. ANALOG

a. Voltage Fail

The signal VFAIL occurs if the AGC voltages (28, 14, 4) are out of limits as described in Digital Development Memo #243. This signal produces STRT1 if it stays on for a period of between 157 and 470 μsec and if it is not inhibited by the interface signal NHVFAL (D-912). If the computer is in the STANDBY mode, an input to the AGC WARNING FILTER is generated simultaneous with STRT1. STRT1 is buffered to the test connector (MVFAIL/) and causes RESTART unless it is grounded by a switch in the CTS buffer box.

b. Oscillator Fail

Occurs if the oscillator stops. Has nominal 250 millisecond (1/4 sec) delay to keep signal present after the oscillator starts. Also occurs when AGC is in STANDBY because of loss of power to front end of circuit. This gives 250 millisecond delay in starting when AGC comes out of STANDBY into OPERATE. This circuit is also described in Digital Development Memo #243. Also occurs if 4 voltage drops below 2 volts, by virtue of new connection to MYCLMP circuit (see Digital Development Memo #243). Causes immediate restart without waiting for time pulse 12. Sets inverted inbit flip-flop 33/15, 16. Buffer to test connector (MOSCAL/).

c. Scaler Fail

There are two scaler alarm circuits in the AGC. One generates the signal SCAFAL if scaler stage 17 (1.28 second period) fails to produce pulses. This provides a check on the timing for all logic alarms. This alarm is buffered to the test connector (MSCAFL/). The second scaler alarm generates the signal SCADBL if the 100 pps scaler stage operates at a pulse rate of 200 pps or more. This signal is buffered to to the test connector (MSCDBL/), and is absent in prototype computers. SCAFAL turns on AGC WARNING directly. SCADBL is an input to the WARNING FILTER and thus causes AGC WARNING. See Digital Development Memos #255 and #272.

The input test signal DOSCAL tests the SCAFAL circuit; DBLTST similarly tests the SCADBL signal.

B. AUXILIARY TIMING CIRCUITS

1. RESTART (GOJAM)

a. RESTART occurs at next time 12 following occurrence of any one or more of the following:

1.	PARITY FAIL	(See A.1)
2.	RUPT LOCK	"
3.	TC TRAP	"
4.	NIGHT WATCHMAN	"
5.	VOLTAGE FAIL	(See A.2.a)
6.	STANDBY	(See D.4)
7.	MSTART	(See D.3)

b. RESTART occurs immediately and forces time counter to 12 upon occurrence of OSCILLATOR FAIL.

c. RESTART causes the computer to transfer control to address 4000 as soon as it disappears. It sets a flip-flop which lights the RESTART CAUTION lamp in the DSKY. The flip-flop is reset either by the ALARM RESET hard wired signal or by the CAUTION RESET outbit CH11 B10. ALARM TEST operates the lamp but not the flip-flop. RESTART is buffered to the test connector (MGOJAM). See Section E.1.

2. WARNING FILTER

This circuit is used to operate the AGC WARNING (E-2) output following repeated or prolonged occurrences of:

a. RESTART
b. COUNTER FAIL
c. VOLTAGE FAIL in standby mode
d. ALARM TEST
e. Scaler double alarm

All occurrences of these signals are stretched so that no more than one input to the filter is generated in each 160 millisecond period. Approximately six consecutive stretched pulses cause AGC WARNING to turn on for about 5 seconds. Non-consecutive stretched pulses may also cause AGC WARNING after an interval dependent on the frequency of the pulses. Nominally, the output will not occur if input pulses occur at a frequency of less than about 0.9 pps; and the output will remain on if pulses occur at a frequency of about 0.6 pps or more. The threshold of the filter resumes its normal level with a time constant of many seconds after the filter has received inputs. See Digital Development Memo #255. The output is buffered to the test connector (MWARNF/) and sets the inverted inbit flip-flop CH33 B14.

C. AGC ALARM INPUTS

1.	IMU CDU FAIL	CH30 B12
2.	IMU FAIL	CH30 B13
3.	TEMP IN LIMITS	CH30 B16/15
4.	OPTICS CDU FAIL	CH30 B07

D. ASSOCIATED SIGNALS

1. LIGHT TEST

This is a flip-flop outbit, CH13 B10, used to test the DSKY lights and relays not accessible to program. It generates:

a. RESTART CAUTION LIGHT
b. AGC WARNING VIA WARNING FILTER
c. STANDBY LIGHT

When this outbit is reset, these signals revert to their proper condition. If AGC WARNING is not present, the warning signal will disappear in about 5 seconds (see B.2).

2. ALARM RESET

This is both a key code and a hard wired signal into the AGC from the DSKY. Its function is to furnish a reset for any CAUTION signals which are on and for the "Operator Error" status light.

3. MSTART

This is a test connector signal from the Test Set or the Monitor which causes a RESTART if it stays on for a period which varies from 157 to 470 microseconds.

4. STANDBY

This is a signal which turns on RESTART and turns off the switchable +4 and +14 voltages, thus putting the AGC into a low power mode where only the scaler, timing signals, and a few auxiliary signals are operative. STANDBY is initiated by first setting the ENABLE STANDBY outbit (CH13 B11), and then pressing the STANDBY button on the DSKY for a time which varies from .64 sec to 1.92 sec, at the end of which time the STANDBY LIGHT is turned on. All AGC alarms are inhibited during the standby mode with the exception of AGC WARNING, which can be caused by VOLTAGE FAIL or SCALER FAIL; and TEMPERATURE CAUTION, which can be caused by TEMP ALARM (C.3).

Normal operation is resumed by pressing the STANDBY button on the DSKY again; time of depression same as above.

E. DSKY A RELAYS

1. RESTART CAUTION

Turned on by occurrence of RESTART (B.1). Stays on until reset by ALARM RESET or outbit CH11 B10. Also turned on by LIGHT TEST. Lights RESTART CAUTION lamp on DSKY. Generates PGNS CAUTION. This alarm is inhibited in STANDBY.

2. AGC WARNING

a. WARNING is turned on by WARNING FILTER (B.2) as a result of:

1. RESTART
2. COUNTER FAIL
3. VOLTAGE FAIL in standby mode
4. ALARM TEST
5. Scaler double alarm

b. AGC WARNING is also turned on by SCAFAL (A.2.c). This signal is not quantized as are the ones listed above.

c. AGC WARNING is also turned on by failure of the primary AGC voltage.

d. The AGC warning relay operates a spacecraft warning lamp, but none on the DSKY.

3. ISS WARNING

This relay is operated by an outbit CH11 B01. The relay in turn operates a spacecraft warning lamp, but none on the DSKY.

4. COMPUTER ACTIVITY

Operated by outbit CH11 B02. Lights COMPUTER ACTIVITY lamp on DSKY.

5. UPLINK ACTIVITY

Operated by outbit CH11 B03. Lights UPLINK ACTIVITY lamp on DSKY.

6. TEMPERATURE

Lights TEMP lamp on DSKY. Generates PGNS CAUTION signal. Operated by outbit CH11 B04 and/or by TEMP alarm (C.3).

7. KEYBOARD RELEASE

Operated by outbit CH11 B05. Lights KEYBOARD RELEASE lamp on DSKY. Modulated by flash signal.

8. VERB-NOUN FLASH

Operated by outbit CH11 B06. Causes flash modulation of VERB-NOUN number lamps.

9. OPERATOR ERROR

Operated by outbit CH11 B07. Lights OPERATOR ERROR lamp on DSKY. Modulated by flash signal.

10. STANDBY

Operated by STANDBY circuit. Lights STANDBY lamp on DSKY. Also operated by LIGHT TEST.

11. SIVB INJ SEQ

Operated by outbit CH12 B13. Output to S/C.

12. SIVB CUTOFF

Operated by outbit CH12 B14. Output to S/C.

F. DSKY R RELAYS

1. PROGRAM CAUTION

Operated by RLYWD 1100 B9. Lights PROGRAM CAUTION lamp on DSKY. Generates PGNS CAUTION signal.

2. GIMBAL LOCK

RLYWD 1100 B6. Lights GIMBAL LOCK lamp on DSKY. Generates PGNS CAUTION signal.

3. TRACKER

RLYWD 1100 B8. Lights TRACKER lamp on DSKY. Generates PGNS CAUTION signal.

4. AUTO

RLYWD 1100 B1. Lights AUTO lamp on DSKY.

5. HOLD

RLYWD 1100 B2. Lights HOLD lamp on DSKY.

6. FREE

RLYWD 1100 B3. Lights FREE lamp on DSKY.

7. NO ATT

RLYWD 1100 B4. Lights NO ATT lamp on DSKY.

8. (SPARE)

RLYWD 1100 B5. Lights spare status lamp on DSKY.

9. (SPARE)

RLYWD 1100 B7. Enables PIPA's.

G. DSKY RELAY OUTPUTS

1. AGC WARNING

See B.2 and E.2.

2. ISS WARNING

See E.3.

3. PGNS CAUTION

This is the or of relay signals.

a. PROGRAM CAUTION (E.6).
b. TEMP (F.1).
c. GIMBAL LOCK (F.2).
d. TRACKER (F.3).
e. RESTART CAUTION (E.1).

4. INJ SEQ START

See E.11.

5. SIV CUTOFF

See E.12.

6. Spare

Sections Changed in This Revision

A.1.b

A.1.c

A.1.g

A.1.h

A.2.b

A.2.c

B.2