

GRUMMAN AIRCRAFT ENGINEERING CORPORATION

BETHPAGE, L. I., NEW YORK

SECTION VI

Rendezvous and Landing Radar

Sig. Ref.	Figure	
F1	20	RR in "1" (data flow)
F2	20	RR in "0" (data flow)
F3	20	LR in "1" (data flow)
F4	20	LR in "0" (data flow)
F5	21	RR Reset Strobe
F6	21	RR Range Gate Strobe
F7	21	RR Range Rate Gate Strobe
F8	21	RR Counter Read-out Command
F9	21	LR Reset Strobe
F10	21	LR Range Gate Strobe
F11	21	LR XA Velocity Gate Strobe
F12	21	LR YA Velocity Gate Strobe
F13	21	LR ZA Velocity Gate Strobe
F14	21	LR Counter Read-out Command
F15	22	LR Antenna Position Command
F16	23	RR Auto Angle Track Enable
F17	24	RR Data Good
F18	24	RR Range Low Scale Factor
F19	24	RR Power On & in LGC Mode
F20	25	LR Range Data Good
F21	25	LR Antenna Pos. 1 Indication (Descent)
F22	25	LR Antenna Pos. 2 Indication (Hover)
F23	26	LR Velocity Data Good
F24	26	LR Range Low Scale Factor

Signals F1 - F4

Pulse Characteristics (See Appendix A for pulse terminology)

Amplitude:	7 ± 3 volts
Width:	4 ± 2 microseconds
Droop (max):	20%
Backswing (max):	4 volts
Rise time (max):	0.2 microseconds
Repetition rate:	digital data at 3.2 KPPS

- Noise limits:
1. During the "ON" condition, the signal plus noise shall remain within the envelope defined by the parameters specified above.
 2. During the "OFF" condition, the noise shall remain within the envelope defined by the upper limit of $+0.4V$, and lower-limit of $-4.0V$, measured with respect to the amplitude reference level.

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Source and load impedances are measured between "HI" and "LO". Signals are defined and/or measured with respect to "LO" as reference.

Signals F5 - F14

Pulse Characteristics (See Appendix A for pulse terminology)

Amplitude:	3.75 ± 1.50 volts
Width: *	3 ± 0.5 microseconds
Droop (max):	20%
Backswing (max):	4 volts
Rise time (max):	0.2 microseconds
Repetition rate:	3.2 KPPS
Noise limits:	

1. During the "ON" condition, the signal plus noise shall remain within the envelope defined by the parameters specified above.
2. During the "OFF" condition, the noise shall remain within the envelope defined by the upper limit of +0.4V, and lower-limit of -4.0V, measured with respect to the amplitude reference level.

Source and load impedances are measured between "HI" and "LO". Signals are defined and/or measured with respect to "LO" as reference.

Signals F1.- F14 are not used in LM-1 due to the deletion of Rendezvous and Landing Radars. Each interface will be loaded with a 200 ohm resistor on the GAEC side of the interface.

Signal F15

Signal levels, source and load impedances are specified with respect to LGC Return (interface connector P/J 222 Pin G). Source impedance includes radar isolation resistance.

Signal F16

Signal levels, source and load impedances are specified with respect to LGC Return (interface connector P/J 222 Pin G).

* SEE NOTE * Page 50

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Signals F17 - F24

Signal levels, source and load impedances are specified with respect to LGC Return (interface connector P/J 222 Pin G). Source impedance includes LGC isolation resistance.

- Noise limits:
1. Switch closed ("1"): Maximum noise amplitude -50V, if noise pulse does not exceed 0.5 millisecond width at maximum repetition rate of 50 pps.
 2. Switch open ("0"): Maximum noise amplitude +50V, if noise pulse does not exceed 1.0 millisecond width at maximum repetition rate of 50 pps.

Signals F17 - F24 are not used in LM-1 due to deletion of Rendezvous and Landing radars. Each interface will be left open on GAEC side of interface.

* LGC may issue split pulses on the following interfaces:

F8 for LTA-8, LM-1 thru LM-5

F10 }
F11 }
F12 } for LTA-8, LM-1 thru LM-5
F13 }
F14 }

Effectivity based on LGC Program Imaginary 1B being incorporated in LM-6 and subsequent.

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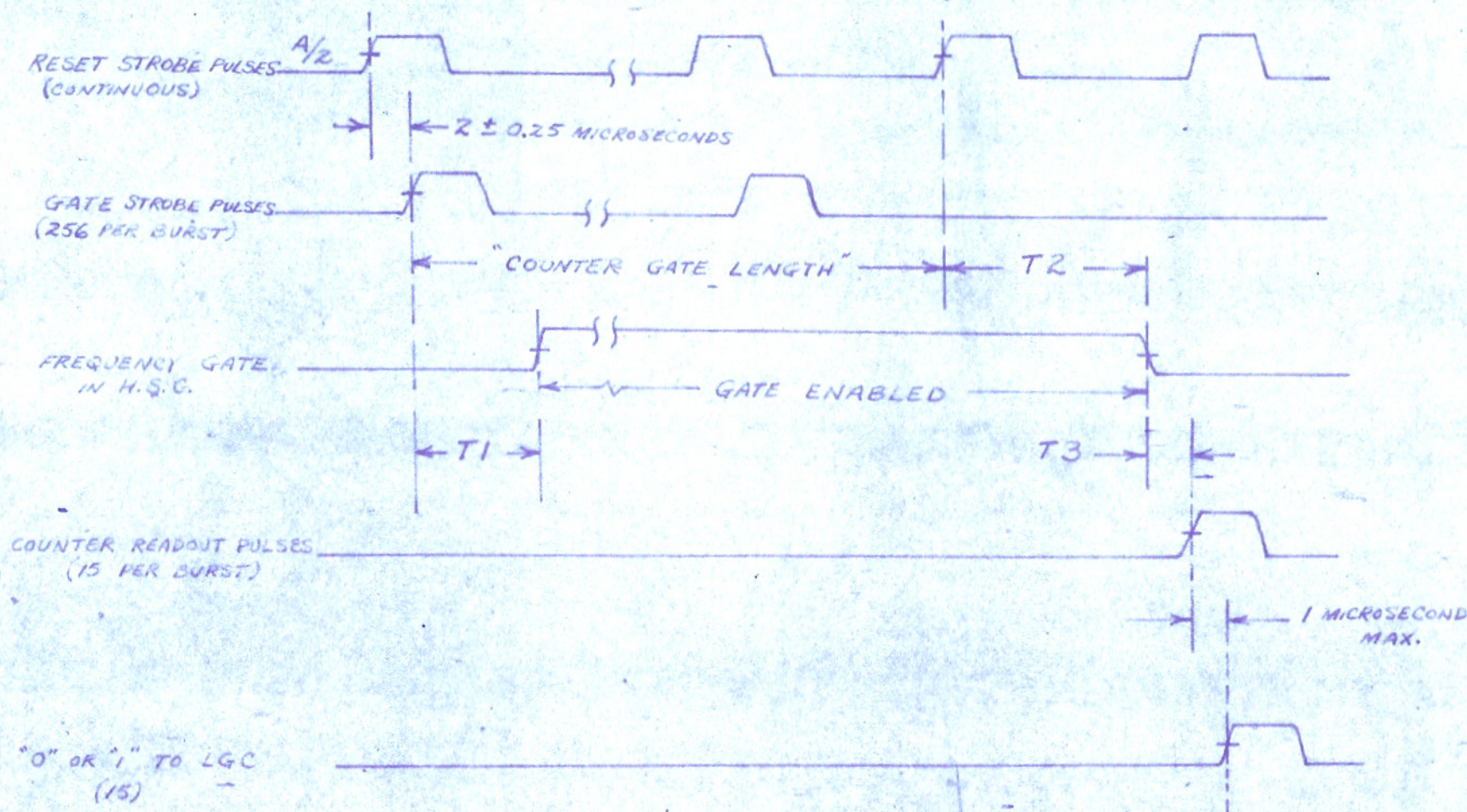


Fig. 19
RADAR PULSE TIMING

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Radar Pulse Timing (See Figure 19)

A. Maximum delay of 1 μ sec. between Counter Readout and Data Pulse.

B. The 15 Counter Readout pulses will generate 15 "0" or "1" pulses. The more significant bit will occur earlier in time. A "1" is represented as a pulse on the "1" line and a "0", as the presence of a pulse on the "0" line.

C. Delay between the first gate pulse and opening of frequency gate:

Rendezvous Radar: $T_1 = 313.5 \pm 0.75 \mu$ sec.

Landing Radar: $T_1 = \text{Approx. } 0.1 \mu$ sec.

D. Delay between reset pulse and closing of frequency counter gate:

Rendezvous Radar: $T_2 = 315.5 \pm 0.5 \mu$ sec.

Landing Radar: $T_2 = 3.1 \pm 0.5 \mu$ sec.

E. Gate Closure to CRO Pulse:

Rendezvous Radar: $T_3 = 309.5 \pm 0.5 \mu$ sec (minimum value)

Counter is reset, and may be strobed again at end of T_3 .

Landing Radar: $T_3 = 2 \mu$ sec. (minimum value)

Counter is reset, and may be strobed again, 312.5 μ sec. after end of Counter Gate.

F. Counter Gate Length:

Rendezvous Radar: $79998.0 \pm 0.25 \mu$ sec.

Landing Radar: $79998.0 \pm 0.25 \mu$ sec.

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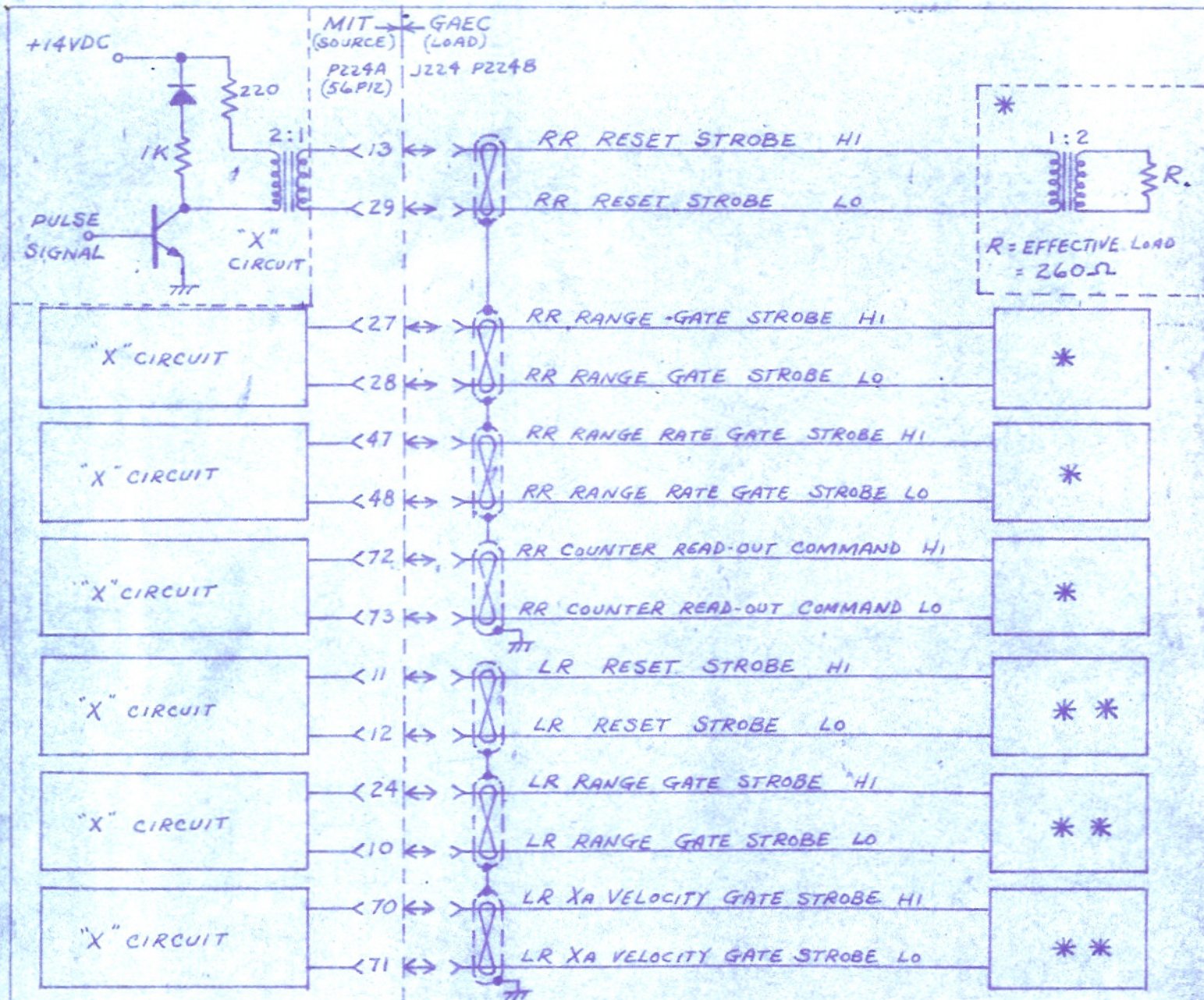
ID	SIGNAL	Z _{SOURCE} OHMS ±10%		Z _{LOAD} OHMS ±10%		FUNCTIONAL DESCRIPTION	
		LOGIC	"1"	"0"	"1"		"0"
F1	RR in "1" (Data Flow)		<100	<10 _v <(10mh)	200	<20 _v <(20mh)	Range or Range Rate data "ones". A positive pulse accomplishes transfer of a binary "one" from the RR output registers to the LGC.
F2	RR in "0" (Data Flow)		<100	<10 _v <(10mh)	200	<20 _v <(20mh)	Range or Range Rate data "zeros". A positive pulse accomplishes transfer of a binary "zero" from the RR output registers to the LGC.
F3	LR in "1" (Data Flow)		<100	<10 _v <(10mh)	200	<20 _v <(20mh)	A positive pulse accomplishes transfer of an altitude or velocity data binary "one" from the LR output registers to the LGC.
F4	LR in "0" (Data Flow)		<100	<10 _v <(10mh)	200	<20 _v <(20mh)	A positive pulse accomplishes transfer of an altitude or velocity data binary "zero" from the LR output registers to the LGC.
							*inductance of transformer winding "seen" at interface.

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* * SEE FIG. 21A

Fig. 21

RR & LR COUNTER STROBES & READOUT COMMANDS

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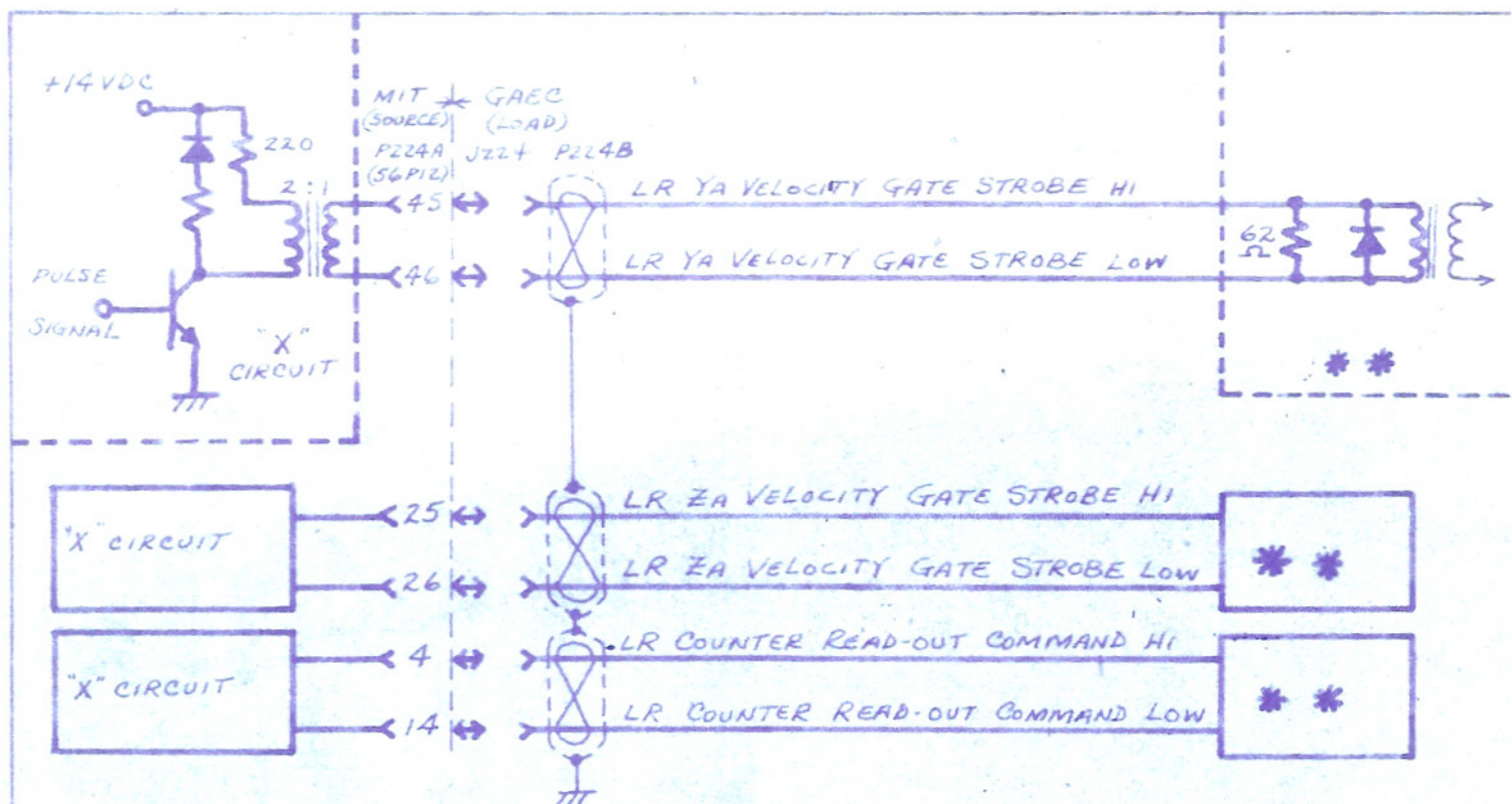
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EFFECTIVITY:

LTA-8, LM-1-LM-4, LM-6 ^{± Sub} ~~LM-15~~

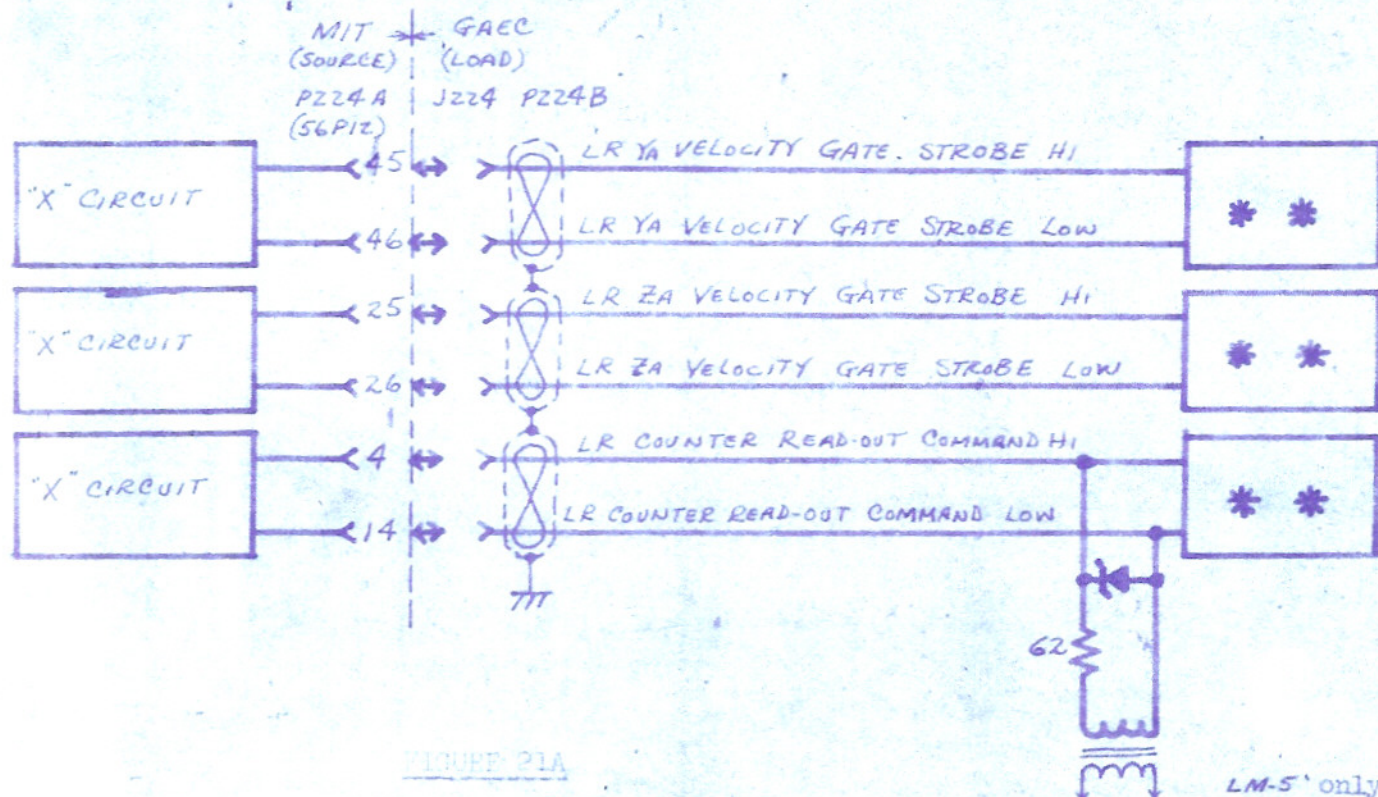


FIGURE 21A

LR Counter Strokes & Readout Command

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ID	SIGNAL	Z SOURCE OHMS ±10%		Z LOAD OHMS ±10%		FUNCTIONAL DESCRIPTION	
		LOGIC	"1"	"0"	"1"		"0"
F5	RR Reset Strobe		<100	<10 <(10mh)	65	<10 <(10mh)	A continuous positive pulse train which resets the range and range rate transfer gates.
F6	RR Range Gate Strobe		<100	<10 <(10mh)	65	<10 <(10mh)	Positive pulses provide timing to enable proper transfer of range data into the RR output shift registers.
F7	RR Range Rate Gate Strobe		<100	<10 <(10mh)	65	<10 <(10mh)	Positive pulses provide timing to enable proper transfer of range rate data into the RR output shift registers.
F8	RR Counter Read-Out Command		<100	<10 <(10mh)	65	<10 <(10mh)	Positive pulses from the IGC enable transfer of data from the RR output register to the IGC.
F9	LR Reset Strobe		<100	<10 <(10mh)	65	<10 <(10mh)	A continuous positive pulse train resets the range and velocity transfer gates.
F10	LR Range Gate Strobe		<100	<10 <(10mh)	65	<10 <(10mh)	Positive pulses provide timing to enable transfer of range (altitude) data to the LR output register.
NOTE: Values in parenthesis are inductance of transformer "seen" at interface.							

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ID	SIGNAL	Z SOURCE OHMS $\pm 10\%$		Z LOAD OHMS $\pm 10\%$		FUNCTIONAL DESCRIPTION	
		LOGIC	"1"	"0"	"1"		"0"
F11	LR X _A Velocity Gate Strobe		< 100	< 10 < (10mh)	65	< 10 < (10mh)	Positive pulses provide timing to enable transfer of X _A velocity data to the LR output register.
F12	LR Y _A Velocity Gate Strobe		< 100	< 10 < (10mh)	65	< 10 < (10mh)	Positive pulses provide timing to enable transfer of Y _A velocity data to the LR output register.
F13	LR Z _A Velocity Gate Strobe		< 100	< 10 < (10mh)	65	< 10 < (10mh)	Positive pulses provide timing to enable transfer of Z _A velocity data to the LR output register.
F14	LR Counter Read-Out Command		< 100	< 10 < (10mh)	65	< 10 < (10mh)	Positive pulses from the LGC enable transfer of data from the LR output register to the LGC.
values in parenthesis indicate inductance of transformer winding "seen" at interface.							NOTE: See Figure 19 for relative timing.

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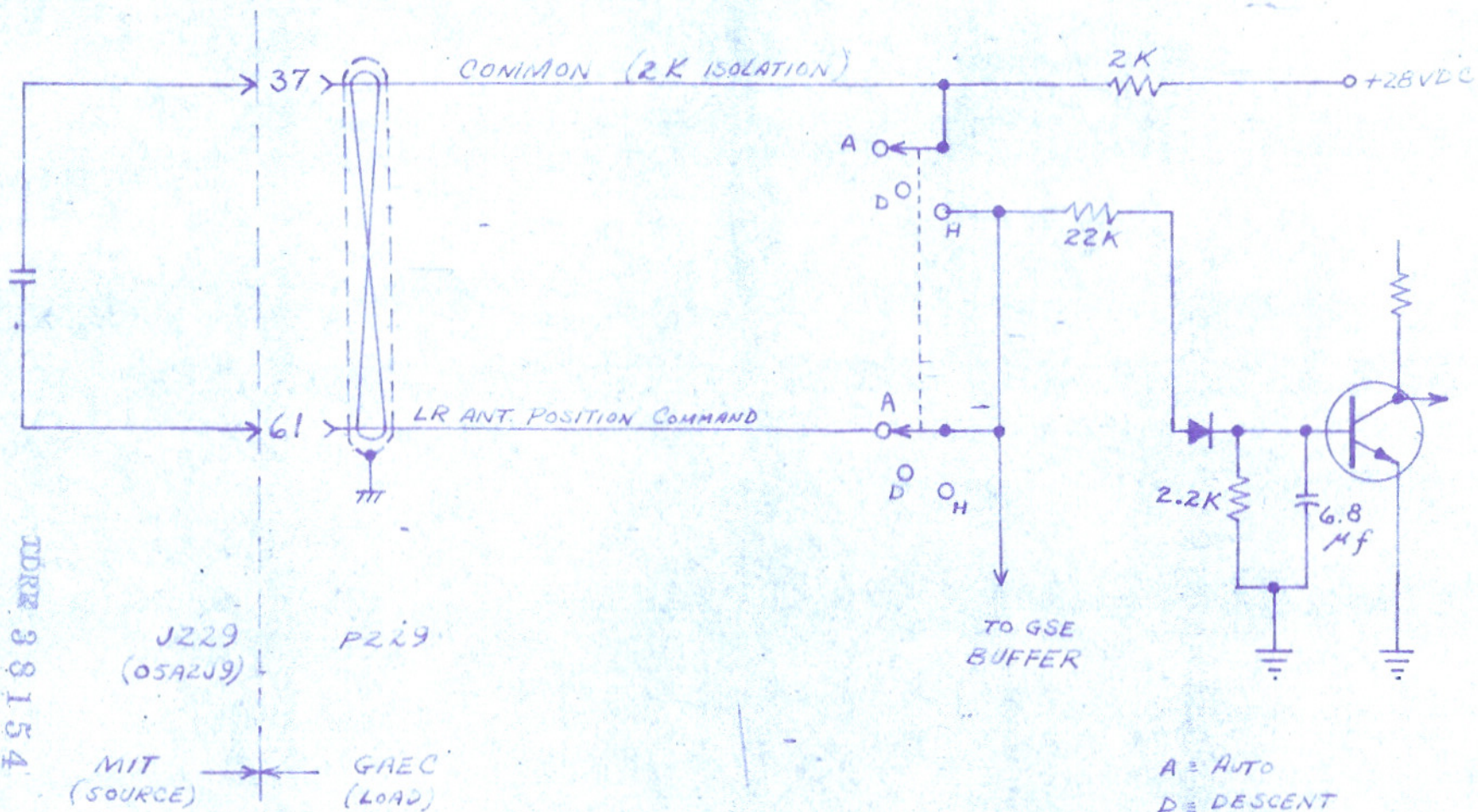


Fig. 22

LR ANTENNA POSITION COMMAND

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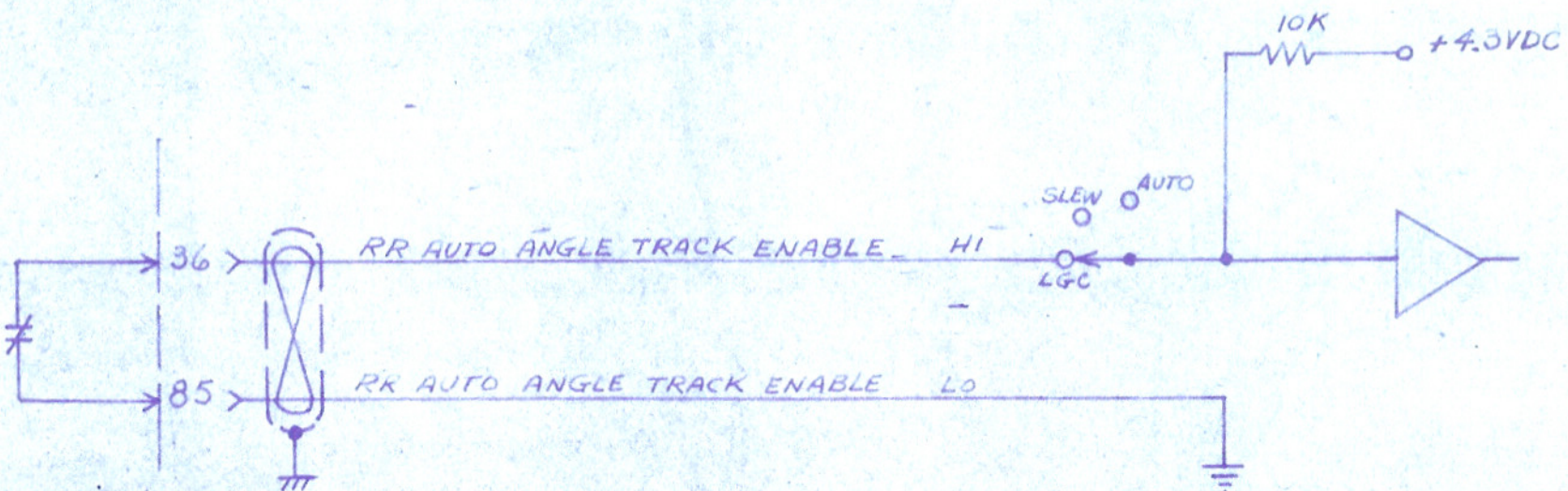


Fig. 23

RR TRACK ENABLE COMMAND

J229 P229
(05A2J9)
MIT → GAEC
(SOURCE) (LOAD)

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ID	SIGNAL	SIGNAL LEVEL DC VOLTS		Z SOURCE OHMS $\pm 10\%$		Z LOAD OHMS $\pm 10\%$		FUNCTIONAL DESCRIPTION	
		LOGIC	"1"	"0"	"1"	"0"	"1"		"0"
F15	LR Antenna Position Command		26 $\pm$ 10	0 $\pm$ 2	2K	OPEN	22K	22K	A logic "1" at the interface commands the LR antenna to move to position two when the LR antenna position switch is in the LGC position. There is no provision for the LGC to return the antenna to position 1.
F16	RR Auto Angle Track Enable		4.3 $\pm$ 1	0 $\pm$ 1	OPEN	CLOSED	10 K	10 K	When the LGC has slewed the RR Antenna to within 0.5° of the estimated CSM line of sight, the presence of a logic "1" (open relay contact in DSKY) enables the RR range and angle trackers to acquire the target.

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RR MODE & STATUS DISCRETES

ID	SIGNAL	SIGNAL LEVEL DC VOLTS		Z SOURCE OHMS $\pm 10\%$		Z LOAD OHMS $\pm 10\%$		FUNCTIONAL DESCRIPTION	
		LOGIC	"1"	"0"	"1"	"0"	"1"		"0"
F17	RR Data Good		28 $\pm$ 11	0 $\pm$ 2	3.2K	OPEN	22K	22K	When the RR range tracker and frequency tracker have completed acquisition and F16 is present, the radar provides a logic "1" to the LGC which enables use of RR data by the LGC.
F18	RR Range Low Scale Factor		28 $\pm$ 11	0 $\pm$ 2	3.2K	OPEN	22K	22K	When the RR range counter has "zeros" in the three most significant bit positions (representing less than approx. 50.6 nautical miles) the RR implements low scale factor using the 15 least significant bits of the RR accumulator, and issues a positive discrete (F15) causing the LGC to use the low range scale factor when the RR mode switch is in the LGC position.
F19	RR Power On & In LGC Mode		28 $\pm$ 11	0 $\pm$ 2	3.2K	OPEN	22K	22K	When the RR power is on and the RR mode switch is in the LGC position, a positive discrete enables the LGC to control the RR.

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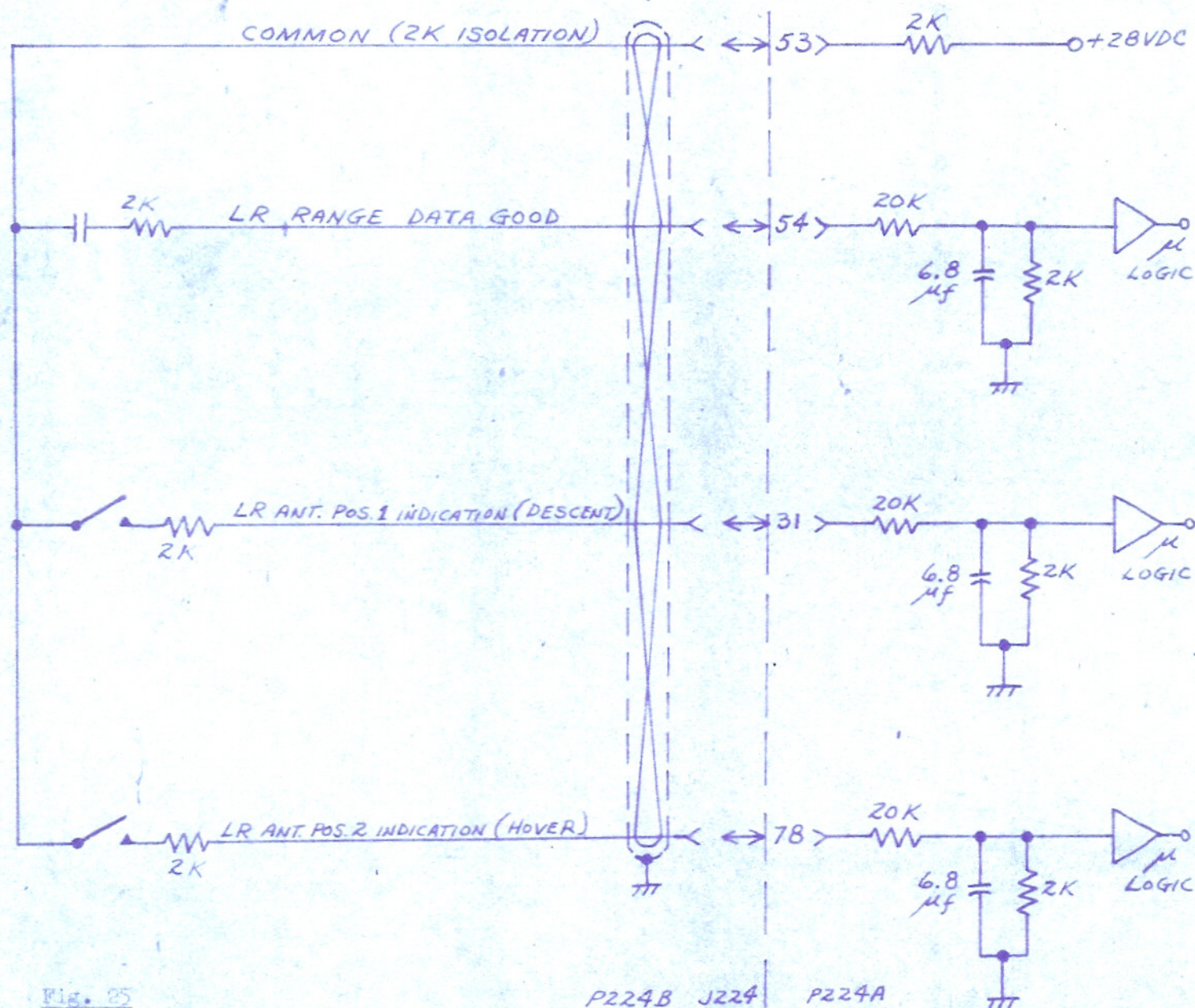


Fig. 25
LR STATUS DISCRETES

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ID	SIGNAL	SIGNAL LEVEL DC VOLTS		Z SOURCE OHMS $\pm 10\%$		Z LOAD OHMS $\pm 10\%$		FUNCTIONAL DESCRIPTION	
		LOGIC	"1"	"0"	"1"	"0"	"1"		"0"
F20	LR Range Data Good		28 $\pm$ 11	0 $\pm$ 2	4K	OPEN	22K	22K	When the LR range and two velocity trackers (beams one & two) have acquired a target, a relay closure in the radar presents a logic "1" to the LGC which enables the LGC to use the LR range data.
F21	LR Antenna Pos. 1 Indication (Descent)		28 $\pm$ 11	0 $\pm$ 2	4K	OPEN	22K	22K	A switch closure in the LR presents a logic "1" to the LGC indicating that the LR antenna is in position 1.
F22	LR Antenna Pos. 2 Indication (Hover)		28 $\pm$ 11	0 $\pm$ 2	4K	OPEN	22K	22K	A switch closure in the LR presents a logic "1" to the LGC indicating that the LR antenna is in position 2.

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GRUMMAN AIRCRAFT ENGINEERING CORPORATION
BETHPAGE, L. I., NEW YORK

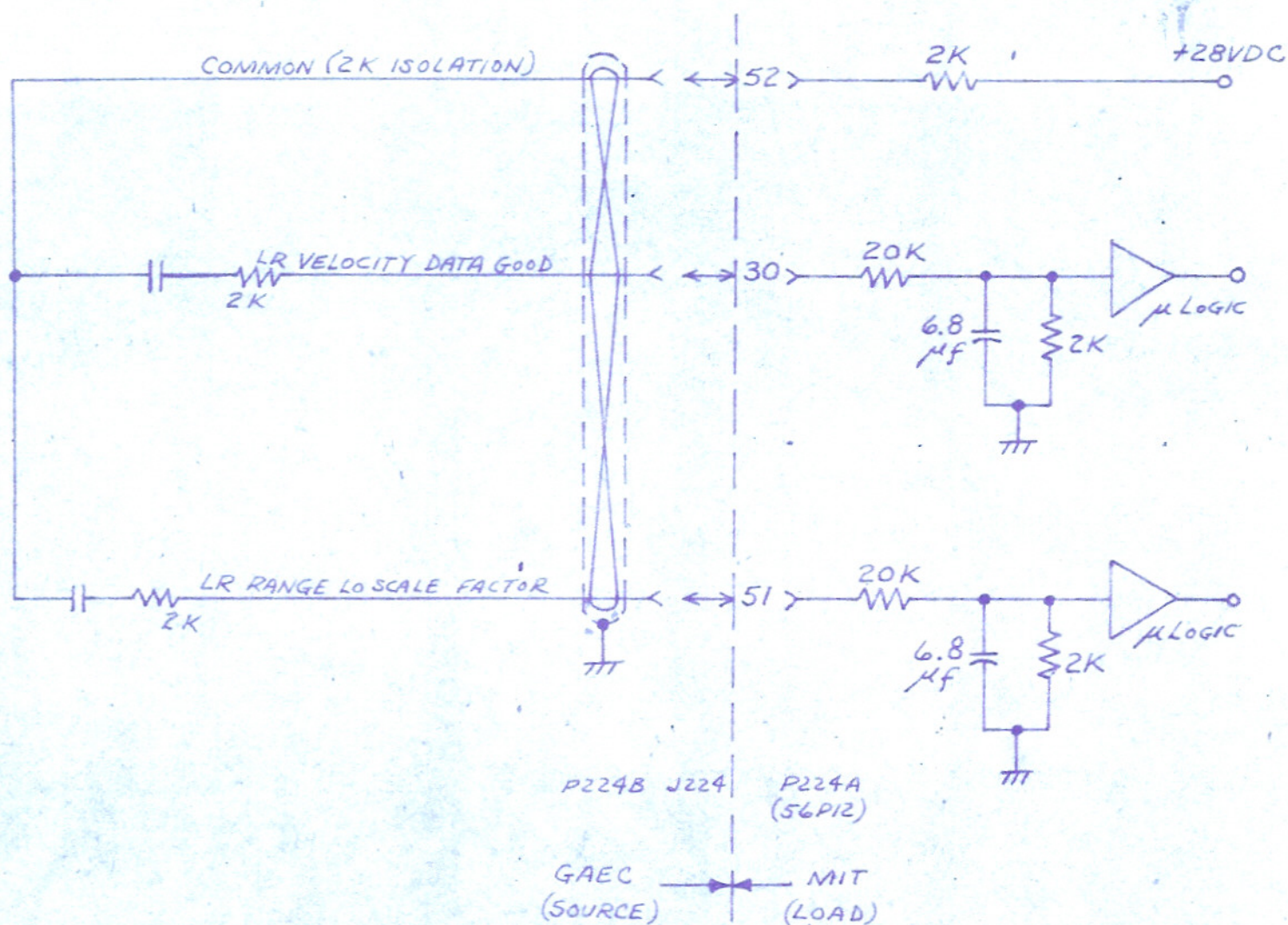


Fig. 36

LR CONTROL MODE & STATUS DISCRETES

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ID	SIGNAL	SIGNAL LEVEL DC VOLTS		Z SOURCE OHMS $\pm 10\%$		Z LOAD OHMS $\pm 10\%$		FUNCTIONAL DESCRIPTION	
		LOGIC	"1"	"0"	"1"	"0"	"1"		"0"
F23	LR Velocity Data Good		28 $\pm$ 11	0 $\pm$ 2	4K	OPEN	22K	22K	When the three LR velocity beams have acquired a target, a relay contact closure in the LR presents a logic "1" to the LGC which enables the LGC to use LR velocity data.
F24	LR Range Lo Scale Factor		28 $\pm$ 11	0 $\pm$ 2	4K	OPEN	22K	22K	A relay contact closure in the LR presents a logic "1" to the LGC indicating that the LR range low scale factor is to be used.

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