

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

SECTION IV

Main Engine Signals

Sig. Ref.	Figure	
D1	14	Increase Throttle
D2	14	Decrease Throttle
D3	15	Engine On
D4	15	Engine Off
D5	16	+Pitch Trim
D6	16	-Pitch Trim
D7	16	+Roll Trim
D8	16	-Roll Trim
D9	17	Pitch Gimbal Off (Gimbal Off)
D10	17	Roll Gimbal Off (Apparent Gimbal Fail)

D1 & D2:

Pulse Characteristics (See Appendix A for pulse terminology)

Amplitude: 7 ± 3 volts
 Width: 3 ± 1 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 +0.4 volts, and lower limit of -4.0 volts, measured with respect to the amplitude reference level.

For D3 - D10:

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

For D5 - D8 :

LGC isolation resistors are included in the load impedance.

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For D9 & D10:

IGC isolation resistors are included in the source impedance.

For D1 & D2:

Source and load impedances are specified between "Hi" and "Lo". Signals are defined and/or measured with respect to "Lo" as reference.

For D3 - D8:

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

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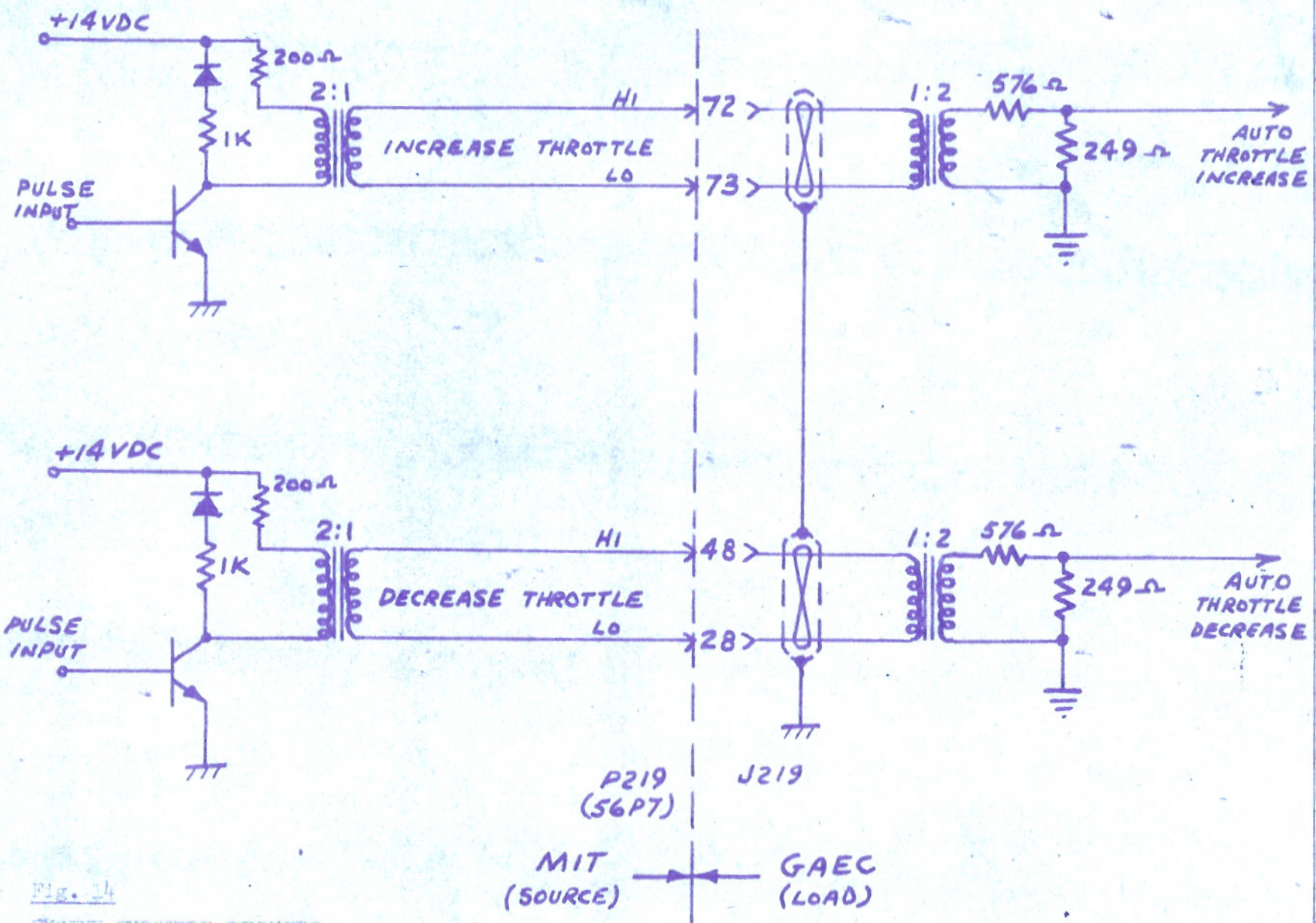


Fig. 24
 ENGINE THROTTLE COMMANDS

MIT (SOURCE) ← → GAEC (LOAD)

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ENG 57.2.1-44

ID	SIGNAL	Z SOURCE OHMS ±10%		Z LOAD OHMS ±10%		FUNCTIONAL DESCRIPTION	
		LOGIC	"1"	"0"	"1"		"0"
D1	Increase Throttle		<100	<10 _* <(10mh)	200	<20 _* <(20mh)	Pulses at the interface are incremental commands to the descent engine throttle controls in a direction to increase the thrust towards the fixed throttle point.
D2	Decrease Throttle		<100	<10 _* <(10mh)	200	<20 _* <(20mh)	Pulses at the interface are incremental commands to the throttle controls in a direction to decrease the thrust toward the zero throttle point. The vehicle will not respond to commands below the manually commanded thrust value or the 10% level, whichever is higher.
*inductance of transformer winding "seen" at interface.							

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* OPERATED BY GUIDANCE
 CONTROL SWITCH
 PGNS POSITION - RESET (SHOWN)
 AGS POSITION - SET

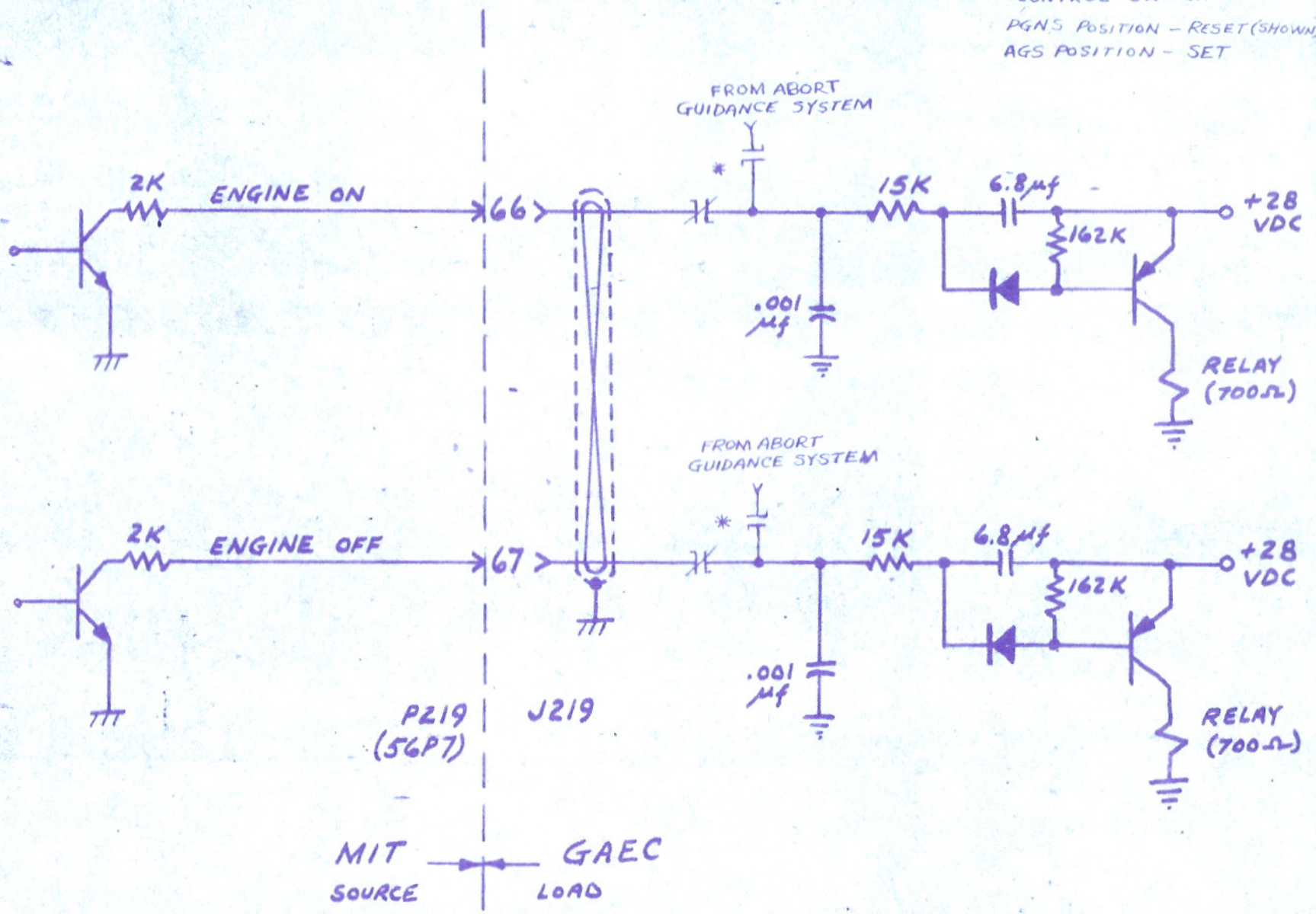


Fig. 15
 ENGINE ON-OFF DISCRETES

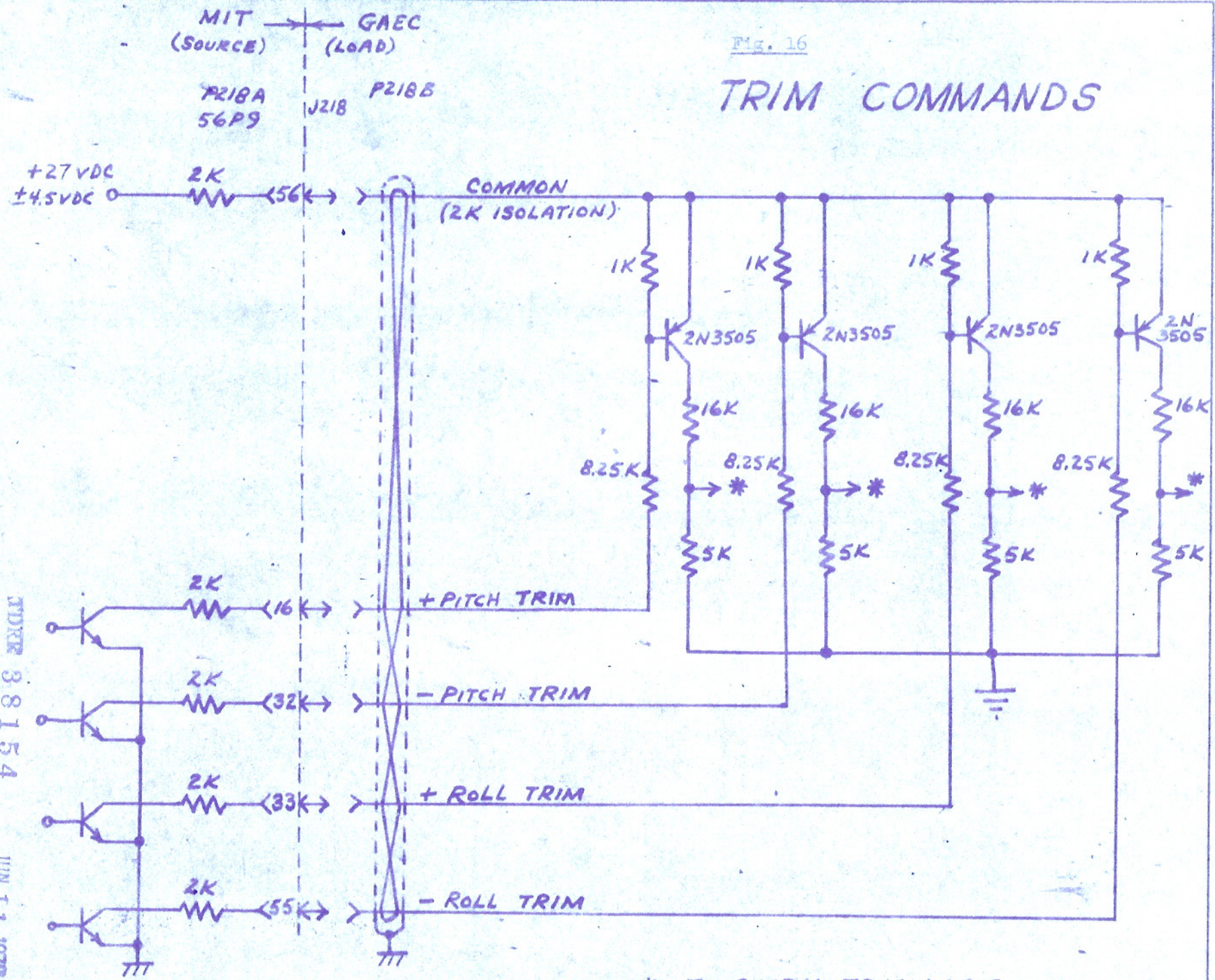
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ENG 37.2 1-64

Fig. 16

TRIM COMMANDS



* TO GIMBAL TRIM LOGIC

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MIT (SOURCE) → GAEC (LOAD)
 P218A 56P9 J218 P218B

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ID	SIGNAL	SIGNAL LEVEL DC VOLTS		Z SOURCE OHMS ± 10%		Z LOAD OHMS ± 10%		FUNCTIONAL DESCRIPTION	
		LOGIC	"1"	"0"	"1"	"0"	"1"		"0"
D3	Engine On		3±2	28±11	< 3K	> 500K	15K	15K	The presence of a logic "1" at the interface is a command to turn on the ascent or descent engine provided that the Engine OFF signal (D4) is a logic "0".
D4	Engine Off		3±2	28±11	< 3K	> 500K	15K	15K	The presence of a logic "1" at the interface is a command to turn off the ascent or descent engine provided that the Engine ON signal (D3) is a logic "0". <u>NOTE:</u> The LM will not recognize the presence of a logic "1" simultaneously on both of the above interfaces, or the presence of a logic "0" simultaneously on both of the above interfaces as a legal command and will leave the engine in its last legal commanded state.
D5	+Pitch Trim		5±3	17 min. 31.5max	3K	500K	11.5K	11.5K	Presence of a logic "1" at the interface is a command to the DECA for a vehicle rate of change of angular acceleration in a right hand positive direction about the LM +Y axis during descent engine firing. See note page 41.

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ID	SIGNAL	SIGNAL LEVEL DC VOLTS		Z SOURCE OHMS ± 10%		Z LOAD OHMS ± 10%		FUNCTIONAL DESCRIPTION	
		LOGIC	"1"	"0"	"1"	"0"	"1"		"0"
D6	-Pitch Trim		5±3	17 min 31.5max	<3K	>500K	11.5K	11.5K	Presence of a logic "1" at the interface is a command to the DECA for a vehicle rate of change of angular acceleration in a right hand negative direction about the LM +Y axis during descent engine firing. See note below.
D7	+Roll Trim		5±3	17 min 31.5max	<3K	>500K	11.5K	11.5K	Presence of a logic "1" at the interface is a command to the DECA for a vehicle rate of change of angular acceleration in a right hand positive direction about the LM +Z axis during descent engine firing. See note below.
D8	-Roll Trim		5±3	17 min 31.5max	<3K	>500K	11.5K	11.5K	Presence of a logic "1" at the interface is a command to the DECA for a vehicle rate of change of angular acceleration in a right hand negative direction about the LM +Z axis during descent engine firing. See note below.

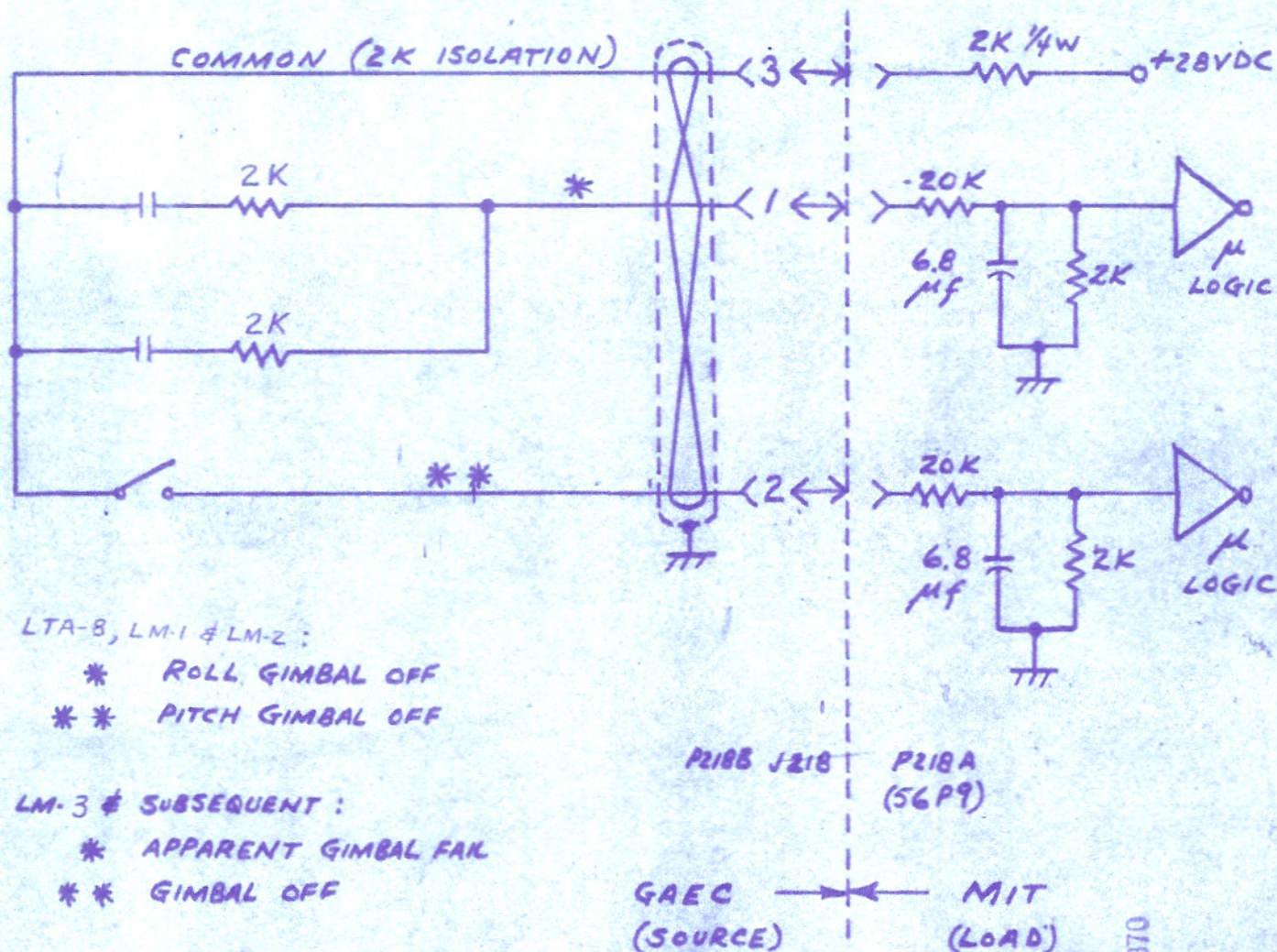
Note: For LCC Test Program Aurora these signals will command vehicle rates of change of acceleration in the opposite directions.

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LTA-8, LM-1 & LM-2:

- * ROLL GIMBAL OFF
- ** PITCH GIMBAL OFF

LM-3 & SUBSEQUENT:

- * APPARENT GIMBAL FAIL
- ** GIMBAL OFF

P218B J218 P218A (56P9)

GAEC (SOURCE) MIT (LOAD)

Fig. 17

ENGINE GIMBAL FAIL 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"
D10	Roll Gimbal Off (LTA-8, LM-1 & LM-2 Only)		28±11	0±2	3-4K	OPEN	22K	22K	Presence of a logic "1" at the interface is an indication to the LGC that the Roll and/or Pitch GDA has been disabled.
D10	Apparent Gimbal Fail (LM-3 & Subsequent)		28±11	0±2	3-4K	OPEN	22K	22K	Presence of a logic "1" at the interface is an indication to the LGC that the Roll and/or Pitch malfunction logic in DECA has detected a malfunction.
D9	Pitch Gimbal Off (LTA-8, LM-1 & LM-2 Only)		28±11	0±2	2K	OPEN	22K	22K	Presence of a logic "1" at the interface is an indication to the LGC that the Engine Gimbal switch has been placed in the "OFF" position. <u>Note:</u> in LTA-8, LM-1 & LM-2, the presence of this discrete is not an indication that the GDA's have been disabled.
D9	Gimbal Off (LM-3 & Subsequent)		28±11	0±2	2K	OPEN	22K	22K	Presence of a logic "1" at the interface is an indication to the LGC that the Engine Gimbal switch has been placed in the "OFF" position thereby disabling the Pitch and Roll GDA's. <u>Note:</u> In LM-3 and subsequent, when D9 is present, D10 will not be present. In LTA-8, LM-1 & LM-2 they may be present at the same time.

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