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Mulligan, M. F.

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PREPARED BY..... M.F.M.

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SUBJECT T/I Calibration Unit Interface

PREPARED BY M.F. Mulligan

ISSUED TO

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## T/I Calibration Unit Interface

### Introduction

A device is being used in the Engine Lab (M-7) to calibrate pressure transducers. The device, namely, the "Texas Instruments Calibration Standard" will measure and provide calibration pressures with an accuracy of .01% of reading. A manual system to control the device was first manufactured with a second in mind to complement the first. The second system was to be remote in the sense that it would be controlled by the PDP 11/23 minicomputer's data acquisition system's digital output. This report will describe the design of an interface built to link both the manual system to the minicomputer's system to the T/I calibration standard.

### Design Criteria

Supplied by Texas Instruments was a Digital Interface Model 178 which would accept Binary inputs ranging from  $2^0$  to  $2^{19}$ .\* The operation of such a device required a definite digital High (1) or digital Low (0) as inputs during operation. For the manual control system a +5V (1) or ground (0) was used. When the remote system was introduced the following requirements had to be met:

- 1) Both control systems (manual and remote) had to output Positive Logic.
- 2) Both had to be independent of each other's outputs with protection for each digital source.
- 3) Both had to operate as individual digital sources.

With the above criteria the following "truth table" was generated.

Control Switch Position (Manual-Enabled)	1	1	0	0
(Computer-Enabled)	0	0	1	1
Manual Switch Output	0	1	X	X
Computer TTL Output	X	X	0	1
Interface Output to T/I	0	1	0	1

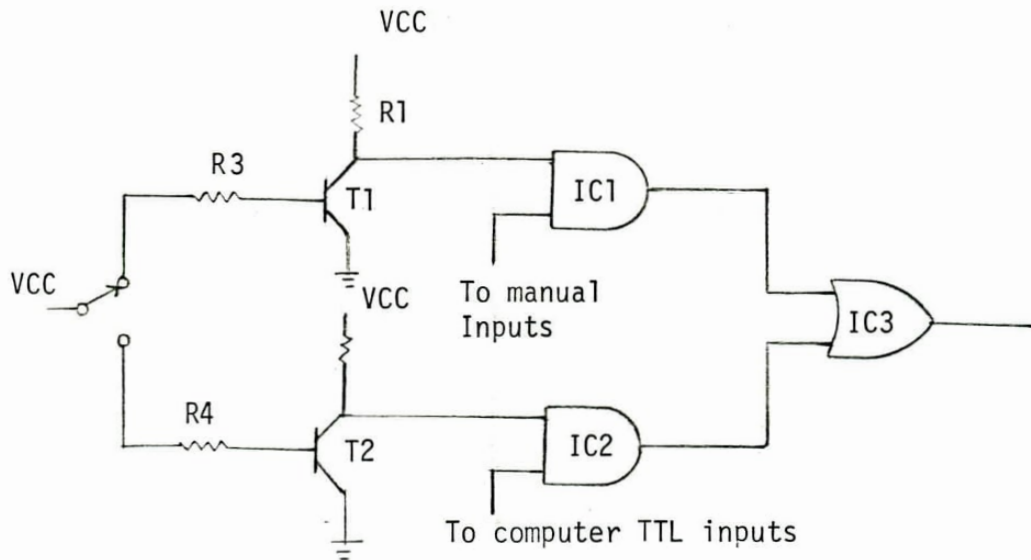
- (1) Logical High  
(0) Logical Low  
(X) don't care.

---

\*Note: Since our T/I calibrator counts to 200,000 a maximum of only  $2^{16}$  binary inputs was required.

It should be noted that a TTL digital output module exists in the data acquisition system which was currently used to operate relays and now is being paralleled to control the Texas Instrument's calibration unit.

From the "truth table" the following circuit was designed for each binary input.



R1 = R2 = 15K $\Omega$                       R3 = R4 = 2.2K $\Omega$   
T1 = T2 = 2N3707, 2N3904  
IC1 = IC2 = N7807                      IC3 = N74L532

Interface Circuit  
(Typical .17 req.)

### Circuit Operation

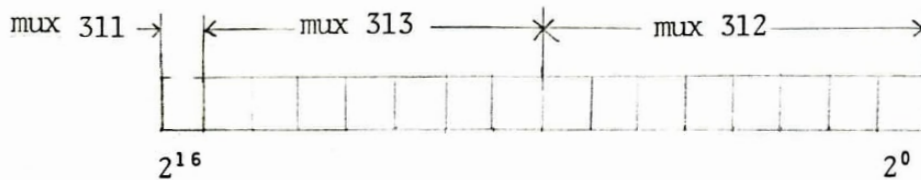
In the above circuit, transistors are used to enable and disable the inputs from either the manual or computer input services. When in the enable mode as dictated by the position of a control switch (SW1) inputs from each device are "And"ed and then a "OR"ed before being sent to the T/I calibrator. Note that only one set of inputs, manual or computer, can be enabled at any one time in order to make each system totally independent of each other.

Wiring Pinouts

Binary input code	"AND" gate input Comp. & man. connector Pin No.	computer Pin Out No. and Max.			"AND" gate output to "OR" gate		"OR" gate inputs from "AND" gate		output from "OR" gates to T/I	25 Pin conn on T/I
		Pin	Data	Mix	comp.	man.	comp.	man.		
2 <sup>0</sup>	12	Pin T1	Data (1)	Mix 312	11	11	11	12	13	1
2 <sup>1</sup>	2	S1	(2)	312	3	3	2	3	4	2
2 <sup>2</sup>	4	R1	(4)	312	6	6	5	6	7	3
2 <sup>3</sup>	7	P1	(10)	312	9	9	8	9	10	4
2 <sup>4</sup>	18	N1	(20)	312	25	25	30	31	32	5
2 <sup>5</sup>	13	M1	(40)	312	15	15	14	15	16	6
2 <sup>6</sup>	14	L1	(100)	312	16	16	17	18	19	7
2 <sup>7</sup>	17	K1	(200)	312	19	19	20	21	22	8
2 <sup>8</sup>	30	J1	(1)	313	31	31	41	42	33	9
2 <sup>9</sup>	22	H1	(2)	313	23	23	27	28	29	10
2 <sup>10</sup>	24	F1	(4)	313	26	26	34	35	36	11
2 <sup>11</sup>	27	F1	(10)	313	29	29	38	39	40	12
2 <sup>12</sup>	41	D1	(20)	313	42	42	12*	13*	14*	13
2 <sup>13</sup>	33	C1	(40)	313	34	34	3*	4*	2*	14
2 <sup>14</sup>	35	B1	(100)	313	36	36	6*	7*	8*	15
2 <sup>15</sup>	38	A1	(200)	313	39	39	9*	10*	11*	16
2 <sup>16</sup>	20	U1	(1)	311	21	21	24	25	26	17
	Pin 1 T5V Pin 43 grd Pin 5 Enable									

\* Circuit Board #2.

Computer Address Coding



Example

To set 4096 on computer TTL card and output to T/I

$$4096 = 2^{12} = \text{bit } 13$$

Set mux 313 "20

Call DORTN ("313, "20, 1)

T/I will produce to a pressure equivalent to 4096 decimal counts.

Conclusion

With the existing computer system (PDP 11/23) and T/I configuration calibrations can now be executed on pressure transducers while testing, or at any other time. Such a system enhances the operation of a test system in providing a means to calibrate pressure devices accurately in a testing environment.

Pressure transducers were previously calibrated off-line by using a dead-weight standard. This took time after a test run was completed, and did not permit on-line calibration, or checking during a test. The system described here has improved the procedure for gas turbine testing.