ACQUISIZIONE AUTOMATICA DI PARAMETRI METEOROLOGICI PER OSSERVAZIONI VLBI.

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Indice

INTRODUZIONE.

La richiesta sempre piu' pressante di informazioni meteorologiche da rilevare durante le osservazioni VLBI (specie se di tipo geodinamico), ci ha spinto a realizzare una apparecchiatura per l'acquisizione automatica dei principali parametri meteo, chiamata brevemente MET SENSOR (METeorological SENSOR data aquisition system), partendo da un progetto gia' esistente (realizzato da istituti americani), ma rivisto, in funzione delle nostre esigenze e della strumentazione a noi disponibile.

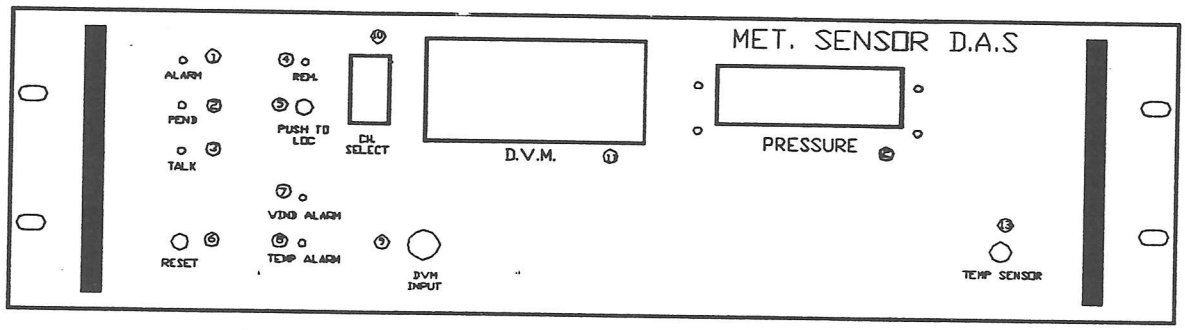
Un primo prototipo fu realizzato nell'1987. Ora si e' passati alla versione definitiva, con la quale si pensa di equipaggiare entrambe le stazioni di Medicina e Noto, e della quale si scrive in questo rapporto interno come documentazione definitiva.

Una nota va spesa riguardo al tempo passato da quando partirono i primi lavori, alla data attuale; ne e' trascorso molto, ma vogliamo precisare che il far parte dello staff operativo della parabola VLBI di Medicina, impegnata costantemente in lavori di gestione e manutenzione dell'antenna, ha notevolmente intralciato la conduzione del progetto, obbligandoci ad abbandonarlo e a riprenderlo piu' volte.

In ultimo, si coglie l'opportunita' per ringraziare Marco Morsiani (considerevole il contributo da lui prestato nella progettazione della parte analogica), e il Dott. Roberto Ambrosini (ci ha fornito indispensabili indicazioni sulle principali caratteristiche che l'oggetto doveva avere).

1. CARATTERISTICHE TECNICHE.

Il dispositivo permette principalmente l'acquisizione automatica di tre parametri meteo importanti nel campo VLBI; la pressione atmosferica (PRESS), la tempertura esterna (TE) e l'umidita' relativa (RH) misurate al suolo.
Oltre a queste tre grandezze ne sono disponibili, allo stesso modo, altre cinque che sono: la temperatura ambiente rilevata in due luoghi diversi, la direzione e l'intensita' del vento e la misura di una tensione di qualsiasi genere, applicata ad un apposito BNC di ingresso (vedi fig. 1).



1 Allarme MAT.
2 Dati pendenti.
3 MAT in trasmissione.
4 Dispositivo in REMOTO.
5 Selezione modo LOCALE.
6 RESET della MAT.
7 Allarme per vento
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9 Ingresso segnale per canale DVM
10 TUMBLEWHEEL di sett. canale.
11 Voltmetro digitale
12 Barometro digitale.
13 Sensore di temp. PT (Front)

Fig. 1 Pannello frontale

L'apparecchiatura e' utilizzabile autonomamente (modo LOCAL) predisponendo, tramite un selettore di canale, la grandezza da misurare che verra' poi visualizzata su un apposito indicatore (DVM). La sua compatibilita' col Field System (FS) ne permette l'utilizzo durante le osservazioni VLBI in modo completamente automatico (modo REMOTE); ad ogni richiesta della schedula osservativa, vengono acquisiti e memorizzati i parametri neccessari.

Di seguito sono riportate le grandezze misurabili e il relativo canale per la loro visualizzazione.

- **PRESSIONE: campo da 800 a 1100 mBar con risoluzione 0.2mBar. L'indicazione e' visualizzata permanentemente su di un display apposito.**

- **TEMPERATURA ESTERNA: campo da -10 a +70°C con risoluzione del decimo di grado realizzato con un sensore PT100. Canale per la visualizzazione locale #3. Segnale di ingresso da 4mA (-10°C), a 20mA (70°C).**

- **UMIDITA' RELATIVA ESTERNA: campo da 5% a 98% .Sensore a capacita' variabile.Il canale di visualizzazione e' il #0. Segnale di ingresso da 4mA (5%) a 20mA (98%)**

- **SENSORE DI TEMPERATURA RT: campo da -55°C a 150°C con risoluzione del decimo di grado, realizzato con sensore tipo AD590. Canale di visualizzazione #4. Ingresso 1uA/°K**

- **SENSORE DI TEMPERATURA FT: con le stesse specifiche del sensore di temperatura RT ma con canale #2. Il sensore e' montato in modo permanente sul pannello frontale dello strumento.**

- **VELOCITA' VENTO: campo da 0 a 120Km/h con risoluzione di alcuni chilometri/ora. Il canale di visualizzazione e' il #1. Segnale di ingresso 0V (0Km/h) 12VDC (120Km/h)**

- **DIREZIONE VENTO: campo da 0° a 360°. Risoluzione minima, il grado, comunque dipendente dal tipo di sensore usato. Canale di visualizzazione #6. Segnale di ingresso 0V (0°) a 2VDC (360°)**

- **INGRESSO DVM (DIGITAL VOLTMETER): campo da -1.999VDC a +1.999 VDC con risoluzione +/- 1mV. Impedenza di ingresso 10MOHM, canale di visualizzazione #5. Segnale di ingresso -1.999V , +1.999V con rapporto di visualizzazione 1/1.**

La velocita' di lettura dei due display e' di 2 misure al secondo (in modo remoto e' possibile solo una lettura al secondo).

Sul pannello posteriore vengono riportati i tre segnali analogici PRESS (da 8V a 11V per pressioni da 800mB a 1100mB), TE (-100mV per -10°C e 700mV per 70°C), RH (50mV per 5% e 980mV per 98%) e un segnale relativo al canale selezionato (campo da -1.999V a 1.999V), tutti applicabili ad un qualsiasi strumento supplementare (reg. a carta, ecc.) purche' fornito di ingressi differenziali (fig. 2).

Oltre alle grandezze misurate, il MET SENSOR fornisce due circuiti di allarme a soglia preselezionabile, posti sul canale #1 (velocita' vento) e #4 (sensore di temperatura RT), collegati ciascuno ad un avvisatore acustico, ad un led rosso, e ad un rele' i cui contatti NC o NO sono disponibili per usi esterni (connettore OUT ALARM sul pannello poste-

riore). Le soglie di commutazione impostate sono segnate su di un bollino colorato posto sul retro dell'apparecchiatura.

Pannello posteriore

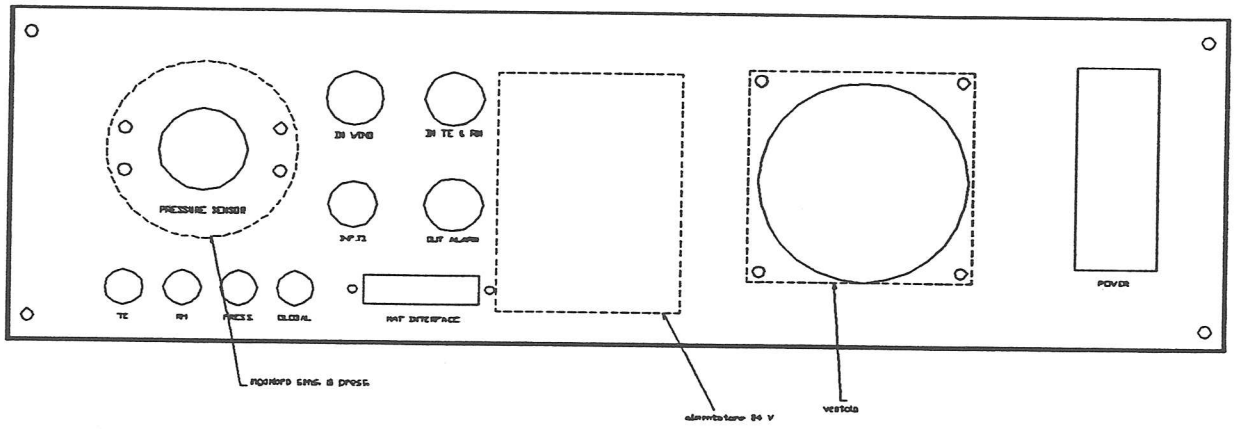


Fig. 2 Pannello posteriore.

Un interfaccia serializzatrice intelligente, del tipo presente nel MARK III (MK3) e denominata MAT (Microprocessorized Ascii Transceiver) provvede al collegamento del MET SENSOR con eventuali calcolatori esterni, permettendo cosi' l'acquisizione automatica con relativa memorizzazione dei dati. Lo standard di comunicazione addottato e' un sottoinsieme dell'RS 232 C (V24), nel senso che sulla porta seriale sono presenti solo i circuiti 103 (TD), 104 (RD) e 102 (SG). La comunicazione avviene con parole composte da 8 bit + 1 di parita' pari, 9600 Baud ed handshake software di tipo XON/XOFF (per ulteriori informazioni sulla comunicazione remota col dispositivo consultare il capitolo CONTROLLO REMOTO).

2. DESCRIZIONE CIRCUITALE.

Riferendosi allo schema riportato in fig. 3 (SCHEMA A BLOCCHI DEL MET SENSOR), inerente all'unita' di acquisizione dei segnali provenienti dai sensori si puo' osservare il blocco denominato CIRCUITI DI CONVERSIONE E DI ADATTAMENTO, raggruppante tutta l'elettronica utilizzata per la conversione dei segnali di ingresso in tensione (qualora non lo fossero) e/o per il loro addattamento in ampiezza.

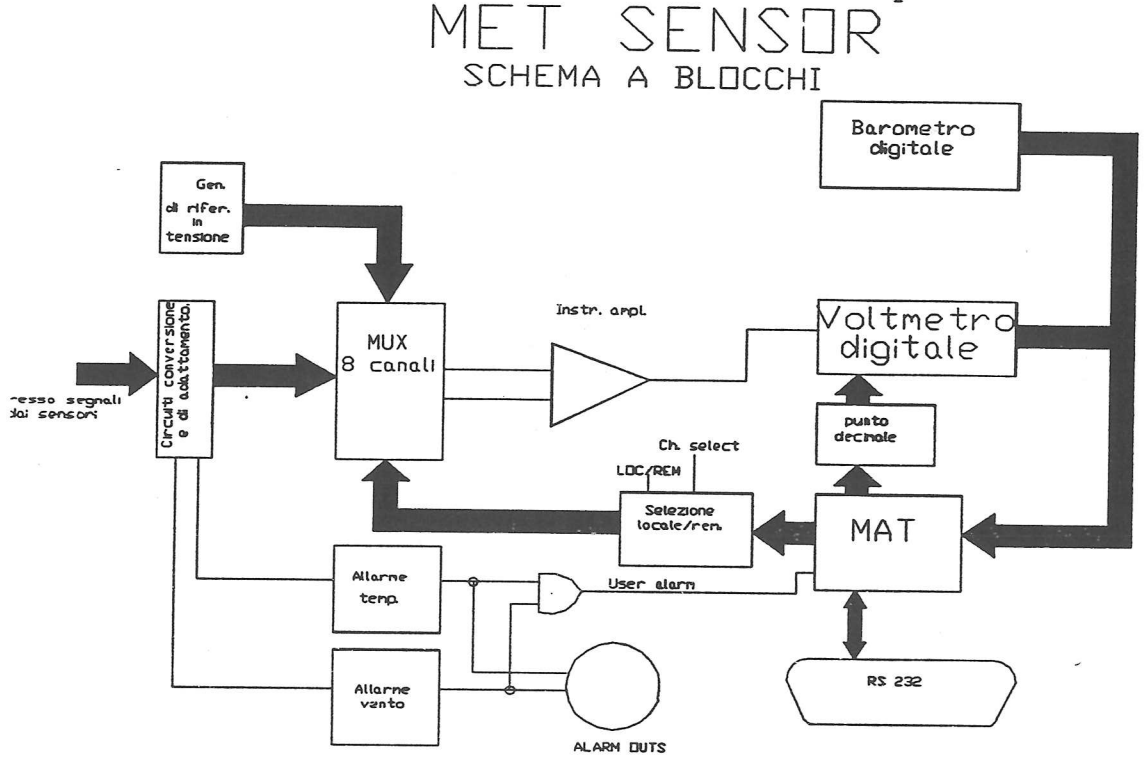


Fig. 3 Schema a blocchi.

I sensori dell'umidita' e della temperatura esterna, forniti dal costruttore con una unita' di linearizzazione e di trasmissione dei segnali, mandano un segnale costituito da una corrente che varia da 4mA a 20mA, corrispondenti ad una umidita' relativa di 5% e di 98%, o ad una temperatura di -10°C e di +70°C. Il metodo di trasmissione e' particolarmente congegnale alla nostra applicazione perche' permette lunghe distanze fra sensori e strumento, e una buona immunita' ai disturbi (a Medicina i sensori sono infatti montati sopra alla parabola, mentre il MET SENSOR sta all'interno, nella stanza di controllo). Una resistenza opportunamente calcolata per ogni sensore (R15, e R18,Vedi schema elettrico MET02.SCH riportato in appendice A), permette la conversione del segnale da corrente a tensione. Il rapporto V/I viene finemente aggiustato grazie ai due trimmer R16, ed R17 visto che la resistenza col valore necessario non ricade nei valori della serie standard.

I segnali provenienti dai due sensori di temperatura AD 590 sono anch'essi costituiti da una corrente(1 uA/K).

Opportune resistenze di conversione, di circa 10K ognuna, trasformano il segnale in una tensione garantendo un rapporto 10mV/K (in serie alle resistenze ci sono piccoli trimmer per la calibrazione).

I due segnali del vento, velocita' e direzione, vengono per prima cosa mandati a due buffer di ingresso in modo da evitare loop di massa (il sensore del vento puo' essere anche parecchie centinaia di metri distante). La presenza di questi buffer di ingresso, ad alta impedenza, permette di inserire liberamente, a monte dello strumento, i partitori necessari all'adattamento dei segnali, senza complicare eccessivamente i calcoli delle reti resistive.
I segnali accettati sono tensioni DC con campo 0/12V per la velocita' (0/120Km/h), e 0/2V per la direzione (0^o, 360^o).
I due segnali vengono poi adattati tramite attenuatori resistivi, al livello di input del DVM, ed inviati al multiplexer di selezione canale.

Infine, c'e' un'entrata generale, differenziale, denominata DVM, che permette la misura di qualsiasi grandezza in tensione purche' nel campo compreso fra - 1.999V e +1.999V. Sul circuito stampato e' stato pero' riservato il posto per un partitore in modo da rendere possibili altri valori di fondo scala. La resistenza di ingresso e' attorno ai 10M, circa uguale alle due resistenze montate fra gli ingressi differenziali dell'operazionale e massa, necessarie alla richiusura delle correnti di fuga degli ingressi.

Una parte del circuito, nello schema a blocchi individuabile come GENERATORE DI RIFERIMENTI IN TENSIONE, serve a generare numerosi riferimenti che vengono usati in piu' parti del circuito. Collegata ad un generatore di tensione costante LM 336 (5 V), una serie di partitori provvede a generare le controtensioni necessarie: alla conversione dei gradi K in gradi C, come soglie di scatto dei circuiti di allarme per vento o temperatura (vedi piu' avanti), come offset da inserire sui segnali RH, e TE.

I segnali opportunamente adattati, provenienti dai sensori, e le relative controtensioni, vengono inviati ad un multiplexer a 8 canali, realizzato con un integrato DG 507 (2 vie 8 canali).
Come gia' precisato, lo strumento puo' lavorare sia in locale, che in remoto, collegato cioe' ad un calcolatore remoto tramite l'apposita porta seriale. La selezione del canale da visualizzare puo' infatti essere effettuata localmente, con un tumblewheel, oppure remotamente, tramite calcolatore, spedendo al MET SENSOR appositi caratteri di *strobe* (vedi tabella 1). In entrambi i casi un'apposita circuiteria, rappresentata nello schema a blocchi come SELEZIONE LOC/REM, provvede a indirizzare propriamente il multiplexer, prelevando l'indirizzo da un tumblewheel posto sul pannello frontale (modo locale) o decodificandolo dallo strobe ricevuto (modo remoto). Sebbene il modo locale sia sempre selezionabile tramite il pulsante

Tabella 1. Indirizzi canali.

CH	PARAMETRO	UNITA' DI MISURA	CARATT. DI STROBE	CAMPO	NOTE
0	Umidita' rel.	%	%	5 98.5	
1	Vel. vento	Km/h	(	0 120	
2	Sens. temp.FT	C	)	-55 +125	Sens. sul pann. frontale
3	Temp. esterna	C	+	-10 +70	
4	Sens. temp.RT	C	-	-55 +125	
5	DVM	V	.	+/- 2	
6	Dir. vento		;	0 360 gradi	
7	Vref (2.73V)	V	Non disp. in rem.	/	

(LOC) posto sul pannello frontale, alla prima richiesta di dati effettuata dal calcolatore (host), viene comunque abilitato il modo remoto, evitando cosi' che l'operatore possa inavvertitamente bloccare l'acquisizione automatica.

Il segnale selezionato dal multiplexer passa ad un amplificatore di tipo instrumentation, a guadagno unitario il cui compito e' di fungere da buffer di ingresso ad alta impedenza, e costituire un vero e proprio amplificatore differenziale, assolutamente neccessario in casi come questo.

Esso prosegue poi, verso il voltmetro digitale, costituito da uno strumento di tipo commerciale della ditta BINDING UNION mod 4000 a $3^{1/2}$ cifre e fondo scala +/- 1999mV, che provvede a convertirlo e a visualizzarlo con una frequenza di 2.5 volte al sec.. Questo strumento e' gia' dotato di interfaccia BCD tristate,che ne permette l'aggancio diretto alla MAT, ed ha inoltre la caratteristica di essere poco "rumoroso", nel senso che il convertitore contenuto al suo interno, genera poche interferenze, altrimenti dannose per l'intera circuiteria analogica (il prototipo montava un DVM della ANALOG DEVICES che introduceva enormi spikes). L'unico segnale da esso non visualizzato, e' la pressione, che viene gestita autonomamente dal barometro digitale (SETRA mod. 350-1 oppure 361).

I segnali convertiti, provenienti da entrambi gli strumenti digitali (barometro e voltmetro), vengono inviati alla MAT che dopo averli serializzati, li manda al calcolatore remoto. La configurazione in cascata dei due strumenti, e' resa possibile dal tipo di uscite digitali adottate (tristate). Infatti, in base allo strobe di selezione canale, solo le uscite di un unico strumento vengono abilitate al dialogo con la MAT (in pratica per tutte le grandezze, ad eccezione della pressione, viene abilitato il DVM).

Per il voltmetro digitale c'e' un circuito per la determinazione della posizione del punto decimale. Grazie ad una serie di porte, codificanti gli indirizzi del MUX, e' possibile avere , per ogni canale, la lettura diretta della grandezza , nell'unita' di misura indicata in tabella 1.

Due circuiti simili, costruiti con un doppio comparatore LM 339, permettono il costante controllo della velocita' del vento, e della temperatura RT (CH #4, a Medicina la temperatura della stanza del calcolatore). Qualora una delle due grandezze dovesse superare la soglia preimpostata (trimmer R3 per il vento, e R12 per la temperatura) scatterebbe il comparatore relativo, e di conseguenza un allarme acustico, un led rosso, l'allarme generale della MAT, e un rele' i cui contatti NO NC sono disponibili sul connettore OUT ALARM (pannello posteriore).

Una particolare premura e' stata riservata alla separazione fra la massa digitale e la massa analogica che dovrebbero unirsi solamente sui morsetti di uscita dell'alimentatore. In ogni caso, tramite il ponticello J (normalmente aperto),e' possibile unire le due masse.

Un altro ponticello, denominato JP1, e' stato previsto per permettere l'utilizzo di due modelli diversi di barometri digitali.
IL primo barometro (SETRA 361) ha una linea denominata DATA HOLD che se attivata inibisce l'aggiornamento delle uscite digitali. Per questo strumento e neccessario inserire il ponticello JP1, cosi' da lasciare al monostabile U1 (vedi il disegno MET01.SCH appendice A)la facolta' di controllare questa linea.

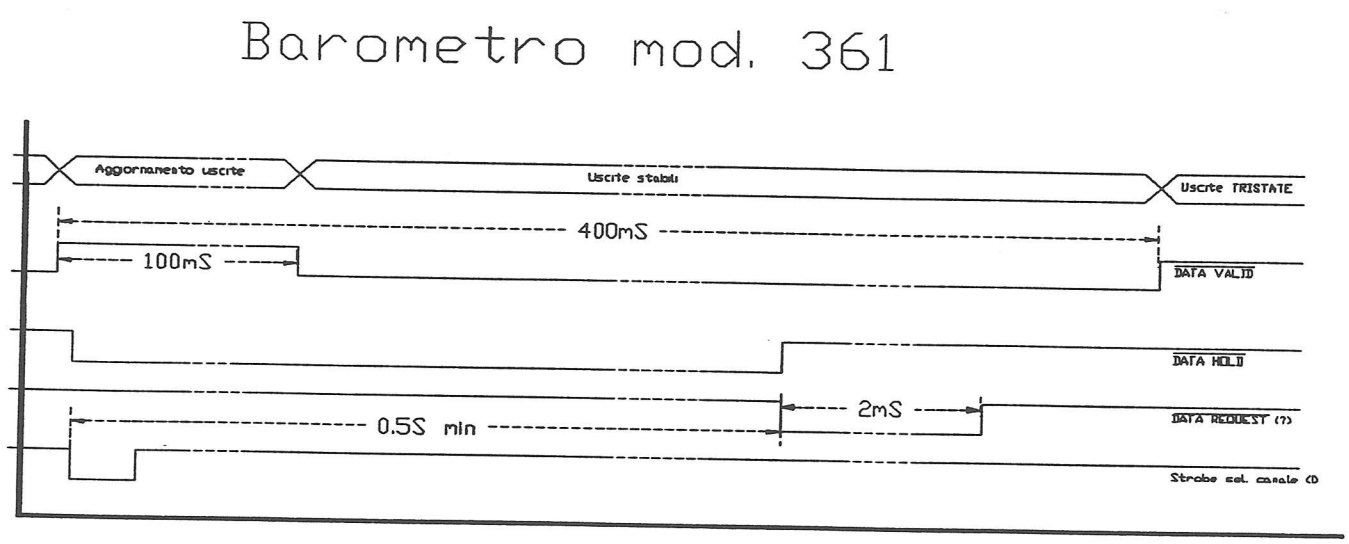


Fig. 4 Temporizzazioni SETRA mod. 361

Quando il calcolatore remoto manda lo strobe di indirizzamento (il carattere !), oltre all'abilitazione delle uscite tristate, viene attivata la linea DATA HOLD, a prescindere dallo stato del barometro (puo' essere in corso l'aggiornamento delle uscite, che viene effettuato ogni 400mS, e che dura 100mS). Dopo circa 0.5 secondi (questo e' il tempo che deve essere garantito dal software!) viene inviato, dall'host il carattere di lettura dati, lo strobe ? (dura 2mS), che provoca la lettura delle linee digitali ora sicuramente stabili, e sblocca la linea DATA HOLD (vedi fig. 4).
Nel caso invece del barometro SETRA mod 350-1, a causa della mancanza di una linea DATA HOLD, occorre procedere obbligando la MAT a sincronizzarsi con esso, attraverso il modo TRANFER CONTROL TO USER, e tenendo aperto il ponticello JP1.
Lo strobe ! viene ora utilizzato solamente per abilitare le uscite tristate del barometro,

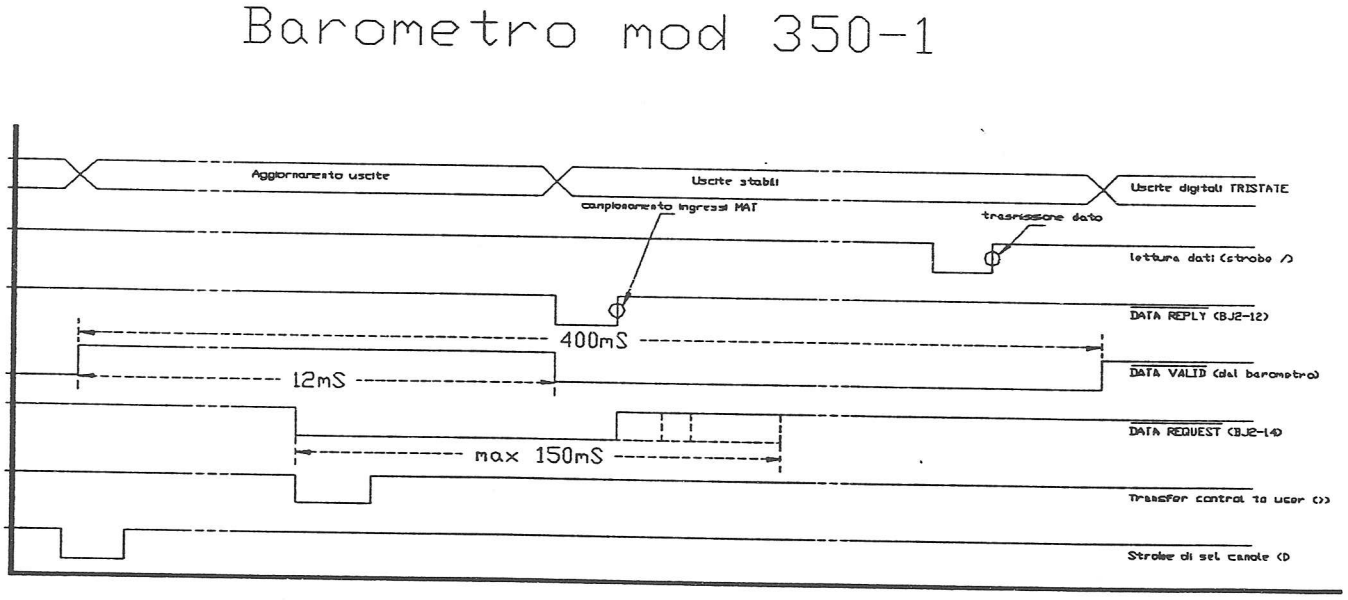


Fig. 5 Temporizzazioni SETRA mod 350-1

mentre lo strobe > provoca l'attivazione della linea DATA REQUEST (BJ2-14) che di fatto arma la porta U15B. Dal SETRA proviene una linea, denominata DATA VALID, indicante lo stato stabile delle uscite. La sua transizione da 1 a 0, corrispondente alla terminazione della fase di aggiornamento delle uscite, fa scattare la linea DATA REPLY attraverso la porta U15B precedentemente armata, provocando cosi' la lettura delle linee digitali da parte della MAT. All' host viene poi inviato il carattere ACK che lo autorizza a richiedere il dato precedentemente campionato, attraverso lo strobe / (vedi fig. 5).
Per il voltmetro digitale non e' neccessaria alcuna sincronizzazione (fortunatamente, perche'non sarebbe stato possibile, visto la mancanza di appcsite linee).

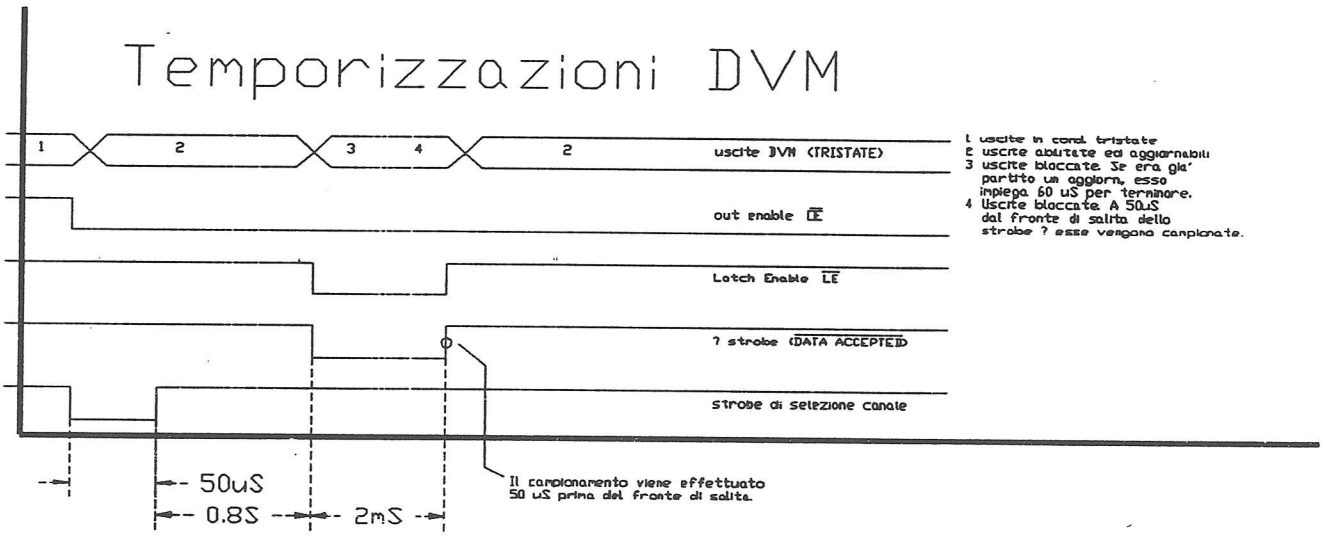


Fig. 6 Temporizzazioni DVM BINDING UNION mod 4000

Dopo aver indirizzato opportunamente il canale da visualizzare, provocando cosi' l'abilitazione delle porte tristate, sul fronte di discesa dello strobe di richiesta dati (?) viene abilitato il segnale LE (Latch Enable) del voltmetro, bloccando cosi' l'aggiornamento delle linee di uscita. Questa situazione permane per 2 mS e quindi il tempo neccessario a far terminare un eventuale aggiornamento in corso (l'aggiornamento viene effettuato ogni 400mS, e dura 60 uS). Poi, sul fronte di salita vengono campionate le linee digitali (vedi fig.6).

3. CONTROLLO REMOTO.

Il MET SENSOR puo' essere facilmente collegato ad un qualsiasi calcolatore, anche posto a distanze remote, (nel qual caso usando un modem), grazie ad una interfaccia serializzatrice intelligente, gia' all'interno dell'apparecchiatura, che permette il trasferimento di 64 bit (32 di input e 32 di output) attraverso una semplice linea seriale. Questo dispositivo denominato MAT (Microprocessorized Ascii Transceiver) utilizzato come interfaccia di comunicazione standard nel MK3, e' particolarmente versatile per queste applicazioni, anche se usato al di fuori del suo ambiente naturale, il FIELD SYSTEM.

Sulla porta RS 232 (in realta' un sottoinsieme della RS 232) sono presenti il SIGNAL GROUND (SG) sul pin 7, il TRANSMIT DATA (TD) sul pin 3 e il RECEIVE DATA (RD) sul pin 2. Il protocollo usato e' a caratteri ASCII di 8 bit piu' 1 di parita' pari, 1 start bit, 2 stop bit e baud rate di 9600. L'handshaking utilizzato e' di tipo software (XON/XOFF).
Volendo sono possibili anche altre configurazioni, selezionabili con dei ponticelli posti sullo stampato della MAT, per le quali predisposizioni si rimanda al manuale del MK3.
La procedura da seguire per la richiesta di dati dal MET SENSOR, consiste nell'invio al dispositivo di caratteri particolari, detti strobes (tabella 1), che provocano l'indirizzamento del canale relativo al segnale da acquisire. Un ulteriore strobe (il carattere ?), denominato DATA REQUEST, mandato sempre dall'host, provoca il campionamento dei 32 bit di input della MAT, e di conseguenza della grandezza desiderata. In seguito la MAT provvede direttamnte ad inviare all'host i dati memorizzati, sotto forma di 8 caratteri ASCII. Ogni carattere rappresenta la codifica in esadecimale (da 0 a F) di un gruppo di 4 bit, appartenente ai 32 bit di input della MAT. Il primo carattere spedito e' quello relativo agli ultimi 4 bit piu' significativi.

Per permettere a piu' MAT di coesistere sulla stessa linea seriale (il MET SENSOR lavora tipicamente nel contesto MK3 dove sono presenti circa 20 MAT), e' possibile abilitare, per ognuna di esse, un indirizzo logico formato dal carattere # e due numeri esadecimali (da 00 a FF). All'arrivo del prefisso di indirizzo, il carattere #, tutte le MAT presenti si mettono in ascolto per verificare chi di loro verra' indirizzata. Solo quella che riesce a confrontare con successo l'indirizzo ricevuto, con quello settato al suo interno su di un apposito DIP SWITCH si collega con l'host (cioe' risponde alle sue richieste), e lo rimane, fino all'arrivo di un altro comando di selezione di indirizzo.

Piu' in dettaglio, il protocollo di comunicazione fra host e la MAT individuata, in questo caso, dall'indirizzo AF, si articola nel seguente modo:

#AF +

l'host effettua la selezione di un canale del MET SENSOR

#AF ?

l'host provoca l'acquisizione del dato, e l'invio del medesimo attraverso la porta seriale.

123A5F78 <LF><CR>

il MET risponde con gli 8 caratteri del dato, in questo caso 123A5F78 seguiti sempre da un LF e un CR.

Il significato degli 8 caratteri esadecimali ricevuti in risposta dal MET e' rappresentato, per ogni canale, in tabella 2.

E' obbligatorio far intercorrere un certo lasso di tempo fra lo strobe di selezione del canale e lo strobe DATA REQUEST in modo da lasciare agli strumenti digitali il tempo neccessario per effettuare la misura (per il BINDING UNINON mod 4000 occorre almeno 0.8 sec, mentre per il barometro occorrono 0.5S).

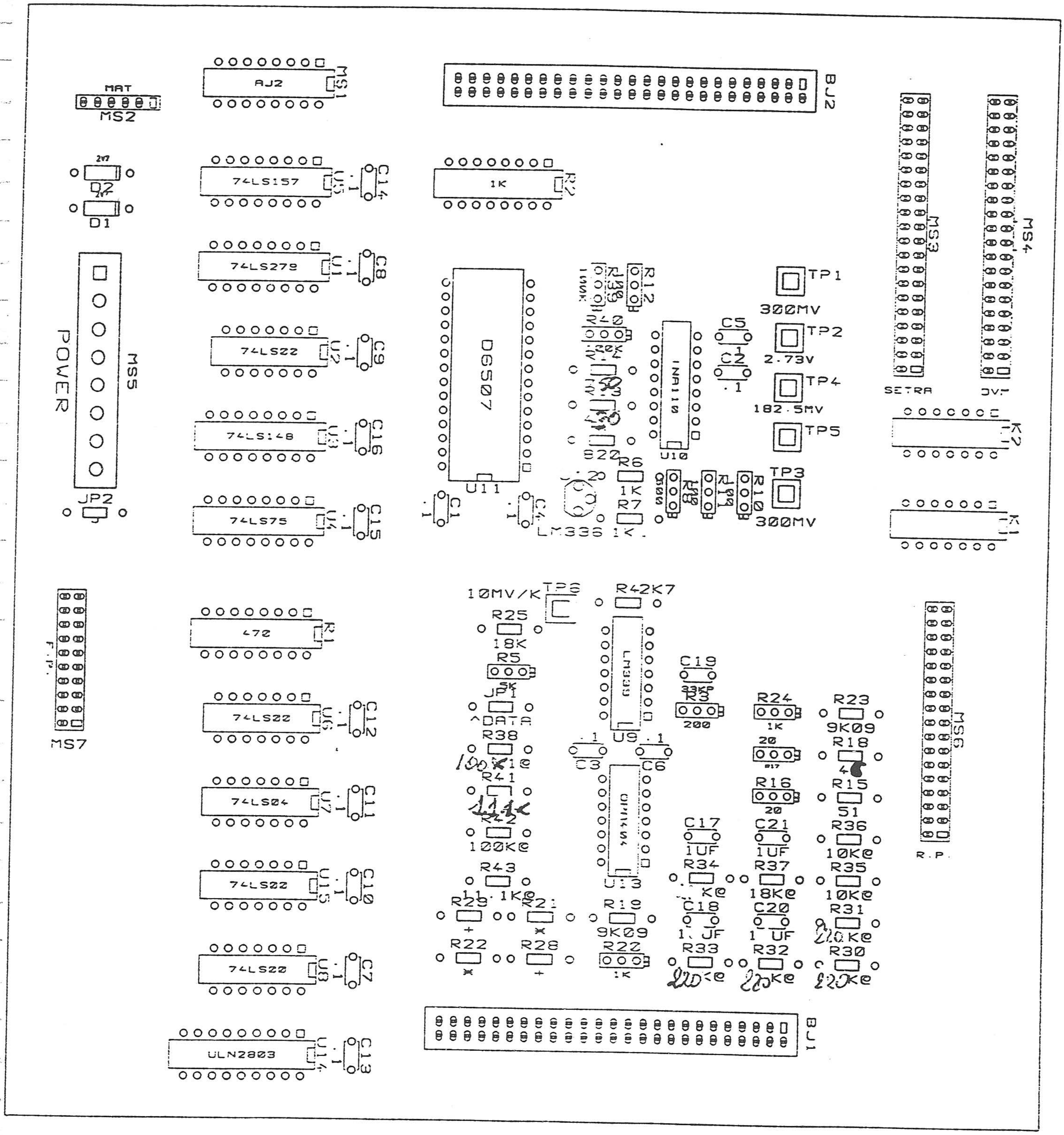
Per i casi in cui e' necessario sincronizzarsi con il dispositivo da leggere (ad esempio l'ultimo modello di barometro digitale), la MAT prevede un handshaking particolare, denominato TRANSFER CONTROL TO USER.
Una volta indirizzato il canale desiderato tramite l'invio dell'apposito strobe, si manda al posto del DATA REQUEST il carattere >. Da questo momento il dispositivo ha tempo 150mS per preparare il dato sul bus di ingresso della MAT ed avvisare quest'ultima attraverso una linea apposita chiamata DATA REPLY. Se cio' avviene la MAT memorizza lo stato delle sue 32 linee di ingresso, e restituisce all'host la sequenza <ACK><LF><CR> che lo autorizza a richiedere il dato (strobe /). Se il dispositivo non risponde in tempo utile, la MAT riprende il controllo dell'handshaking, avvisando l'host dell'insuccesso dell'operazione con la sequenza <NAK><LF><CR>.

Temperature buffer: WX000atttt (in degrees C*10) where a=B for t >0, a=C for t <0 The humidity buffer: WX00000hhh (in percent*10) The pressure buffer: WX000Ppppp (in mbars*10) The temperature RT: WX000atttt (in degrees *10) The temperature FT: WX000atttt (same as above) The voltage of DVM : WX000avvvv (in volts *1000) The wind direction : WX00000ddd (in degrees) The wind speed : WX0000ssss (in Km/h *10) If the response is FFFFF, the instrument is down.

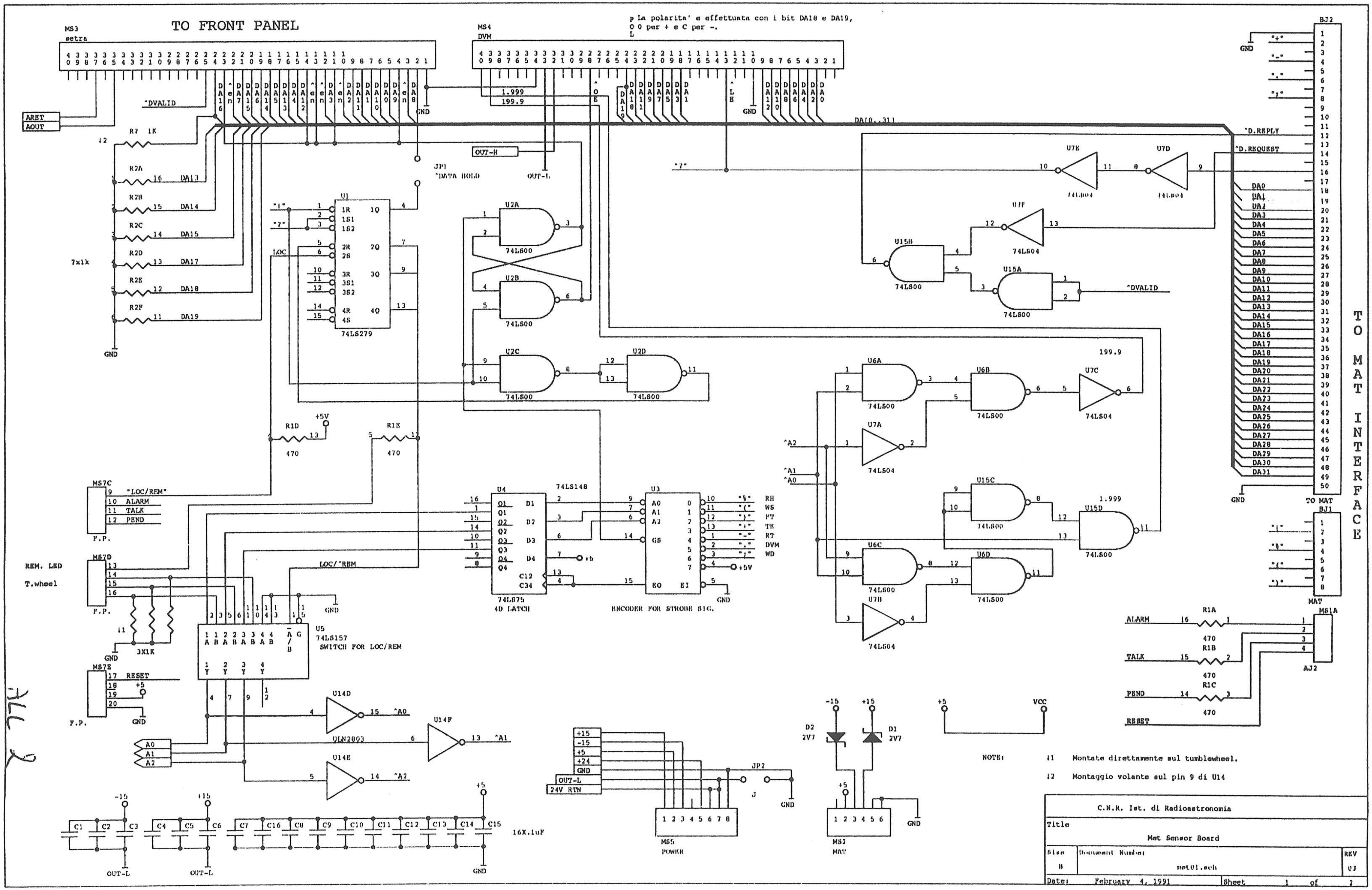
Tab. 2 Buffer di risposta.

APPENDICE A. SCHEMI.

In questa parte del rapporto si riportano i disegni elettrici e meccanici, e le tabelle di cablaggio utilizzati nella realizzazione del progetto. La lista di seguito riporta l'elenco con un riferimento per la loro ricerca.

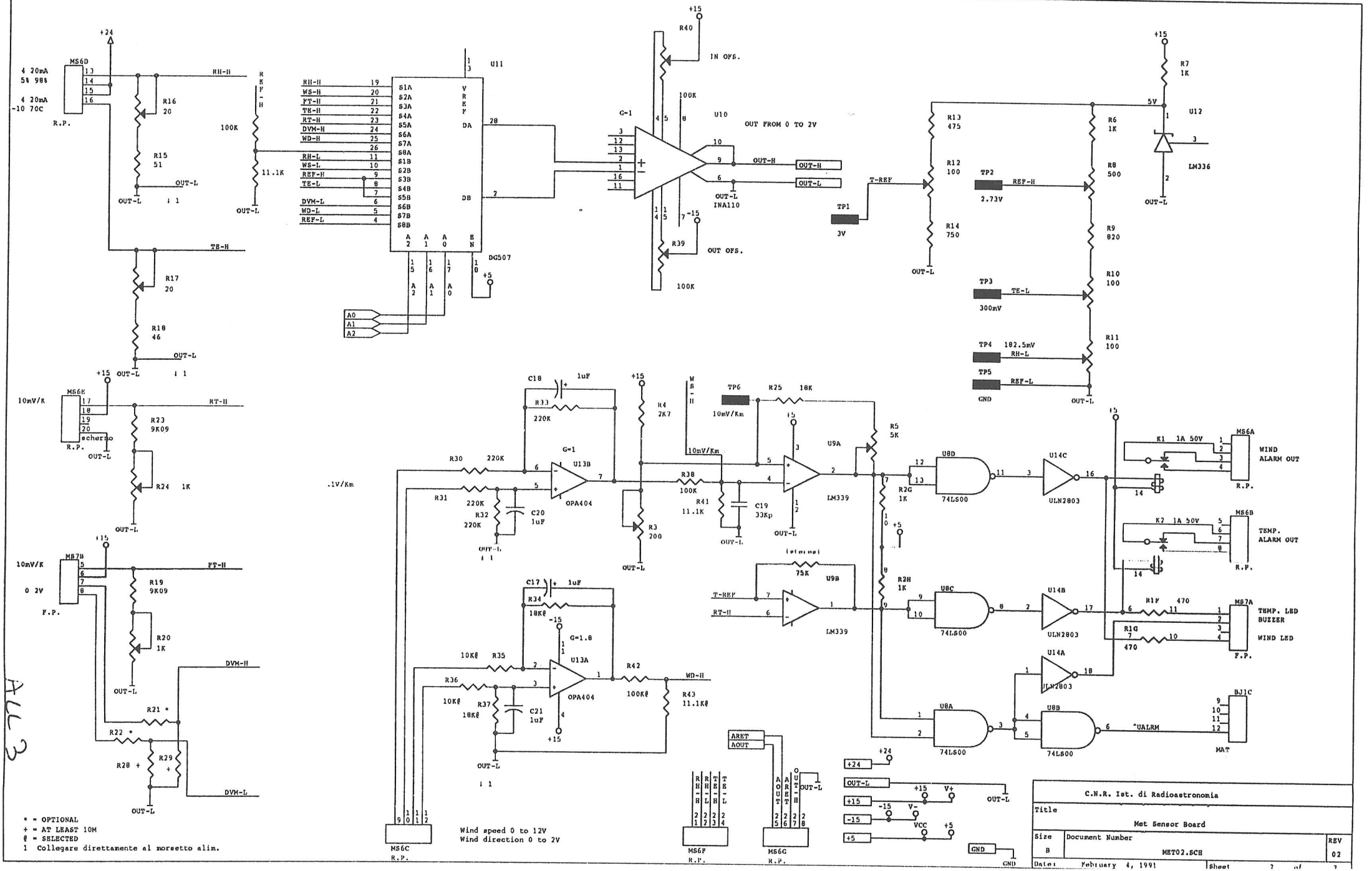

MAT
MS2
MS1
AJ2
BJ2
D2
D1
74LS157
U5
C14
1K
R2
MS3
MS4
74LS279
U1
C8
POWER
MS5
74LS22
U2
C9
DG507
R39
R12
R40
TP1
300MV
C5
INA118
C2
TP2
2.73V
TP4
182.5MV
SETRA
DVI
74LS148
U3
C16
TP5
U10
K2
822
R6
1K
R7
R8
R9
R10
TP3
300MV
U11
JP2
74LS75
U4
C15
C1
C4
LM336
K1
MS7
F.P.
10MV/K
TP6
R42K7
R25
18K
LM339
470
R1
R5
5K
C19
JP1
^DATA
R3
200
R24
R23
9K09
74LS22
U6
C12
R38
U9
C3
C6
R18
R41
R16
R15
51
74LS04
U7
C11
100K
C17
1UF
C21
1UF
R36
10K
MS6
R.P.
R43
U13
R34
R37
18K
R35
10K
74LS02
U15
C10
R29
R21
R19
9K09
C18
C20
R31
R22
R28
R22
1K
R33
R32
R30
74LS20
U8
C7
BJ1
ULN2803
U14
C13

ALL. 1

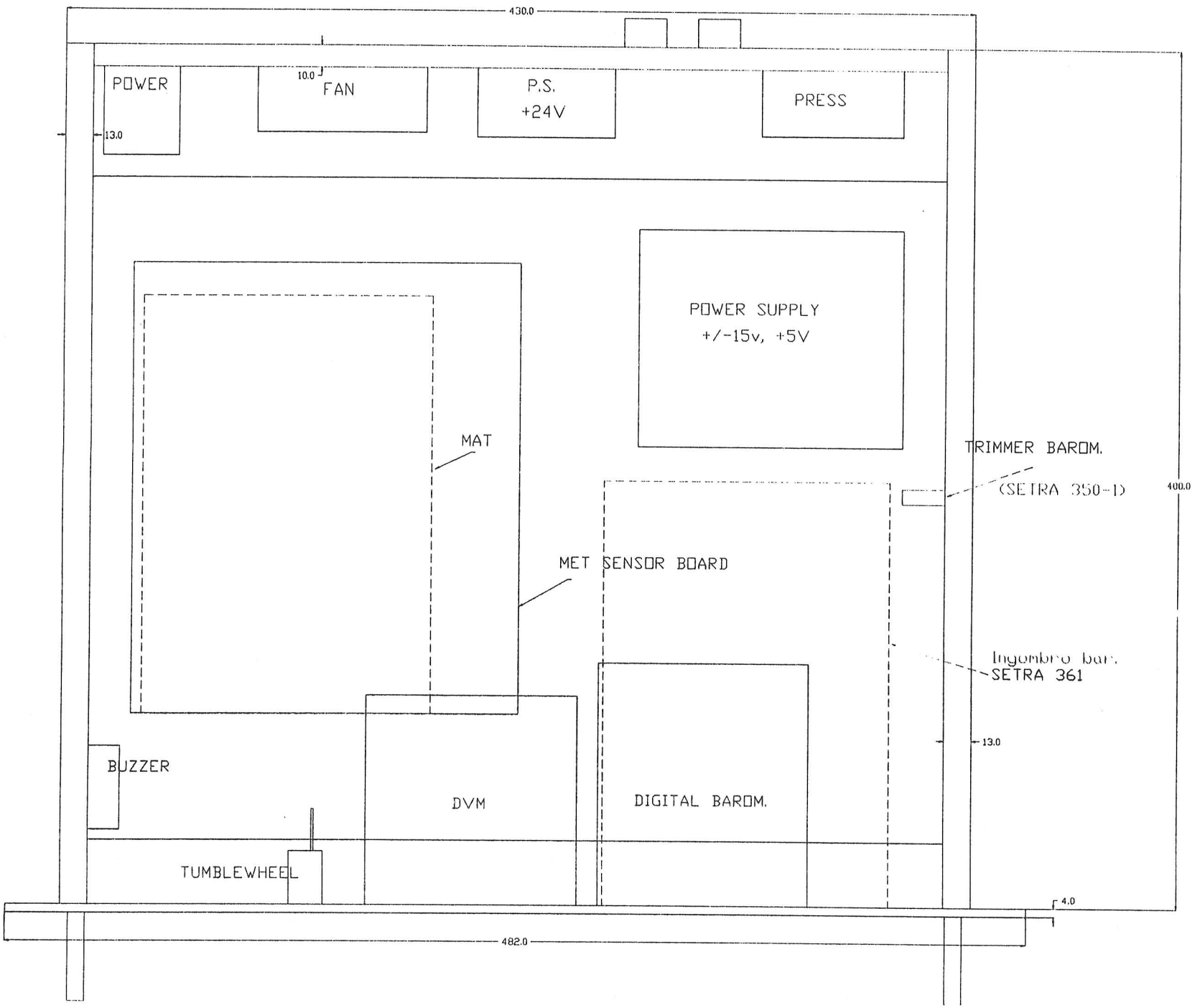


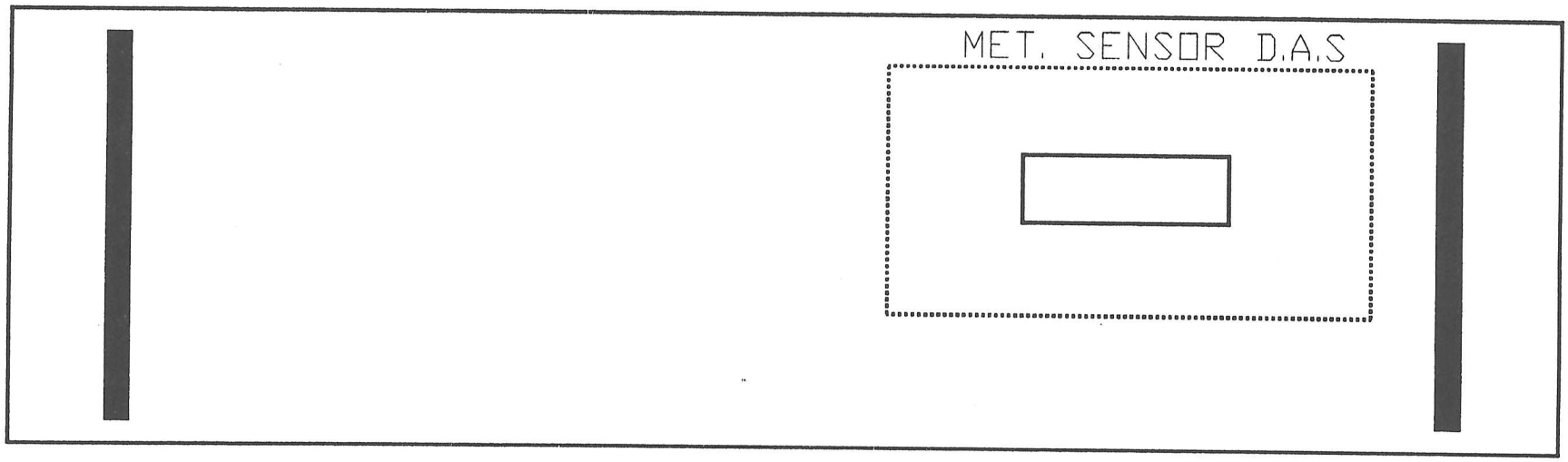
TO FRONT PANEL
TO MAT INTERFACE
MS3 setra
MS4 DVM
p La polarita' e effettuata con i bit DA18 e DA19,
O 0 per + e C per -.
L
BJ2
BJ1
TO MAT
MAT
^DVALID
^D.REPLY
^D.REQUEST
DA[0..31]
JP1 ^DATA HOLD
OUT-H
OUT-L
7x1k
R7 1K
74LS279
74LS00
74LS04
74LS148
74LS75 4D LATCH
ENCODER FOR STROBE SIG.
74LS157 SWITCH FOR LOC/REM
ULN2003
LOC/^REM
REM. LED
T.wheel
F.P.
3X1K
ALARM
TALK
PEND
RESET
470
MS5 POWER
MS2 MAT
MS1A
AJ2
JP2
16X.1uF
NOTE:
11 Montate direttamente sul tumblewheel.
12 Montaggio volante sul pin 9 di U14
C.N.R. Ist. di Radioastronomia
Title
Met Sensor Board
Size B
Document Number met01.sch
REV 01
Date: February 4, 1991
Sheet 1 of 2

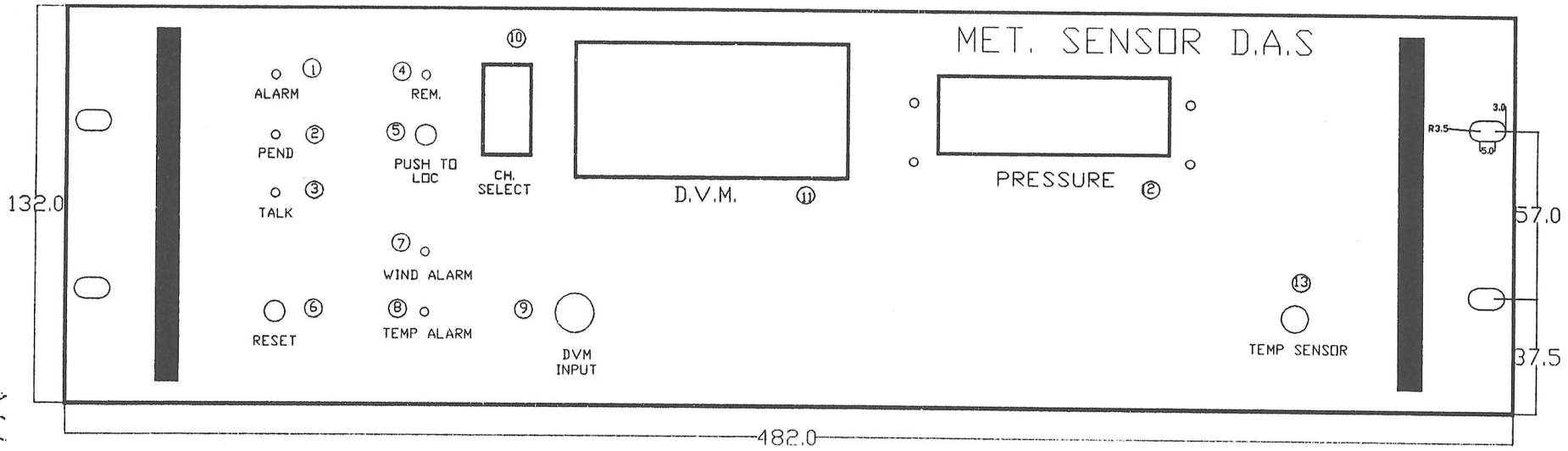
ALL 2


4 20mA 5% 98%
4 20mA -10 70C
MS6D
R.P.
RH-H
R16 20
R15 51
OUT-L
100K
11.1K
TE-H
R17 20
R18 46
10mV/K
MS6K
RT-H
R23 9K09
R24 1K
0 2V
MS7B
FT-H
R19 9K09
R20 1K
DVM-H
DVM-L
R21 *
R22 *
R28 +
R29 +
* = OPTIONAL
+ = AT LEAST 10M
@ = SELECTED
1 Collegare direttamente al morsetto alim.
U11
DG507
RH-H
WS-H
FT-H
TE-H
RT-H
DVM-H
WD-H
RH-L
WS-L
REF-H
TE-L
DVM-L
WD-L
REF-L
A0
A1
A2
R40
IN OFS.
100K
G-1
U10
OUT FROM 0 TO 2V
OUT-H
OUT-L
INA110
R39
OUT OFS.
T-REF
TP1
3V
R13 475
R12 100
R14 750
TP2
REF-H
2.73V
TP3
TE-L
300mV
TP4
102.5mV
RH-L
TP5
REF-L
GND
R7 1K
R6 1K
R8 500
R9 820
R10 100
R11 100
U12
LM336
C18 1uF
R33 220K
R30 220K
R31 220K
R32 220K
C20 1uF
G=1
U13B
OPA404
R4 2K7
R3 200
R38 100K
R41 11.1K
C19 33Kp
LM339
U9A
TP6
10mV/Km
R25 10K
R5 5K
R2G 1K
R2H 1K
R2F 470
R2G 470
U8D
74LS00
U8C
U8B
U8A
U14C
U14B
U14A
ULN2803
K1 1A 50V
K2 1A 50V
MS6A
MS6B
MS7A
R.P.
F.P.
WIND ALARM OUT
TEMP. ALARM OUT
TEMP. LED BUZZER
WIND LED
C17 1uF
R34 10K@
G=1.8
U13A
R35 10K@
R36 10K@
R37 10K@
C21 1uF
OPA404
R42 100K@
R43 11.1K@
WD-H
T-REF
RT-H
75K
U9B
LM339
ARET
AOUT
MS6F
MS6G
MS6C
Wind speed 0 to 12V
Wind direction 0 to 2V
BJ1C
MAT
^UALRM
GND
V+
V-
VCC
C.N.R. Ist. di Radioastronomia
Title
Met Sensor Board
Size B
Document Number MET02.SCH
REV 02
Date: February 4, 1991
Sheet 2 of 2

VISTA DA SOPRA

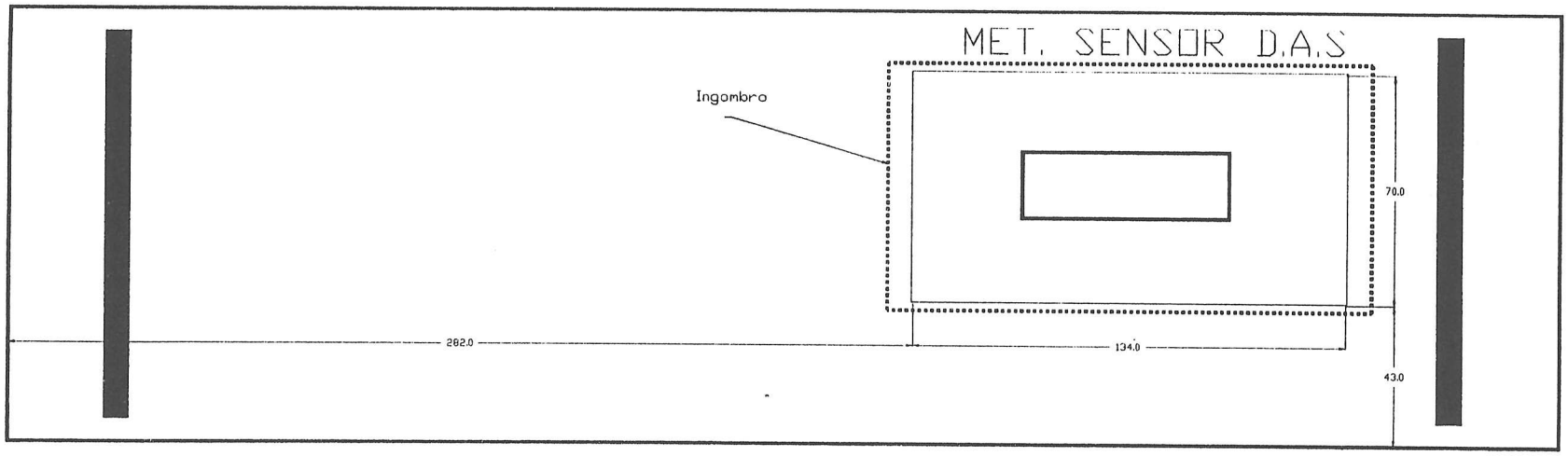




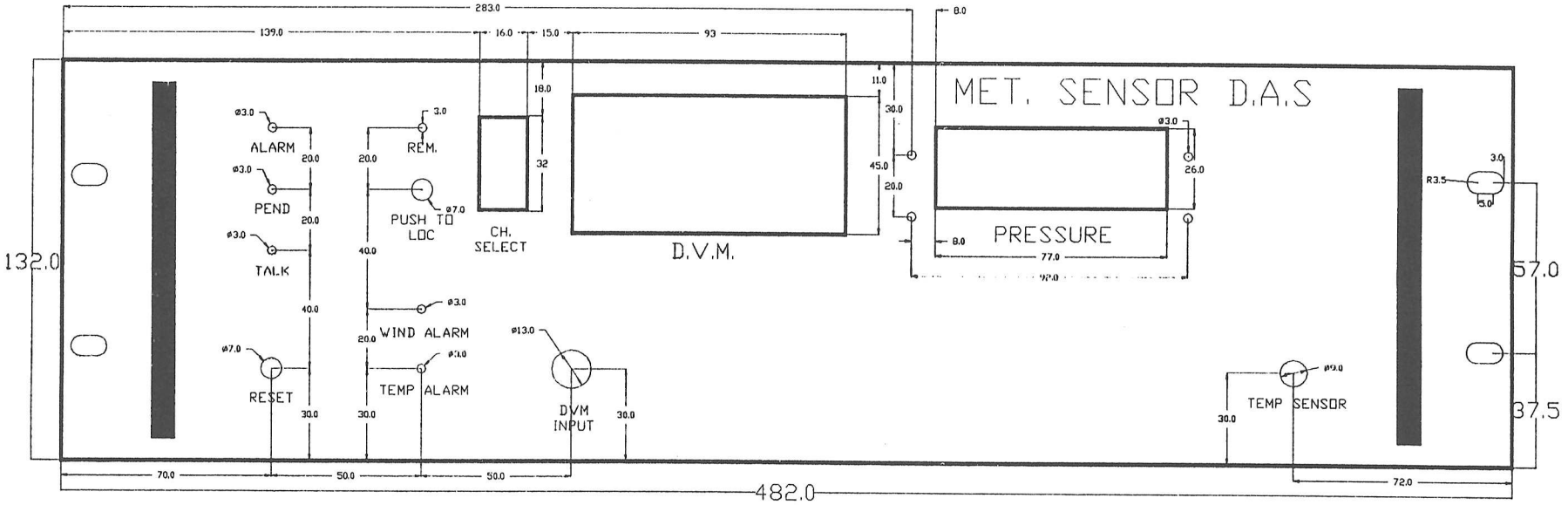


1 Allarme MAT.
2 Dati pendenti.
3 MAT in trasmissione.
4 Dispositivo in REMOTO.
5 Selezione modo LOCALE.
6 RESET della MAT.
7 Allarme per vento
8 Allarme per sovratemperatura.
9 Ingresso segnale per canale DVM
10 TUMBLEWHEEL di sett. canale.
11 Voltmetro digitale.
12 Barometro digitale.
13 Sensore di temp. FT (front)

ALL 5

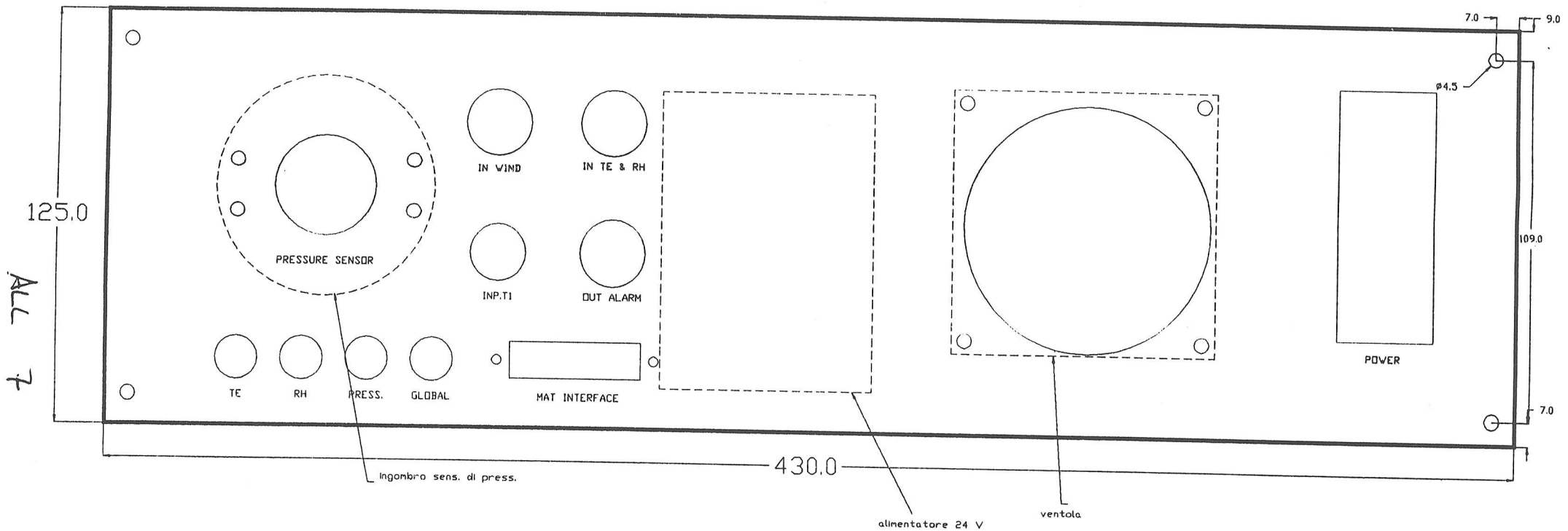


Pannello frontale

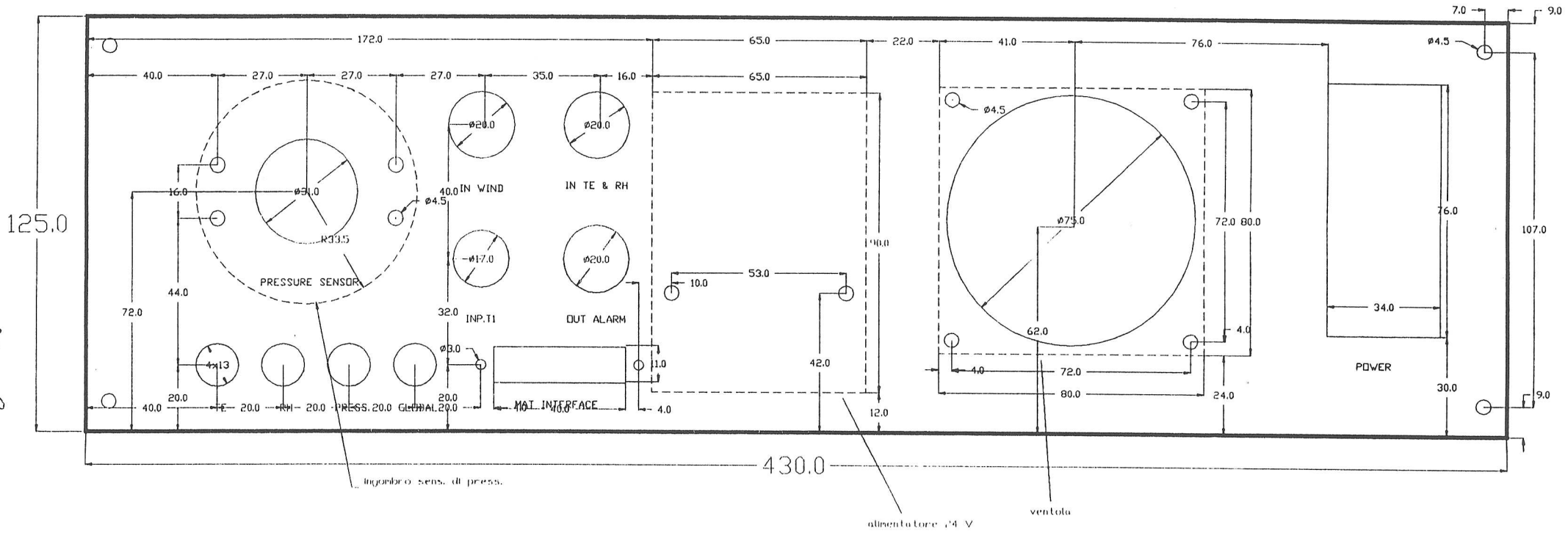


ALL 6

Pannello posteriore



Pannello posteriore



CONNETTORE HS1	tipo : ☐maschio ☐femmina pin
proveniente da MET SENSOR BOARD	diretto a MAT-AJ2
locato su	note

PIN	FUNZIONE
1	ALARM LED
2	TALK LED
3	PEND LED
4	RESET

PIN	FUNZIONE
27	O/C ALARM
28	" TALK
29	" PEND
23	MANUAL RESET

ALL 9

CONNETTORE MS2	tipo : ☒ maschio ☐ femmina 6 pin
proveniente da MET SENSOR BOARD	diretto a AJ5 (MAT)
locato su	note

MS2

PIN	FUNZIONE
1	NC
2	+5
3	-12
4	+12
5	GND
6	GND

AJ5

PIN	FUNZIONE
1	NC
2	+5
3	-12
4	+12
5	GND
6	GND

ALC 10

CONNETTORE MS3	tipo: ☐maschio ☒femmina 40 pin
proveniente da HET SENSOR BOARD	diretto a SETRA MOD 361
locato su	note VALIDO SOLO x SETRA 361

MS3

PIN	FUNZIONE
1	GND
2	DATA HOLD
3	100
4	EN
5	200
6	1
7	400
8	2
9	800
10	4
11	EN
12	8
13	EN
14	EN
15	1000
16	10
17	2000
18	20
19	4000
20	40
21	8000
22	80
23	EN
24	10000
25	DATA VALID
26	DC
35	ALALOG +
37	" —

SETRA 361

PIN	FUNZIONE
1	GND
2	DISP HOLD
3	100
4	UNITS EN
5	200
6	1
7	400
8	2
9	800
10	4
11	HUND EN
12	8
13	THOUS. EN
14	TENS EN
15	1000
16	10
17	2000
18	20
19	4000
20	40
21	8000
22	80
23	MSD EN
24	10000
25	DATA VALID
26	POL
35	ALALOG +
37	" —

ALL 11

CONNETTORE MS3	tipo ☐maschio ☒femmina 40 pin
proveniente da MET SENSOR BOARD	diretto a SETRA MOD 350-1
locato su	note SETRA MOD 350-1 Connettore 26 Pin

MS3

PIN	FUNZIONE
1	GND
2	$\overline{\text{DATA HOLD}}$
3	100
4	$\overline{\text{EN}}$
5	200
6	1
7	400
8	2
9	800
10	4
11	$\overline{\text{EN}}$
12	8
13	$\overline{\text{EN}}$
14	$\overline{\text{EN}}$
15	1000
16	10
17	2000
18	20
19	4000
20	40
21	8000
22	80
23	$\overline{\text{EN}}$
24	10000
25	$\overline{\text{DATA VALID}}$
26	NC

SETRA 350-1 Conn 26 pin

PIN	FUNZIONE
1/2	
7	
25	
5	
23	
3	
21	
26	
19	
22	
24	
10	
17	
8	
15	
6	
13	
4	
11	
12	
16	

ALL 11/bis

CONNETTORE MSG	tipo ☐maschio ☐femmina pin
proveniente da MET DIG. BOARD	diretto a DVM
locato su	note flat cable Lapin

MSG

PIN	FUNZIONE
3	DA0
4	DA2
5	DA4
6	DA6
7	DA8
8	DA10
9	DA12
10	GND
13	$\overline{LE}$
18	DA 1
19	DA 3
20	DA5
21	DA7
22	DA9
23	DA11
24	DA18 /DA19
28	$\overline{OE}$
32	OUT-H
33	OUT-L
34	GND
39	199.9 DP
40	1.999 DP

DVM

PIN	FUNZIONE
3A	1
4A	4
5A	10
6A	40
7A	100
8A	400
9A	1000
10A	GND
13A	$\overline{LE}$
3B	2
6B	8
5B	20
6B	80
7B	200
8B	800
9B	Polarity
13B	$\overline{OE}$
J1-2	IN+
J1-3	IN-
J1-8	GND
J1-9	199.9 DP
J1-11	1.999 DP
J1-12	AC 220V ~
J1-13	AC 220V ~

ALL 12

CONNETTORE MS5	tipo ☐maschio ☐femmina pin
proveniente da MET SENSOR BOARD	diretto a ALIMENTATORI
locato su	note Cavi singoli

PIN	FUNZIONE
1	+15
2	+5
3	−15
4	NC
5	+24
6	NC
7	OUT-L
8	GND

PIN	FUNZIONE
	#2 + } ELIND
	#1 +5V/2A }
	#3 − }
	+
	±15 RTRN
	±15, +5, +24 RTRN

ALL 13

CONNETTORE MS6	tipo ☐maschio ☐femmina pin
proveniente da MET DIG. BOARD	diretto a Pannello posteriore
locato su	note flat 34 poli

MS6

PIN	FUNZIONE
1	NC
2	C (WIND ALARM OUTS)
3	NC (WIND ALARM OUTS)
4	NO (WIND ALARM OUTS)
5	NC
6	C (TEMP ALARM OUTS)
7	NC (TEMP ALARM OUTS)
8	NO (TEMP ALARM OUTS)
9	WIND SPEED IN-
10	" " IN+
11	WIND DIR IN-
12	" " IN+
13	RH-H
14	+24V
15	+24V
16	TE-H
17	RT-H
18	+15V
19	NC
20	GND
21	RH-H
22	RH-L
23	TE-H
24	TE-L
25	PRESS-H *
26	PRESS-L
27	GLOBAL-H
28	GLOBAL-L
29	
30	
31	
32	
33	
34	

Rear panel

PIN	FUNZIONE
-	
8	3 pol ferm Com
9	N close
10	OUT N open
	ALARM
1	Com
2	N close
3	N open
6	
7	WIND
1	IN
2	
1	
2	IN 5 pol ferm
7	RH & TE
6	
1	3 pol
2	RT Sensor
3	
PIN	BNC
SHIELD	OUT RH
PIN	BNC
SHE	OUT TE
PIN	BNC
SHE	OUT PRESS
PIN	BNC
SHE	OUT GLOBAL

ALL 14

CONNETTORE MS7	tipo ☐maschio ☐femmina pin
proveniente da MET. INT. BOARD	diretto a Front panel
locato su	note flat 20 poli

PIN	FUNZIONE
1	Led temp. -
2	BUZZER -
3	NC
4	Led manual -
5	RT-H
6	+15 V
7	DVM-H
8	DVM-L
9	LOC/REM
10	ALARM
11	TALK
12	PEND
14	A2
15	A1
16	A0
13	REM
17	Reset
18	NC
19	+5
20	GND
	Nota A: +5 a tutti gli anodi dei led, al Buzzer, al comune dei Thumbersvitch
	Nota B GND all' NO di tutti i pulsanti (Reset, LOC)

PIN	FUNZIONE
-	Allarme x temp.
	Av. acustico
	Allarme x vento
	} AD590 -
	+
PIN	} BNC
SHE	} ingresso DVM
	Comun pulsante LOC
	Catodo Led Allarm
	Catodo Led Talk
	Catodo Led Pend
	} Thumberswith 4
	2
	1
	Catodo Led Remote
	Comun puls reset
	Nota A
	Nota B

ALL 15

CONNETTORE IN WIND	tipo : ☐maschio ☐femmina pin
proveniente da	diretto a M96
locato su pannello posteriore	note

PIN	FUNZIONE
1	WIND DIR +
2	" " -
6	WIND SPEED +
7	" " -

PIN	FUNZIONE

ALL 16

CONNETTORE	tipo
IN RH e TE	☐ maschio ☐ femmina pin
proveniente da	**diretto a**
Sensore RH-TE	~~Pann. post~~ MS6
locato su	**note**
pannello posteriore	

PIN	FUNZIONE
1	RH-H
2	+24 V
6	TE-L
7	+24V

PIN	FUNZIONE
1	RH-H
2	+24 V
6	TE-H
7	+24V

CONNETTORE HAT INTERFACE	tipo ☒ maschio ☐ femmina pin
proveniente da Calcolatore esterno	diretto a HAT – AJ1
locato su pannello post	note

HAT INTERFACE

PIN	FUNZIONE
2	DATA IN (From HOST)
3	DATA OUT (to HOST)
7	Ritorno

AJ1

PIN	FUNZIONE
3	
5	
4	

ALC 18

CONNETTORE IUP T1 (RT)	tipo ☒maschio ☐femmina pin
proveniente da Sensore Temp. RT	diretto a M 36
locato su Pannello post.	note Collegare a schermo

PIN	FUNZIONE
1	Signal out
2	+15V

PIN	FUNZIONE

ALL 19

CONNETTORE OUT. ALARM	tipo: ☒ maschio ☐ femmina pin
proveniente da HS6	diretto a Eventuali disp. esterni
locato su pannello posteriore	note

PIN	FUNZIONE
8	C — Uscite di allarme per troppo Vento
9	NC — Uscite di allarme per troppo Vento
10	NO — Uscite di allarme per troppo Vento
..	
1	C — Uscite di allarme per sovra temp.
2	NC — Uscite di allarme per sovra temp.
3	NO — Uscite di allarme per sovra temp.

PIN	FUNZIONE

ALL 20

CONNETTORE J1	tipo ☒ maschio ☐ femmina 8 pin
proveniente da SETRA MOD 350-1	diretto a Sensore e Alim.
locato su Retro DVM SETRA	note Morsettiera WEIDMULLER

PIN	FUNZIONE
1	NC
2	Terra (marrone/nero)
3	Sensore (giallo)
4	Sensore (nero)
5	Sensore (Bianco)
6	Terra (Giallo/Verde
7	230 (Fucsia)
8	220 (Cont.)

PIN	FUNZIONE

ALL 21

VOLTMETRI IN CORRENTE CONTINUA

3½ digit, range ±1999 mV, predisposti internamente per ricevere tutti i moduli e opzioni per la misura delle diverse grandezze elettriche.

CARATTERISTICHE GENERALI E MODELLI DISPONIBILI

Codice	4000	4311	4312	4313	4314
Fondo scala	±1999mV	±199,9mV	±19,99V	±199,9V	±500V
Impedenza d'ingresso	10Gohm	10Gohm	10Mohm	10Mohm	10Mohm
Serigrafia G.Elettriche	-----	----	V	V	V

Precisione : 0,1% ±1 digit
Stabilità di zero : autozero ±1 µV/°C
Deriva misura : < 0,1%/10°C temperatura ambiente
: < 0,1%/10% tensione di rete
Indicazione : su 3½ digit a LED rossi da 14,2 mm
Polarità automatica : solo segno negativo (-)
Segnalazione fuori scala : spegnimento 3 cifre meno significative
Configurazione di ingresso : vero ingresso differenziale (4000/4311)
Punti decimali DP1/2/3 : programmabili da connettore
Tecnica di conversione A/D : a doppia rampa valor medio
Velocità di conversione : 2,5 letture al secondo

CONDIZIONI CLIMATICHE E FISICHE

Temperatura nominale di impiego : da +5° a 40°C
Peso : 300 g (in AC)
Stabilità termica : > 10 minuti primi
Stabilità delle caratteristiche nominali : sei mesi
Contenitore : in policarbonato nero, autoestinguente 48x96x120
Connessioni elettriche : a vite su connettore estraibile

PRECAUZIONI ALL'USO

Verificare che i valori di ingresso e di alimentazione presenti sulla etichetta corrispondano a quelli richiesti. Controllare che tensione e frequenza di alimentazione rientrino nelle tolleranze previste e se alimentato in c.continua l'esatta polarità (±). In fase di cablatura è consigliabile separare il cablaggio da eventuali barre di potenza, relè, teleruttori, SCR, ecc. La verifica scrupolosa dello schema d'inserzione è doverosa in quanto banali errori di collegamento possono danneggiare a volte irreparabilmente lo strumento.

AVVERTENZE IN CASO DI GUASTO

Le anomalie più frequenti, sono raramente dipendenti dallo strumento è possibile quindi porvi rimedio anche senza attrezzature specifiche. Quando invece i difetti riscontrati sono da imputare all'indicatore è consigliabile ritornare lo stesso in fabbrica per la necessaria riparazione. (N.B.) La resa della riparazione, anche se ancora in garanzia, sarà accettata solamente se autorizzata e in Porto Franco.

LISTA IMBALLO

N.1 Manuale Tecnico ..code 4000.14A
N.1 Contenitore .....code 75110070
N.1 Morsettiera 10 v..code 70100105
N.1 Morsettiera 3 v..code 70100103
N.1 Vite x blocco C.S.code 80100005
N.1 Tappo chiuso.. code 75110100
N.2 Viti x cursori code 80100003
N.2 Cursori ..... code 75110090
N.1 Filtro ottico. code 75110081

OPZIONI

Alimentazione in c.alternata (code A,B,C,D) in c.continua (code F o G)
Uscita analogica 1mV/digit (code 40)
Uscita ad un Allarme (code 41) e a due Allarmi (code 42)
Display 0,8" (code 44),alta efficienza (code 46),zero fisso (code 48)
Funzione di Hold (code 49)
Uscite BCD T.State (code 52),open coll. (code 53),opto isol.(code 54)
Trattamento di tropicalizzazione (code 91)
Certificato di calibrazione (code 99)

ALL 22

ALIMENTAZIONE AUSILIARIA

220 Vac ±10% - Frequenza 50÷60Hz - 3 VA - isolamento 4kV rms (code A)
110 Vac ±10% - " " - " " - " " " (" B)
24 Vac ±10% - " " - " " - " " " (" C)
12 Vac ±10% - " " - " " - " " " (" D)
12 Vdc ±10% - Protetto alle inversioni - isolamento 1kV rms (" F)
24 Vdc ±10% - " " " - " " " (" G)

NORME DI RIFERIMENTO

Gli indicatori sono costruiti per incontrare le normative CEI 66-2.

MESSA IN SERVIZIO

I morsetti che si utilizzano per qualsiasi alimentazione sono segnati sull'etichetta con i numeri 12 - 13 e con la dicitura Power.
L'ingresso di misura va collegato, per mod.4000 e 4311 fra i morsetti 2 / 3 / 4 se differenziale, tra 2 e 4 se singolo cortocircuitando 3 con 4; per i modelli 4312/13/14 fra 1 e 4. L'accensione dei punti decimali avviene cortocircuitando il morsetto 8 e i DP1/2/3.
La funzione Hold (opzione 49) avviene cortocircuitando il morsetto 6 divenuto Hold con il morsetto 7 (Fig.2).
L'uscita analogica (opzione 40) si preleva dai morsetti 5 e 6 (Fig.2)
Lo zero fisso (opzione 48) si inserisce come in Fig.2 (Dummy Zero)
E' consigliabile inserire sempre un fusibile di protezione sia sulla alimentazione che sull'ingresso di misura.
Qualora fosse necessario ritoccare la taratura del fondo scala si consiglia di procedere nel seguente modo:
1) rimuovere il filtro ottico come in Fig.1
2) inserire il segnale di misura, ruotare quindi il trimmer di span sino ad ottenere la lettura desiderata (massimo ±5%) come Fig.6

Fig.1

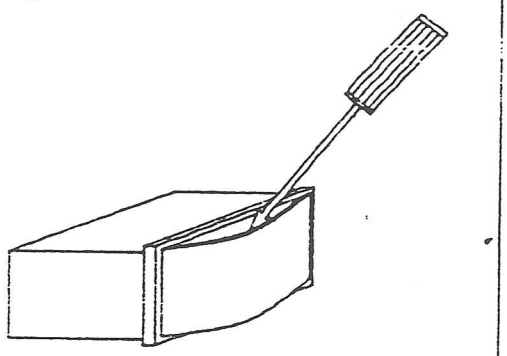


Fig.2

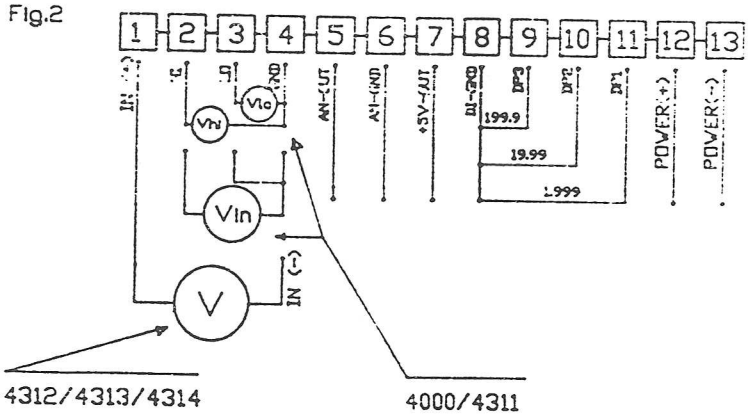


Fig.3

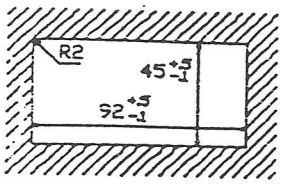


Fig.4

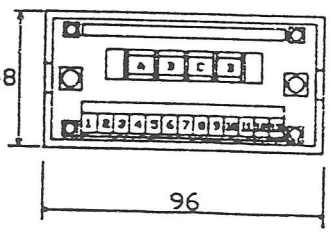


Fig.5

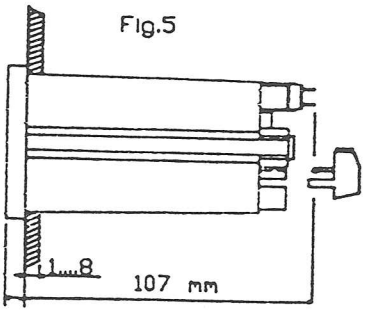
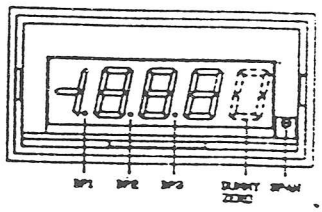


Fig.6



La Binding Union garantisce i propri prodotti per un periodo di 12 mesi dalla data di acquisto con un massimo di 18 dalla consegna, e si riserva il diritto di apportare modifiche in qualsiasi momento e di qualsiasi natura alle proprie apparecchiature senza alcun preavviso.

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M.T. OPZIONI METER 43

USCITE BCD PARALLELO THREE STATE (codice 52)

Questa interfaccia è stata progettata specificatamente per permettere l'interfacciamento degli strumenti di misura della linea Meter 43 ad un sistema di acquisizione dati. Il sistema di uscita è di tipo parallelo three state, CMOS/TTL 0-5 V.
Tramite una programmazione degli indirizzi l'utilizzatore può inserire un codice di identificazione che permette di ricevere i dati da 16 indicatori contemporaneamente.

Caratteristiche generali

1) L'indirizzo è usato come codice di identificazione dello strumento in sistema "multi-drop"

2) Quando lo strumento è usato singolarmente è opportuno non collegare gli ingressi di selezione degli indirizzi, in quanto, esce dalla fabbrica già in configurazione per utilizzo singolo(A0...A3 Floating)

3) Le caratteristiche di interfaccia verso l'utente sono:

Livelli logici ingressi —> A0 - A1 - A2 - A3 - LE - OE
V IL = Min 3,1 / Max 30 V
V IH = Min 0 / Max 0,9 V
I IL = Min — / Max 50 uA
I IH = Min — / Max 100 nA

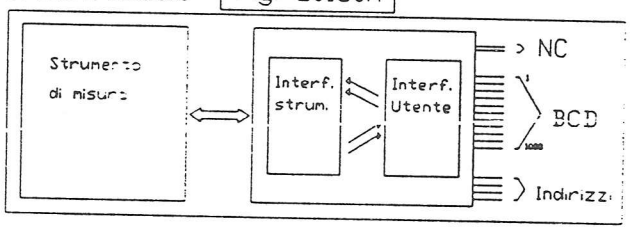
4) Uscite: Buffer three state ±6 mA

5) L'ingresso LE (Latch Enable) attivo basso permette di mantenere indefinitamente il dato dello strumento

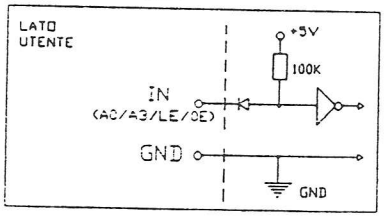
6) L'ingresso OE (Output Enable) attivo basso abilita il circuito di uscita facendolo passare dalla condizione di floating alla condizione attiva

7) Gli indirizzi A0/A1/A2/A3 sono attivi a livello logico alto

SCHEMA A BLOCCHI Fig. 20130A



CIRCUITO DI INGRESSO



SCHEMA CONNESSIONE USCITE BCD

Fila A		Fila B
NC	1	NC
NC	2	NC
1	3	2
4	4	8
10	5	20
40	6	80
100	7	200
400	8	800
1000	9	Polarity (+5V, -5V)
GND	10	GND
GND	11	GND
NC	12	NC
LE (Negato)	13	OE (Negato)
Indirizzo (A0)	14	Indirizzo (A1)
Indirizzo (A2)	15	Indirizzo (A3)

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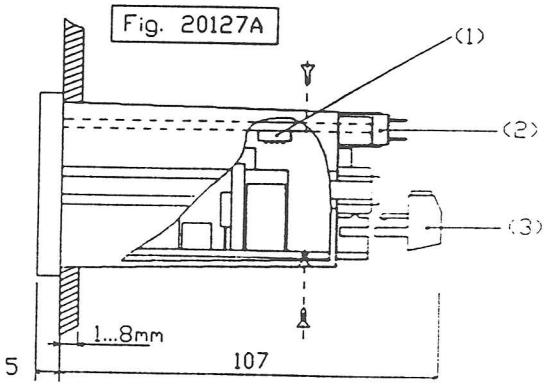
USCITE BCD 52

POSIZIONE NELL'INDICATORE

1) Preselettori decimali
2) Connettore 15+15 a saldare (uscite BCD)
3) Connettore maschio (indicatore)

Fig. 20127A



PROGRAMMAZIONE DEGLI INDIRIZZI

Per effettuare la programmazione degli indirizzi si deve agire nel seguente modo:
sfilare il connettore maschio dalle connessioni, svitare le due viti che bloccano la scheda al contenitore, estrarre lo strumento di misura e la scheda BCD opzionale dall'involucro in plastica spingendo le schede dalla parte posteriore ed asportare quindi il filtro ottico. Ad operazione avvenuta si noteranno sulla scheda opzionale 4 preselettori decimali che dovranno essere predisposti come specificato nella tabella di programmazione.

Particolare della programmazione

Nella configurazione standard i preselettori sono posizionati tutti in OFF, componendo pertanto in codice binario (1,2,4,8) il numero 15, se vengono posizionati tutti in ON il valore sarà uguale a zero, per altre numerazioni seguire la tabella di programmazione.

Fig. 20129A

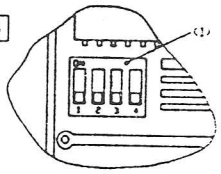


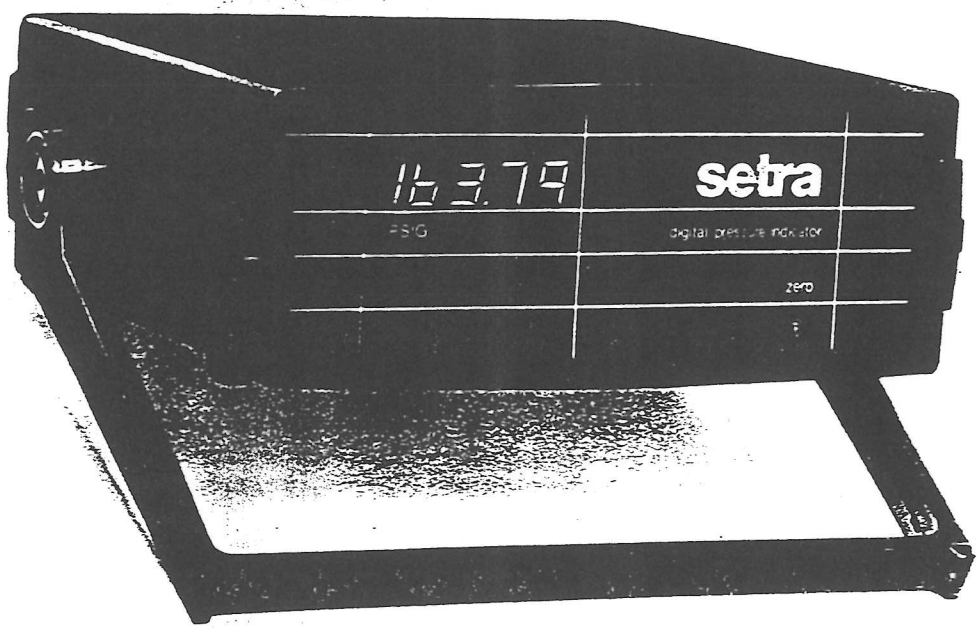
TABELLA DI PROGRAMMAZIONE

Fig. 20132A

Codice	Preselettori decimali			
	1	2	3	4
0	ON	ON	ON	ON
1	OFF	ON	ON	ON
2	ON	OFF	ON	ON
3	OFF	OFF	ON	ON
4	ON	ON	OFF	ON
5	OFF	ON	OFF	ON
6	ON	OFF	OFF	ON
7	OFF	OFF	OFF	ON
8	ON	ON	ON	OFF
9	OFF	ON	ON	OFF
10	ON	OFF	ON	OFF
11	OFF	OFF	ON	OFF
12	ON	ON	OFF	OFF
13	OFF	ON	OFF	OFF
14	ON	OFF	OFF	OFF
15	OFF	OFF	OFF	OFF

Setra Systems, Inc.
PRESSURE TRANSDUCERS AND TRANSMITTERS

Models
304-1, 339-1 and 350-1
Digital Pressure Manometers



Features

- High accuracy
- Complete system with built-in pressure or vacuum sensor.
- Portable bench-top case with easy-to-grip carry handle.
- Wide selection of standard ranges for Gage, Absolute, Differential and Vacuum from ±0.25 inch Wc to 100 psi full scale.
- Excellent long term stability.
- High resolution 4-1/2 digit LED display.
- Pressure displayed in your desired engineering units.
- High level Analog output.

Description

Performance and portability are key features of Setra's 300 Series electronic manometers. All models include a high resolution 4-1/2 digit LED display, zero and span adjustments and analog outputs (BCD output optional). Packaged in a lightweight bench-top case complete with an easy-to-grip carry handle, these units are ideal for use as portable pressure calibration transfer standards.

Model 304-1, 339-1 and 350-1 stand-alone electronic manometers are based on Setra's variable capacitance pressure sensor technology. Extremely low hysteresis and stability under transient temperature or temperature gradient conditions are inherent in these sensor designs. As the applied pressure changes, the capacitance changes. This capacitance is detected and converted to a linear DC signal by Setra's unique electronic circuit. This signal is displayed digitally and is also available at the rear panel.

45 Nagog Park, Acton, Massachusetts 01720/Telephone 1-800-25-SETRA, In MA (508) 263-1400

setra

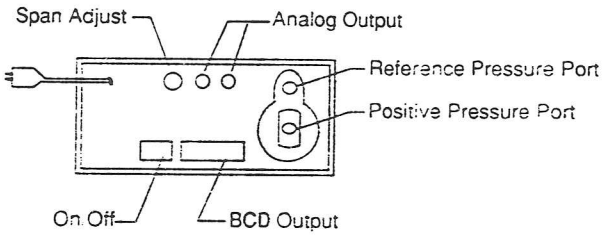
ALL 23

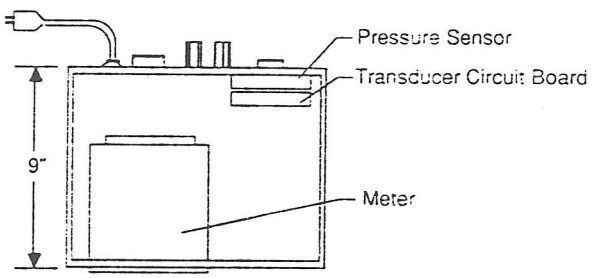
Manometer Type	304-1	339-1	350-1
TYPE OF MEASUREMENT	Gage Pressure Absolute Pressure Vacuum	Differential Pressure or Gage Pressure	Gage Pressure Absolute Pressure Barometric Pressure
STANDARD RANGES[1]	0 to 25, 50, 100 psig 0 to 25, 50, 100 psia 0 to 14.7 psiv 0 to 25, 50, 100 psid 0 to ±10, ±25, ±50, ±100 psid	0 to 0.5, 5, 15, 30 inch WC 0 to ±0.25, ±2.5, ±7.5, ±15inch WC 0 to 5, 10 psi 0 to ±2.5, ±5 psi	0 to 5, 10, 20, 50, 100 psig 0 to 10, 20, 50, 100 psia 600-1100 millibar 800-1100 millibar
SYSTEM ACCURACY*	±0.11% FS ± 2 digits	±0.14% FS ± 2 digits	±0.05% FS ± 2 digits
THERMAL EFFECTS %FS 60°-95°F Thermal Zero Shift Thermal Span Shift	 0.14 max. ± 4 digits 0.11 max. ± 4 digits	 0.35 max. ± 4 digits 0.35 max. ± 4 digits	 0.07 max. ± 4 digits 0.04 max. ± 4 digits
PRESSURE FITTINGS Positive Reference	 1/4"-18 NPT internal 1/8"-27 NPT internal (psid)	 1/8"-27 NPT internal 1/8"-27 NPT internal	 1/8"-27 NPT internal N/A
PRESSURE MEDIA Positive Reference	 Gas or liquid compatible with 17-4 PH stainless steel. Clean dry air or other gases. (Non-corrosive, non-condensable.)	 Gases compatible with stainless steel, hard anodized 6061 aluminum Buna N "O" ring. (Stainless steel in place of aluminum on special order.) Clean dry air or other gases (Non-corrosive, non-condensable.)	 Dry or wet air, water, petroleum products or other media compatible with aluminum, alumina ceramics, gold and elastomer sealant. N/A
ANALOG OUTPUT[3]	Normally 0 to 5 VDC for unidirectional pressure or vacuum ranges. 0 to ±2.5 VDC for bidirectional ranges.	Normally 0 to 5 VDC for unidirectional pressure. 0 to ±2.5 VDC for bidirectional ranges.	0 to 5 VDC for gage and absolute ranges. 6 to 11 VDC for 600 - 1100 mbar 8 to 11 VDC for 800 - 1100 mbar

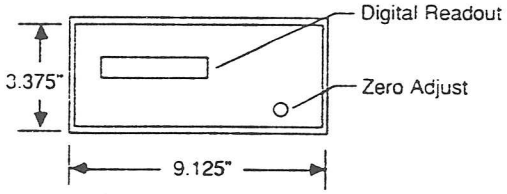
*RSS of transducer non-linearity, hysteresis and non-repeatability, and meter error at 72°F (22°C)

Indicator Specifications

DISPLAY	
Type	Light Emitting Diode
Color	Red
Height of Digits	0.56 inch
Maximum Readout	±19999
Reading Rate	2 per second
Polarity sign	Negative Only
PHYSICAL	
Operating Temperature	32° to 130°F (0° to 55°C)
Storage Temperature	-40° to 185°F (-40° to 85°C)
Width	9.125 inches
Height	3.375 inches
Depth	9 inches
Relative Humidity	0 to 80% Non-condensing
ELECTRICAL	
AC Voltage/Frequency [2]	115VAC ±10%, 50/60 Hz
AC Power	7 watts nominal
Power Cord Length	5 feet (approx.)







Options

(1) Special pressure ranges and other engineering units are available. Consult Factory

(2) Other line voltage (100VAC, 220 VAC or 240 VAC, all ±10% and 50/60 Hz)

(3) Binary Coded Decimal (BCD) Output.

Ordering Information

Order as Model 304-1, 339-1 or 350-1 Manometers. Specify pressure range and desired options.

45 Nagog Park, Acton, Massachusetts 01720/Telephone 1-800-257-3872, In MA (508) 263-1400

Printed in USA SSP 300M 09/88

INSTRUCTION MANUAL
SERIES 300 ELECTRONIC MANOMETERS
MODELS 304-1, 339-1 AND 350-1 WITH LED DISPLAY

I — GENERAL INFORMATION

1-1. Description

Series 300 Electronic Manometers are complete pressure measurement systems designed to provide fast, convenient, and highly accurate measurements of Gage Pressure, Absolute Pressure, Differential Pressure, Barometric Pressure, or Vacuum depending on the model selected. Each system contains an internally mounted transducer consisting of a capacitance type pressure/vacuum sensor and complete signal conditioning electronics, a transducer power supply, and a digital panel meter having a 4 1/2 digit LED display. Specifications for Model 304-1, 339-1, and 350-1 Electronic Manometers are listed on the applicable product bulletin.

Additional sensor and circuit information may be obtained by consulting the appropriate Setra Pressure Transducer bulletin. (A modified Model 204 Transducer is included in Model 304-1 Manometers, a modified Model 239 Transducer in Model 339-1 Manometers and a modified Model 270 Transducer in Model 350-1 Manometers).

A layout drawing of the Series 300 Manometer is shown in Figure 1. The digital display and zero adjustment control are located on the front panel of the manometer. The pressure port(s), on/off switch, two binding posts providing access to the high-level analog voltage output of the transducer, sensitivity adjustment and optional Binary Coded Decimal (BCD) output, if furnished, are located on the rear panel of the case. Devices for adjusting transducer linearity, meter zero and meter span are also provided for use during recalibration only. (See Recalibration Instructions for exact location.)

Schematic and layout drawings of the transducer circuit are shown in Figures 2a and 2b on pages 4 and 5.

Each Series 300 Electronic Manometer is calibrated just before shipment using equipment traceable to the National Bureau of Standards. An identification label is provided on the rear panel of the Manometer case showing the model number, its serial number, the calibrated range of the system, and the AC voltage/frequency for which it is designed.

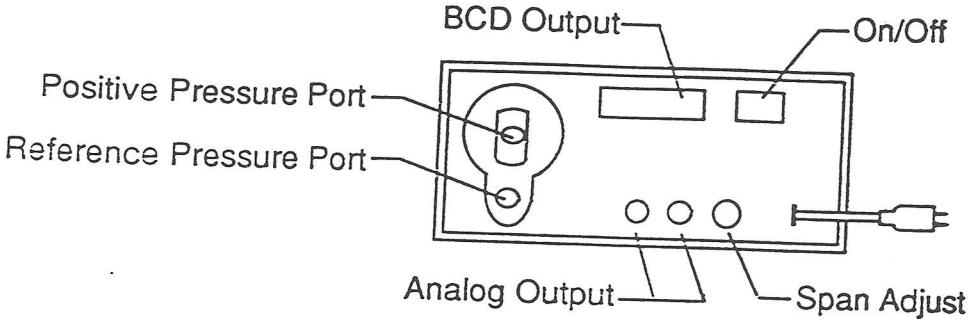
A Calibration Certificate is furnished with each system showing the date of factory calibration, the maximum pressure that may be applied to the system without causing permanent damage, and the digital display and analog voltage outputs observed at the time of calibration. A copy of the Calibration Certificate and additional test data for each system is kept on file at Setra for future reference.

1-2. Accuracy

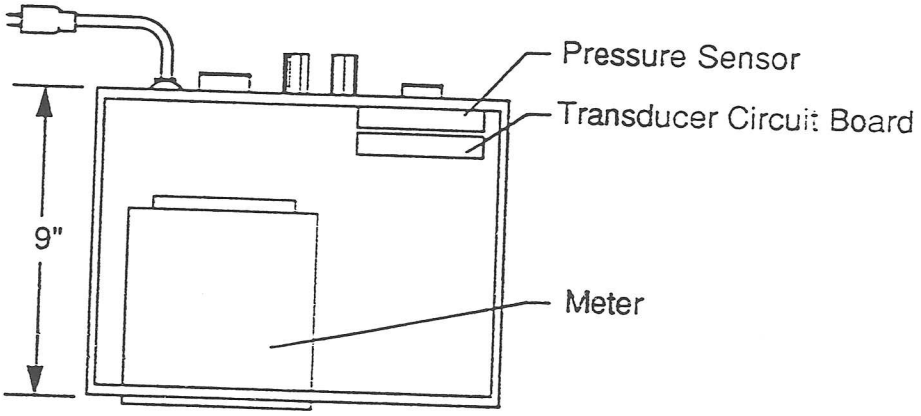
Accuracy data for Model 304-1, 339-1, and 350-1 Electronic Manometers is shown in Table I. Note that the RSS Accuracy figures combine transducer non-linearity, hysteresis and non-repeatability and meter error, but do not include error caused by zero or sensitivity offset (both of which may be adjusted by the user) or output shift caused by temperature effect.

1-3. Handling Note

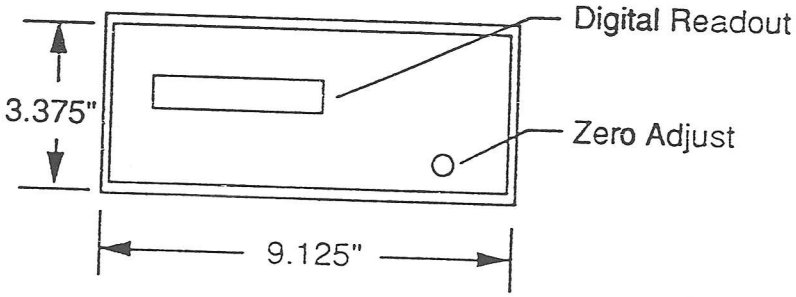
Series 300 Electronic Manometers are small, lightweight systems that may be conveniently transported between points of use where AC power is available, and may be used in many industrial environments as well as more favorable laboratory conditions. Within these parameters, however, careful handling is advised to allow these precise measurement systems to maintain high accuracy and to provide optimum service life. Special care should be taken to ensure that dirt, non-compatible liquids, moisture, harmful gases, and foreign objects such as probes, incorrectly sized pressure fittings, hardware, etc. do not gain entry to the pressure ports during handling.



Rear Panel



Top View
(with Cover Removed)



Front Panel

Figure 1 - Layout Drawing (typical)
Model 304-1, 339-1 and 350-1 Electronic Manometers

Table: 1 - Accuracy Specifications
Model 304-1, 339-1 and 350-1 Electronic Manometers

		Type of Manometer		
		304-1	339-1	350-1
RSS Accuracy (1)		± 0.11% FS ±2 digits	± 0.14% FS ±2 digits	± 0.05% FS ±2 digits
Sensitivity Error (2)		±0.2%R	±0.2%R	±0.2%R
Temperature (3) Effects (%FS/60°-95°F)	Zero Shift	0.14 max. (4) ±4 digits	0.35 max. ±4 digits	0.07 max. ±4 digits
	Sensitivity Shift	0.11 max. ±4 digits	0.35 max. ±4 digits	0.04 max. ±4 digits

Notes: %FS = Percent of Full Scale or Full Range
%R = Percent of Reading
(1) Root-Sum-of-the-Squares combination of transducer non-linearity, hysteresis and non-repeatability, and meter error at 72°F (22°C).
(2) Specified maximum calibration offset. May be reduced by user.
(3) May be adjusted out at operating temperature.
(4) 0.35 max. for vacuum ranges.

4. **Warranty**

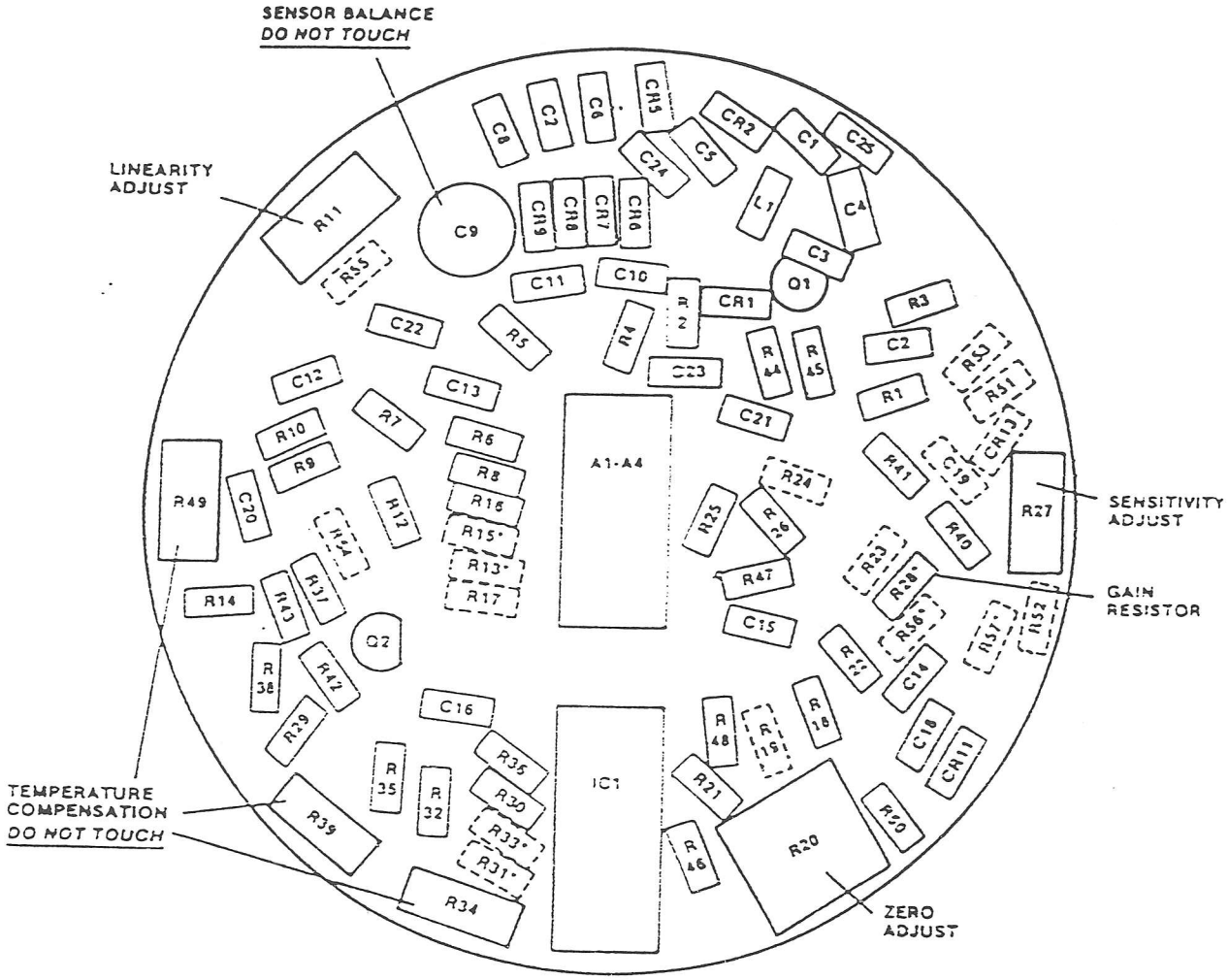
Series 300 Electronic Manometers are covered by the following Limited Warranty:

"For a period of one year from the date of sale by Setra Systems, Inc., (hereinafter Setra), as shown by its documents, Setra warrants its products to the original consumer purchaser to be free from defects in materials and workmanship, subject to the following terms and conditions: Without charge, Setra will repair or replace products found to be defective in materials or workmanship within the period set forth above, provided that:

a) the product has not been subjected to abuse, neglect, accident, incorrect wiring not our own, improper installation or servicing, or use in violation of instructions furnished by Setra;
b) as to any prior defects in materials or workmanship covered by this warranty, the product has not been repaired or altered by anyone except Setra or its authorized service agencies;
c) the serial number has not been removed, defaced, or otherwise changed; and
d) examination discloses, in the judgment of Setra, a defect in materials or workmanship which developed under normal installation, use and service;
e) the product is returned to Setra, transportation charges prepaid.

Setra does not assume the costs of removal and/or installation of the product or any other incidental costs which may arise as the result of any defect in materials or workmanship, nor will Setra be liable for consequential damages.

This warranty is in lieu of all other express warranties. Any warranty implied by law, including warranties of merchantability or fitness, is in effect only for the duration of the express warranties set forth in the first paragraph above. No representative or person is authorized to give any other warranty or to assume for Setra any other liability in connection with the sale of its products. Setra will not be liable for any consequential damages resulting from use or installation of its product."



Notes:
1. Components shown are omitted on some models.
2. *denotes selected item.
3. Zero and sensitivity adjust controls are in parallel with adjustment devices provided on manometer case.

Figure 2a - Transducer Circuit Layout (typical)
Model 304-1 and 339-1 Electronic Manometers
Setra Model 204 and 239 Pressure Transducers

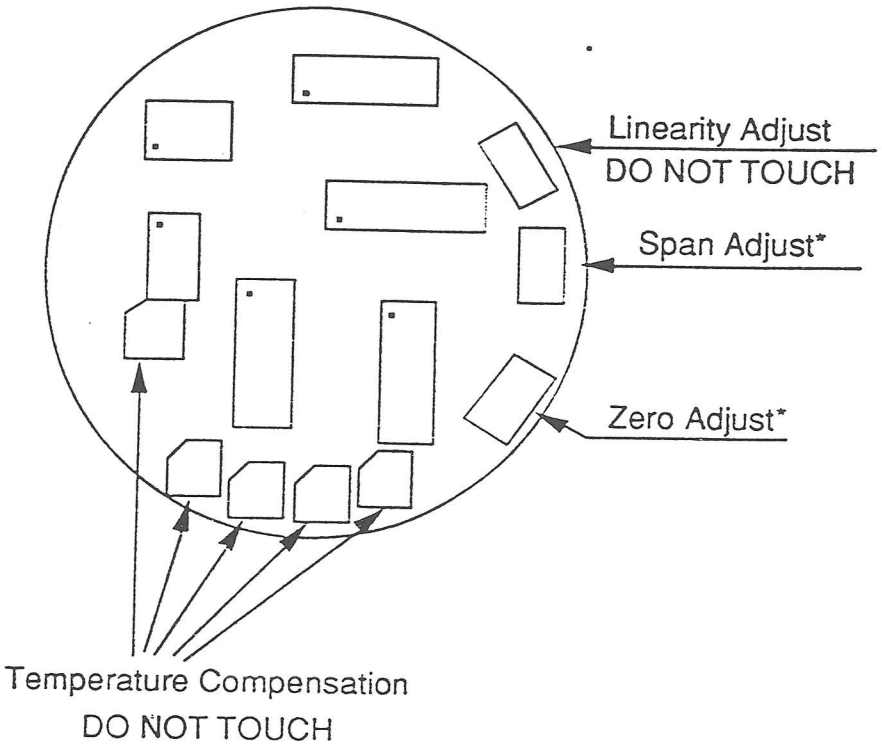


Figure 2b - Transducer Circuit Layout (typical)
Model 350-1 Electronic Manometer
Setra Model 270 Pressure Transducer

II — OPERATING INSTRUCTIONS

2-1. Preliminary

Before using a Series 300 Manometer, check the identification label to verify that the system is designed to provide the type of measurement desired (gage pressure, absolute pressure, differential pressure, barometric pressure, or vacuum), that the calibrated range is adequate for the application, and that proper AC power will be applied. Make certain that the pressure/vacuum medium that will be in contact with the manometer sensor is acceptable as defined in Table II. If unsure about pressure medium compatibility, contact Setra before using the system. Application of a non-compatible medium will result in inaccurate measurements and possible damage to the system that is not covered by warranty.

2. Pressure Connections

Series 300 Manometers being used for gage pressure, absolute pressure, or vacuum measurements require a pressure line connection to the Positive Pressure port. Model 339-1 Manometers being used for differential pressure measurements where the reference pressure is other than atmospheric pressure require pressure line connections to both the Positive Pressure and Reference Pressure ports. No pressure line connection is required to absolute pressure systems used to measure ambient pressure.

A Model 339-1 Manometer calibrated for pressure measurements may also be used to measure vacuum within the calibrated range (assuming medium compatibility) by making a vacuum line connection to the Reference Pressure port and leaving the Positive Pressure port open to the atmosphere.

To make a pressure or vacuum line connection, a pressure fitting must first be installed in the pressure port. The size of the fitting (not furnished by Setra) required for each manometer depends on the type of system, as shown in Table II. The use of pipe thread sealer during installation of the fitting is recommended to ensure a leakproof connection. Tighten the fitting securely using the wrench flats provided on the outside of the Positive Pressure port housing to prevent excessive strain on the instrument case. A fitting which does not match the manometer pressure port dimensions may be used by installing an adapter between the fitting and the port.

After the fitting is installed, attach suitable pressure line between the pressure/vacuum source and the fitting. The pressure line used must be adequate for the application. This is especially important when high pressure or toxic media will be present. On some applications having long pressure lines or where other factors might make it difficult to remove pressure from the line for zero adjustment of the system, a valve installed in the pressure line at or near the fitting might be desirable. For differential pressure systems having two pressure line connections, a valved branch line between the Positive Pressure and Reference Pressure lines to equalize pressure at the manometer may facilitate subsequent zero adjustments.

2-3. Overpressure Protection

Each Series 300 Electronic Manometer will sustain applied pressure beyond its calibrated range up to the Proof Pressure rating shown on its Calibration Certificate without permanent damage, though a small zero shift may occur. If it is possible that excessive overpressure, including transient surges and shock waves, may be applied to a system, a suitable fast-acting pressure relief valve or some other protective device should be installed in the pressure line, or a manometer having a higher pressure range and a corresponding greater Proof Pressure rating, should be used.

2-4. Sensor Volume

The volume of the pressure cavities in Series 300 Manometers is shown in Table II. These volumes are exclusive of the space taken by the pressure fittings added by the user and are small enough to be insignificant to most applications. If the quantity of measurand is limited or for any other reason it is desirable to reduce the sensor volume, a plug may be inserted into the through-hole of the fitting or threaded into the pressure port ahead of the fitting. The plug must not obstruct the flow of measurand into the sensor and it must not touch the inner face of the sensor cavity. Allow .01 inch minimum clearance.

Table II
Pressure Fitting, Acceptable Media, and Sensor Volume Information
Model 304-1, 339-1 and 350-1 Electronic Manometers

Manometer Model	Type of Measurement	Port	Male Fitting Size	Acceptable Pressure/Vacuum Media	Sensor[1] Volume
304-1	Gage, Absolute Differential Vacuum	Positive	1/4"-18 NPT	Gas or liquid compatible with 17-4PH Stainless Steel	.17in.^{3}
339-1	Gage Pressure Differential Pressure	Positive	1/8" -27 NPT	Gas compatible with 300 Series Stainless Steel, Anodized 6061 Aluminum Buna N Elastomer	.12in.^{3}
		Reference	1/8" -27NPT[2]	Clean, dry (non-condensing) non-corrosive gas	.15in.^{3}
350-1	Gage Pressure Absolute Barometric	Positive	1/8" -27 NPT	Clean, dry (non-condensing) non-corrosive gas	.50in.^{3} max

NOTES: *(1) Approximate, before installation of fitting.*
(2) Fitting is required only for differential pressure measurements where reference pressure is other than atmospheric.

An alternate approach to reducing the effective volume of the Positive Pressure port of Model 304-1 and 339-1 Manometers is to fill the cavity and a predetermined amount of the pressure line with water, glycerine, hydraulic fluid or light instrument oil before making pressure measurements. The liquid in the pressure line must reach a point in the line that is at a higher elevation than the port, and care must be taken to ensure that the liquid does not flow backwards in the pressure line into the pressure source. The liquid will put a preload on the system, the magnitude of which will depend on the height of the liquid in the pressure line and its specific gravity. If the preload is small (less than 5% of the full range of the system), it may be adjusted out without loss of accuracy (see zero adjustment instructions) or it may be subtracted computationally from all subsequent measurements.

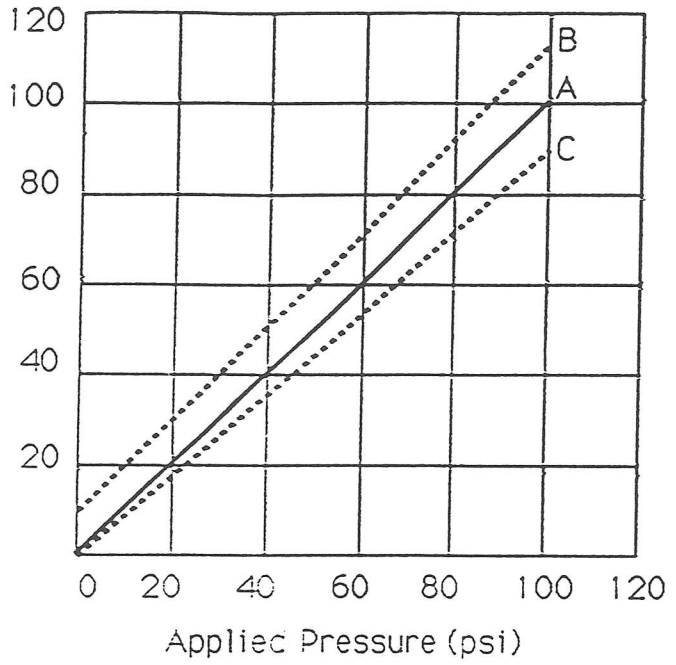
CAUTION: DO NOT ADD LIQUID TO THE REFERENCE PRESSURE PORT OF MODEL 339-1 OR 350-1 MANOMETERS

2-5. Operating Environment

Series 300 Electronic Manometers are designed for use in ambient temperatures between 30°F and 120°F where relative humidity is 80% or less. For best accuracy and stability, avoid locating the system in direct sunlight or near open windows, doorways, heating and air conditioning vents etc., where drafts or temperature gradients may occur. The system must not be subjected to water spray or other liquids and the manometer cover should not be removed where excessive dirt or dust is present in the surrounding atmosphere.

2-6. Analog Voltage Output

The analog voltage output of Model 304-1, 339-1, and 350-1 Electronic Manometers may be used as input to a recorder, data logger, remote indicator, set point control relay, or other type of voltage-sensitive equipment. The output is the high-level output of the transducer signal conditioning electronic circuit and may be used with any grounded or ungrounded load having an impedance of 5000 ohms, or greater, that has compatible input voltage requirements. The output may be attenuated if necessary for use with equipment designed for low-level input. (Attenuator impedance must be 5000 ohms, or greater.)



Curve A: No zero or sensitivity error, no span offset.
Curve B: +10 psi zero offset. No sensitivity error or span offset.
Curve C: No zero error, -10psi/100psi = -10% sensitivity error, -10psi span offset at full scale.

Figure 3-Illustration of Zero Offset, Span Offset, and Sensitivity Error

The standard analog voltage output is 0 to 5 VDC for unidirectional pressure/vacuum ranges, 0 to ± 2.5 VDC for bidirectional ranges and Model 350-1 barometric ranges have 6-11 VDC or 8-11 VDC outputs but, a special analog voltage output may have been requested at the time of purchase. The output for each system is shown on its Calibration Certificate and, except for small zero and sensitivity adjustments, it cannot be changed by the user. With proper system calibration, the accuracy of the analog voltage output is equal to that of the digital readout except for the ±2 digit meter error.

If the analog voltage output is to be used, connect the load to the red (positive) and black (negative) binding posts furnished on the rear panel of the manometer case. The load may be located up to 50 or more feet away from the manometer without significant loss of accuracy or stability. If the connecting cable is more than 50 feet long, however, some instability of the digital display and/or the analog voltage signal may occur due to the capacitance of the cable. If instability occurs, it may be reduced or eliminated by installing a 100 ohm, 1/8 watt (or greater) resistor in series with each cable lead connected to the analog output binding posts.

2-7 Warmup Period

When the required connections have been made to the system, plug the power cord into a proper AC power source and turn the on/off switch to the "on" position. For best accuracy and stability, allow at least 15 minutes for warmup before taking readings. A slightly longer warmup period may be required if the system has been stored at a temperature more than 10°F higher or lower than the operating ambient temperature. The system is ready for use when, with constant pressure applied, the digital display remains constant or has only infrequent ±1 digit fluctuation of the right-side (highest resolution) digit.

2-8. Zero and Sensitivity Offset

Series 300 Electronic Manometers may have small zero and/or sensitivity offsets when shipped, as specified on the applicable transducer product bulletin. The amount of initial calibration offset for each system is shown on its Calibration Certificate. In addition, small zero and/or sensitivity shifts may occur prior to or during use due to rough handling, temperature change, the application of pressure/vacuum outside of the calibrated range, use on a non-horizontal surface, aging of electronic components, significant humidity variation, etc. As shown in Figure 4, zero offset is uniform in magnitude through the full calibrated range of the system and can best be expressed as a percent of full scale or full range, while the magnitude of sensitivity offset varies through the calibrated range but is constant when expressed as a percent of reading. (Setra often specifies sensitivity error as a percent of full scale in order to be consistent with specifications pertaining to other types of error. The user may correctly regard sensitivity error as a percent of reading, however.)

Small zero and sensitivity offsets may be ignored if insignificant to the application, or subsequent measurements may be corrected computationally for known zero and sensitivity error. For highest accuracy, zero and sensitivity adjustments should be made after warmup at operating temperature and, if possible, occasionally during use as described in the following sections.

2-9. Binary Coded Decimal (BCD) Output

Series 300 Electronic Manometers purchased with the optional parallel BCD output have a 25-pin connector mounted on the rear panel of the case (see Figure 1). A mating connector (Amphenol P/N57-30240, or equal) is also furnished.

All digital outputs are positive-true relative to the digital low signal and will drive one standard 7400 series TTL or DTL load. Descriptions of signals at the BCD connector are as follows:

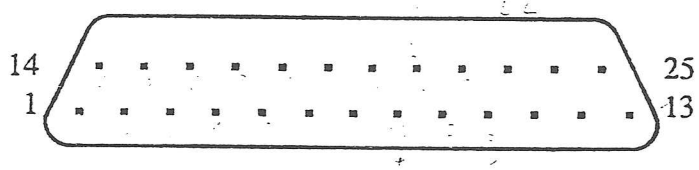
a) **Binary coded Decimal signals:** The BCD signal mnemonics are derived from the decade (10^0 through 10^4) and the binary weight (8, 4, 2 and 1) of the digit. The digital output of the meter is standard and is utilized for a full 4 1/2-digit display with 10^0 assigned to the least significant digit and 10^4 to the most significant digit. The binary weight of the decade is determined by the decimal displayed. If decade 10^2 displays a numeral 9, outputs 8×10^2 and 1×10^2 are true (logical 1), 4×10^2 and 2×10^2 are false (logical 0).

b) **Digital Low:** All BCD outputs are relative to digital low.

c) **Print Commands:** This output indicates that stable data are present in the output. Print is a logical "0" when the parallel BCD data, overrange, and polarity signals are valid. A logical "1" indicates the data is being updated.

d) **Overrange:** The digital output which, when true (logical 1), indicates that the instrument's range has been exceeded.

e) **+ Polarity:** The polarity output is a logical "1" for positive signals and a logical "0" for negative.



1	DIGITAL GROUND		
2	8×10^3	14	8×10^2
3	4×10^3	15	4×10^2
4	2×10^3	16	2×10^2
5	1×10^3	17	1×10^2
6	1×10^4	18	8×10
7	POL (+)	19	4×10
8	PRINT BAR	20	2×10
9	OVERRANGE	21	1×10
10	SPARE	22	8×10^0
11	STROBE 3 BAR	23	4×10^0
12	STROBE 2 BAR	24	2×10^0
13	STROBE 1 BAR	25	1×10^0

FIGURE 4
Pin Designations for Tri-State BCD Option

III — MAINTENANCE AND REPAIR

3-1. Maintenance

Model 304-1, 339-1, and 350-1 Electronic Manometers have no moving parts (except for minute deflection of the sensor under pressure/vacuum) and normally require little, if any, maintenance. When used in a dusty or very humid environment, and/or with media that are corrosive, highly viscous, or contain particulate matter, the following cleaning procedures may be advisable as required:

a) Manometer Case Cleaning

Remove the manometer cover from the case and, with the AC plug disconnected, inspect the transducer circuit board and all wiring harness connections for signs of corrosion or excessive dust accumulation. Clean as required using clean, dry compressed air (15 psig max.) or a small soft-bristled brush. DO NOT USE COMPRESSED AIR WITH OIL OR MOISTURE CONTENT. DO NOT USE CHEMICAL CLEANERS.

b) Sensor Cleaning

To clean the positive pressure port of Model 304-1 and 339-1 Electronic Manometers, flush with room-temperature water, or, if necessary, a solvent compatible with the sensor materials as shown in Table II. *CAUTION:* DO NOT ADD LIQUIDS TO THE REFERENCE PRESSURE PORT OF MODEL 339-1 OR TO THE PORT OF 350-1 MANOMETERS

2. Repair

Model 304-1, 339-1, and 350-1 Electronic Manometers are designed to be highly reliable and, under normal use, repair is not frequently required. Occasional minor repairs may nonetheless be necessary over a period of time, especially if the system is used where line voltage varies from the specified range or if the system is subjected to rough handling or vibration. If necessary, field repairs may be made as follows:

a) Connectors, Wiring, Adjustment Controls, Components

If a system remains inoperative the user may wish to check the appropriate connectors, wiring harnesses, adjustment control devices, or circuit boards for evidence of broken leads, short circuits, failed components, etc. *CAUTION:* IT IS SUGGESTED THAT DETAILED SYSTEM INSPECTION BE ATTEMPTED ONLY BY QUALIFIED ELECTRONIC TECHNICIANS USING APPROPRIATE TEST EQUIPMENT. NO REPAIR OR REPLACEMENT SHOULD BE ATTEMPTED WITHOUT FIRST CONSULTING SETRA.

IV — RECALIBRATION INSTRUCTIONS

4-1. General Information

Model 304-1, 339-1, and 350-1 Electronic Manometers are designed to provide accurate and reliable measurements without recalibration for a period of several months. Like all precision instrumentation, however, periodic recalibration is recommended. The optimum frequency of recalibration depends on several factors, including required accuracy, handling and storage conditions, operating environment (unusual temperature variations, vibration, etc.), the likelihood of pressure applications beyond the calibrated range, and the like. Most users schedule recalibration at intervals of three months or more. If highest possible system accuracy is necessary to meet the requirements of a specific application, it may be desirable to check calibration when a new system is received and to have the system recalibrated after the first one to three months of use in order to establish overall confidence in the system and to determine the stability of the system on the particular application.

Setra Systems maintains a complete Pressure Calibration Department and will quote recalibration charges on request. If the user has access to a Primary Pressure Standard accurate to within ± .03%R and a voltage sensing device with at least .001 VDC resolution and ± .01% accuracy, he may wish to recalibrate the system himself, rather than return it to Setra. Instructions for doing this are shown below.

4-2. Preparation

a) Locate the system to be recalibrated in room temperature (72°F ±2°) or, for best accuracy, in the ambient temperature at which it will be used, if other than room temperature. Connect the voltage indicating device to the analog output of the transducer using the two terminals provided on the rear panel of the Manometer case

b) Apply AC power to the system and allow at lease 15 minutes for warm-up.

4-3. Zero Adjustment

a) Check the Calibration Certificate furnished with the system to determine the pressure or vacuum level at which a 0.000 VDC analog output should occur (usually zero pressure or zero vacuum) and apply this pressure to the system. Depending on the type of system, this will usually require the following:

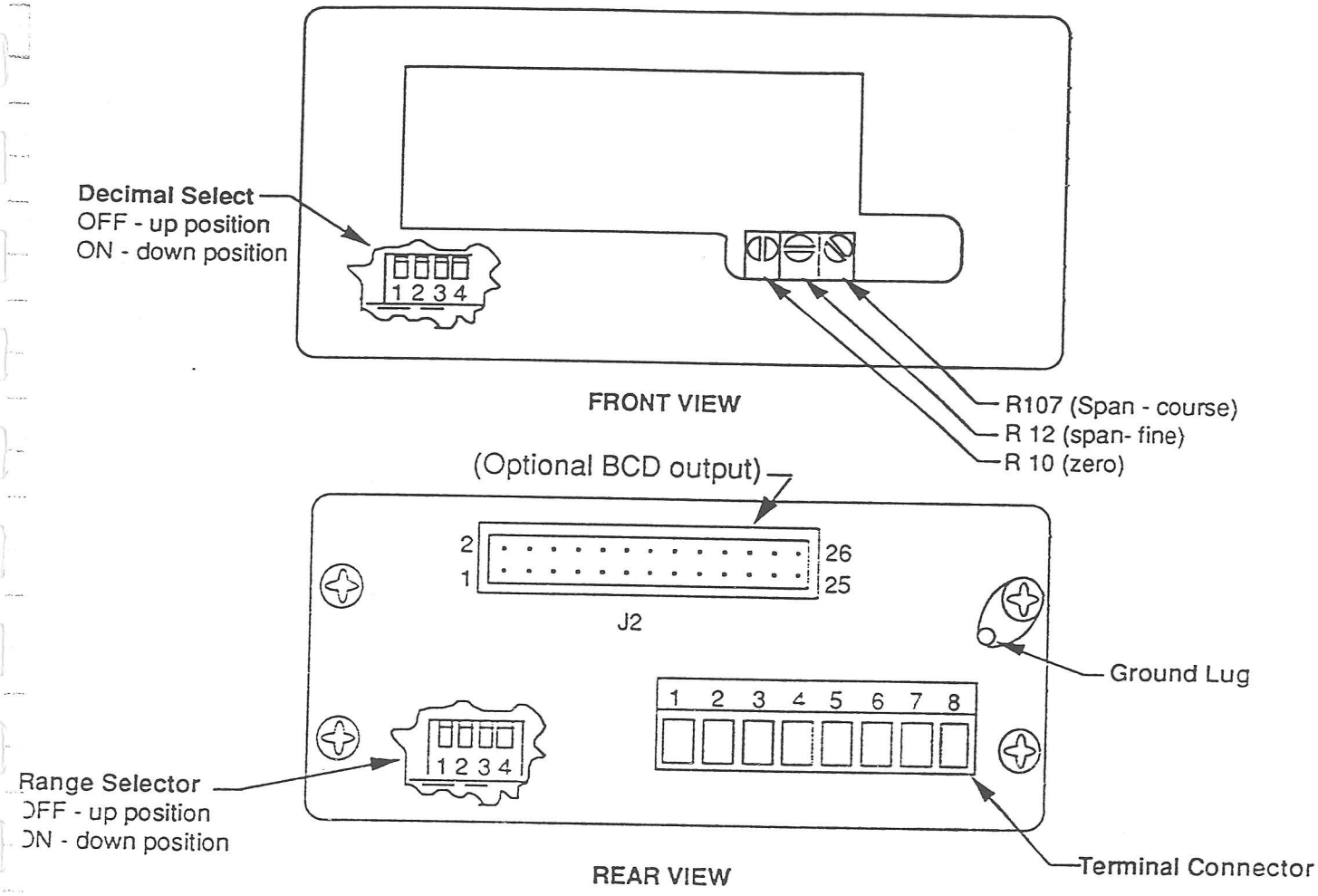
Gage Pressure and Vacuum Systems; Remove the pressure vacuum line from the system or open the line to atmospheric pressure.

Differential Pressure Systems: Remove the pressure/vacuum lines from the system, or, if available, open a connecting valve between the pressure lines to ensure equalized pressure on the Positive and Reference Pressure ports.

Absolute Pressure Systems; Use a vacuum pump or other reliable vacuum-producing equipment to draw high vacuum (10^{-1} Torr, or better) in the pressure line.

If the system was initially calibrated so that 0.000 VDC output occurs within the calibrated range but not at zero pressure (such as in systems having certain special ranges and/or analog voltage outputs), use an accurate pressure standard to apply the precise pressure required to obtain 0.000 VDC analog output as shown on the Calibration Certificate. If this is not feasible, or if 0.000 VDC is not within the calibrated range, see Paragraph 4-3 (c) below.

b) With the appropriate pressure applied to the system, adjust the Manometer zero control located on the front panel to obtain 0.000 VDC analog output. If the digital readout does not display the corresponding pressure (usually 0000, with the decimal point in its fixed location), pry off the front panel of the case. Use a small screwdriver to adjust the meter zero control located in the lower right-hand corner of the LED Display (see Fig. 5) until the correct pressure reading is obtained on the meter display.



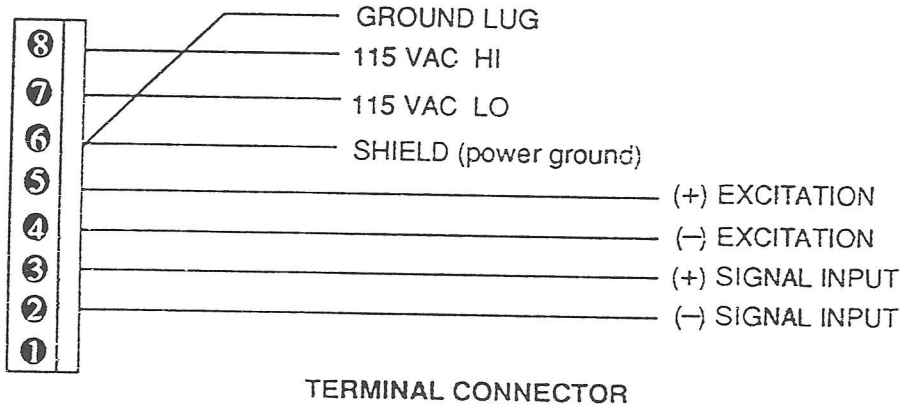


Figure 5 **Meter Adjustments (remove manometer faceplate to access)**
Wiring Connections (remove manometer top cover to access)

c) If the analog voltage output of the system does not equal 0.000 VDC at any point in the calibrated range (for example, a Model 350-1 barometric pressure system with a calibrated range of 800 to 1100 millibars and a 800 to 1100 VDC output), the zero adjustment should be made at the lowest pressure within the calibrated range. Apply the appropriate pressure to the system (800.0 mb in the above example) and adjust the system zero control until the correct output voltage is obtained (800 VDC in the example). Then adjust the meter control as described in Paragraph 4-3 (b) to obtain the correct digital display on the meter.

Note: If neither the exact pressure required to obtain 0.000 VDC output nor the lowest pressure in the calibrated range can be applied to a system for recalibration in the field, any precisely-known pressure near the low end of the calibrated range may be used for zero adjustment. This alternate method may yield slightly less accuracy than the preferred methods shown above, but it may be useful in some instances. When this method must be used, calculate the exact analog output that corresponds to the pressure applied and adjust first the system zero control and then the meter zero control to obtain the correct analog output and digital display, respectively.

4. Sensitivity Adjustment

After the zero adjustment has been made, use the pressure standard to apply precise full scale pressure to the system. (For differential systems with bidirectional ranges, use either the maximum positive or maximum negative pressure, preferably whichever is greatest in magnitude.) Make note of the analog output voltage indicated on the voltage measuring device and compare this value to the correct full scale output voltage shown on the Calibration Certificate. If the indicated value is not equal to or within acceptable tolerance of the correct value, turn the sensitivity control until an acceptable reading is displayed. When this is accomplished, observe the digital pressure readout.

4-5. Linearity Adjustment

If the system will be used only to measure pressure within the highest 10%-25% of the full calibrated range, the above procedures may be adequate for field recalibration. Check this by applying one or two pressures within that portion of the full range that will be used and note the accuracy obtained. If the observed accuracy is inadequate, or if more of the full range will be used, use the Primary Pressure Standard to apply exact mid-range pressure to the system. Calculate the exact analog voltage output that should be present at mid-range pressure (for example, at mid-range pressure of 12.5 psig on a 0 to 25 psig system, the exact mid-range output would be 2.500 VDC if full range output is 0 to 5.000 VDC). Compare the observed mid-range analog output to the calculated value. If the difference is more than ± .1% of full scale for Model 304-1 and 339-1 systems or ± 0.05% for Model 350-1, (.005 VDC in the example used) adjust linearity using the control device furnished on the transducer circuit board (see Figure 2a, Models 304-1 and 339-1; and Figure 2b, Model 350-1, for location) to bring the reading within specification. This adjustment will improve linearity, but it will also affect the sensitivity adjustment made per Section 4-4. Recheck sensitivity, and, if necessary, repeat the steps described in Sections 4-4 and 4-5 one or more additional times to arrive at the optimum settings of the sensitivity and linearity controls.

4-6. Temperature Compensation

When recalibration is done at Setra, thermal stability of the system is also checked, and, if necessary, the temperature compensation controls are adjusted. Additional trimming adjustments may also be made. These steps require special equipment and expertise and it is not recommended that they be attempted in the field. If the system is to be used in varying operating temperature conditions and optimum thermal stability is required, the system should be returned to Setra for recalibration.

4-7. Meter Adjustments

The zero and sensitivity adjustment control devices referred to in the preceding sections are connected into the signal conditioning electronic circuit of the transducer and do not directly affect the zero and span accuracy of the meter. However, the adjustment procedures described in Sections 4-3 and 4-4, while primarily intended to correct for transducer offsets, also compensate for any small meter output shifts that may occur since the procedures are based on the digitally displayed measurement rather than on the analog voltage output of the transducer. Separate controls for making meter adjustments independent of the transducer are located beneath the front of the manometer case (see Fig. 5) but it is recommended that these be used only during recalibration, if at all.

-8. Final Test

After adjusting zero, sensitivity and linearity, it is advisable to check system accuracy at other point(s) in the range, either closer to the pressure(s) at which subsequent measurements will be made or spread through the full calibrated range of the system. In the latter case, additional checks are typically made at 20%, 40%, 60% and 80% of full range. To avoid hysteresis error, the readings should be taken both from low pressure to high pressure and from high pressure to low pressure, and averaged. Additional trial-and-error readjustments of sensitivity and linearity may be required to minimize full range error of the system. Note that combined linearity and sensitivity error may be positive (observed output greater than theoretical) in some portions of the range and negative (observed output less than theoretical) in other portions. The purpose of recalibration is not to eliminate all error through the entire range of the system, but rather to minimize error at the point or points within the range at which subsequent measurements will be made. A record of the error at each specific calibration point will allow subsequent measurements to be mathematically corrected for non-linearity error.

SERIES 300 DIGITAL PRESSURE MEASUREMENT SYSTEM

CALIBRATION CERTIFICATE

PRESSURE RANGE: 600-1100 M/BAR

LINE VOLTAGE: 220 VAC 50 HZ

DATE OF INSPECTION: 7-19-89

MANOMETER MODEL NO.: 350-1

TRANSDUCER MODEL NO.:

TRANSMITTER MODEL NO.:

READOUT MODEL NO.:

INSPECTOR: GF

OUTPUT @ 70° ±5 F*

Analog Output (☒ vdc ☐ mA)

Digital Display (M/BAR)

SERIAL NUMBERS ☐Manom-eter ☐Xducer ☐Xmitter ☐Readout	APPLIED PRESSURE 600 M/BAR	APPLIED PRESSURE 900 M/BAR	APPLIED PRESSURE 1000 M/BAR	1100 M/BAR
222393	6.0002	9.0012	9.9995	11.0014
	600.0	900.1	1000.0	1100.0

NOTES:

THIS CALIBRATION CERTIFIED PER NBS TRACEABLE STANDARDS

*NOTE: Installation or removal of pressure fitting may change zero output slightly. See operating instructions if zero output readjustment wanted.

OPTIONS

☐ Remote Sensitivity ☒ BCD Output ☐ Remote Cal

☐ Other

etra Systems, Inc.
45 Nagog Park, Acton, MA 01720 (617)263-1400

Sig D. MAIC. RETURN B. BOYER
22-102
Code 974

PRELIMINARY OPERATING INSTRUCTIONS
MODEL 361
DIGITAL PRESSURE GAGE
DIGITAL BAROMETER
WITH
SETRACERAM™ SENSOR

AUGUST 1980

1 Strathmore Road, Natick, Massachusetts 01760 (617)655-4645

Setra systems

All 24

PRELIMINARY OPERATING INSTRUCTIONS, MODEL 361 DIGITAL PRESSURE GAGE

SECTION

Setra systems INC

LIMINARY OPERATING INSTRUCTIONS MANUAL MODEL 361 DIGITAL PRESSURE GAGE

. GENERAL INFORMATION

1.1 Description

The Model 361 Digital Pressure Gage is a complete pressure measurement system designed to provide fast, convenient, and highly accurate measurements of absolute pressure. Each digital pressure gage contains a rear-mounted capacitance type pressure sensor, and inside the case there are complete signal conditioning electronics. A 4½ digit LED displays the pressure through the front panel cut-out.

This Digital System incorporates the new SETRACERAM™ high accuracy pressure sensor and new charge-balance amplifier as in the Model 270 Pressure Transducer, with the housing, digital circuits, and display, and power supply as in the Model 360 Digital Pressure Gage.

1.2 Limited Warranty. Reported on the enclosed blue bulletin.

1.3 Accessories Available

Connector - Part No. 360930.

Edge connector with five foot ribbon cable for BCD output, analog output, display test and hold.

1.4 Options Available

The digital pressure gage may be ordered at the factory with the BCD output option installed. When ordered with the BCD output option, the connector, Part. No. 360930 is automatically included as part of the option. The parallel BCD output is more fully described in Sections 3 and 4.

II. INSTALLATION

2.1 Initial Inspection

Carefully examine the digital pressure gage to see that it has not been damaged in shipment or abused by someone prior to your operation of the unit.

Check the label to be sure that it is set for the correct electrical power for your intended use.

Check to be sure that the pressure sensor housing is securely screwed to the back of the cabinet, and has not been damaged or loosened prior to your receipt of the unit. The aluminum hose fitting (pressure port) can be seen at the left side of the rear panel. The three nuts around it secure this housing to the inside of the rear panel.

With no pressure hose or tubing connected to the pressure port, plug in the electrical power cord to the correct operating voltage and observe the functioning of the unit. Turn the power switch on the back of the unit to the "On" position. The digital pressure display will immediately light up and continue to display 18888. This is the DISPLAY TEST MODE. This display should continue for 20 to 30 seconds after turn-on, and then the digits displayed should return to close to the normal display expected for the atmospheric pressure it is sensing.

Absolute pressure units: display will be the atmospheric pressure it is sensing, such as 1000 mbar or 14.7xx psia, 760.0 mmHg, etc..

Continue operation on the bench under examination for several hours, or until unit has reached room temperature.

Installation of Pressure Fitting: For units requiring pressures other than ambient, attach a flexible hose to the aluminum pressure port, using a hose clamp if desired. Do not apply force that could strain the port's coupling to the housing.

Apply a known pressure to the sensor and verify that the digital pressure gage is functioning correctly.

2.2 Claims

Damaged Goods. For reporting damage, see procedure in blue bulletin.

Return of Materials. For returning materials, see procedure in blue bulletin.

2.3 Preparation for Use

Your digital pressure gage should now be ready to use. CAUTION. Maximum pressure rating for the pressure range of your unit is reported on the Model 361 Advance Release. For best performance, do not exceed full rated pressure range.

2.4 Panel installation

Refer to the bulletin of the Model 361 Digital Pressure Gage for size cutouts for panel installation. Note these meet DIN standard 473.

Remove the carrying bale and remove the rubber feet from the base of the digital pressure gage.

Insert the digital pressure gage into the panel cutout from the front of the panel and leave it reasonably loose while you are connecting the pressure plumbing to the pressure sensor. Hard plumbing could of course cause strain on the sensor and must be carefully aligned. Flexible hose should be used instead of pipe.

We recommend that you plumb this very carefully, in order to minimize strain on the pressure port.

Finally, tighten the two panel mounting tabs from the front of the digital pressure gage.

2.5 Cleaning of digital display

The multi-digit display is covered with a plastic lens that can be damaged by many solvents. The manufacturer's recommendation is "cleaning solvents are Freon TF, Isopropanol, Methanol, or Ethanol. These solvents are recommended only at room temperature and for short time periods. The use of other solvents or elevated temperature use of the recommended solvents may cause permanent damage to the lens or display."

III. OPERATION AND CONTROLS

3.1 Introduction

The internal power supply has two items of note:

½ ampere fuse, type 3AG, in fuse clips on the printed circuit board.

Slide switch for operation on (nominal) 100 volts, 110 volts, 220 volts AC, 50 to 60 HZ.

The AC power goes through the fuse into the DC power supply, for driving the digital display and the other electronics of the system. The case is connected to line ground, which is in turn capacitively coupled to the DC circuit ground via a 0.05µf 50V capacitor.

The capacitance-type sensor is part of an analog sensing circuit operating at approximately 80KHz. The DC output signal from the pressure sensing circuitry is available as an analog signal on the edge connector at the rear of the unit, and the same DC signal is converted to the digital display (and BCD digital output that is available (optionally) at the edge connector).

For the first 20 to 30 seconds after turn-on, the display is in test mode at 18888 display.

There also is an output "hold" capability as reported in Section 4.1 of this manual.

3.2A Absolute Pressure Controls and Connectors

IMPORTANT - THESE INSTRUCTIONS APPLY TO ABSOLUTE PRESSURE UNITS ONLY, WHERE THE SYSTEM IS DESIGNED TO MEASURE THE FULL PRESSURE RANGE DOWN TO ZERO PRESSURE.
FOR BAROMETRIC PRESSURE UNITS SEE INSTRUCTIONS (3.2.B).

RETURNING PRODUCTS FOR REPAIR

If a Setra Systems product malfunctions during the warranty period, the unit should be first carefully checked to determine that the unit is, in fact, at fault. The factory should then be contacted to determine if it is necessary for the unit to be returned to the factory for inspection and repair, or if the customer may be able to further check his unit. In the event that it is necessary to return the unit to the factory, the problem should be described to Setra personnel and return authorization will be issued. The product should then be carefully packaged and shipped prepaid to SETRA SYSTEMS, INC. 1 Strathmore Road, Natick, MA 01760. Please include: 1) the name and phone number of the person to contact in case further information is required regarding the unit, and 2) complete shipping instructions for the return of the unit to your facility. Please allow 3 to 4 weeks after receipt at Setra for repair and return of the unit.

For "out of warranty repairs"*, the customer will be invoiced for repair charges. Please include (or send under separate cover) a purchase order to cover repair charges. Or, if an estimate is requested before issuance of a purchase order, please state so and provide the name and phone number of the person to be contacted with the estimate. Please follow the above instructions for obtaining return authorization and shipping the unit to Setra.

*"Out of warranty repairs" are defined as repairs to units which have been in the field more than one year from date of sale by Setra Systems, or repairs to units which, although less than one year old, may not be considered under warranty, as stated in Setra Systems, Inc. published "Limited Warranty".

SERIES 360 DIGITAL PRESSURE GAGE

CALIBRATION CERTIFICATE

GSFC 284396 2/1/82

MODEL NO: 361, SERIAL NO: 46248

PURCHASED BY: Goddard Space Flight Center

PURCHASE ORDER NO: S-89757-B SETRA ORDER NO. AE032

CALIBRATED PRESSURE RANGE: 700-1100 mBAR

PROOF PRESSURE (1): 30 PSIA

LINE VOLTAGE: 117 VAC 60 Hz

DATE OF INSPECTION: 1-25-82 INSPECTOR SC

CALIBRATION DATA

Each Series 360 Pressure Gage is calibrated in Setra's Calibration Laboratory immediately prior to shipment using a primary pressure standard traceable to the National Bureau of Standards. The calibration data applicable to the Gage identified above is as follows:

APPLIED PRESSURE (mBAR)	DIGITAL (2) DISPLAY (mBAR)	ANALOG (2) VOLTAGE (VOLTS DC)
700	700.0	+.0009
1100	1100.0	2.4607

(1) The maximum pressure that may be applied without changing performance beyond specification.

(2) At 70°F±5°F

OPTIONS:

☑ Parallel BCD Output

☑ P/N 360930 (Edge connector/Ribbon Cable)

☐ Other _____

1 Strathmore Road, Natick, Massachusetts 01760 (617)655-4645

Setra systems INC

ZERO ADJUST.

A zero adjust control is conveniently located on the front panel, and is reached by inserting a small screw-driver into the slotted screw that is recessed behind the hole.

OTHER ADJUSTMENTS.

There is a black tape on the right side of the case, when looking at the front of the unit. Removal of this tape allows access to the various circuit adjustments through holes in the case, as shown in attached drawing. The tape should be replaced with Scotch type 472 tape or equivalent.

If in checking full scale output, it is found that the display error is greater than ±0.1%FS, several adjustments are available. Please keep in mind that the analog signal will not be perfectly set to the digital reading, as there are A/D errors. These errors are minimized, but do not attempt to make both "perfect". Our final calibration gives best digital output. If adjustments are needed:

CAUTION: Use a high accuracy dead-weight pressure calibration source.

By word of explanation, the analog circuit gain is factory-set for an output of 0 to 5.000 volts DC, measured into a 1 Megohm (or greater) load. If output sensitivity error is greater than ±0.1%FS (±5 mv DC), adjust the Analog Sensitivity for a full scale output of 0 to 5.000 volts DC (±5 mv).

If the pressure display now is in error beyond ±0.1%FS, adjust the Digital Sensitivity control to give the specific digital full scale output. This control only affects the digital display (and BCD output); it does not affect the analog output. Note that if scaling is to full 19999, there may be a slight error beyond 19993. Therefore, for highest accuracy in calibration it may be best to do the high pressure adjustment at some known pressure slightly below 19993, such as perhaps at 2% below full scale.

The Linearity has been adjusted at the factory using a high accuracy pressure source with calibration traceable to the NBS, so it is not recommended that the Linearity adjustment be touched. The Linearity Adjust is in the analog circuit. Changing of the position of the Linearity Adjust will change the analog full scale output, and you will need to go back and readjust the Analog Sensitivity again.

TABLE I

ANALOG OUTPUT VOLTAGES FOR VARIOUS PRESSURE RANGES, MODEL 361.

PRESSURE	PRESSURE RANGE AND DIGITAL DISPLAY	ANALOG OUTPUT* RELATIVE TO OUTPUT RETURN	NOMINAL ANALOG OUTPUT** RELATIVE TO ANALOG GROUND
Absolute	All Ranges	0 to 5.000V (±5.00 mV)	
Barometric	800 to 1100 mBar	0 to 1.613V (±1.61 mV)	4.300 to 5.913 V
	11 to 16 psia	0 to 1.954V (±1.95 mV)	4.300 to 6.254 V
	600 to 825 mmHg	0 to 1.613V (±1.61 mV)	4.300 to 5.913 V
	x to y (any units)	0 to $4.3\left(\frac{y}{x}-1\right)$ V ($\pm .0043\left(\frac{y}{x}-1\right)$ mV)	4.300 to $4.3\left(\frac{y}{x}\right)$ V
	22 to 32 in.Hg (4 digits only)	0 to 1.955V (±1.95 mV)	4.300 to 6.255 V

* Calibrated into 50Kohm load; operable into loads of 5000 ohms or greater.

** The 4.300V may vary ±several millivolts from unit to unit.

NOTE. Analog output voltages typically are measured between the Analog Output (Contact 35) and the Analog Return (Contact 37) on the edge connector.

The Analog Return is 4.3VDC above the Analog Ground (Contact 32).

FOR BAROMETRIC PRESSURE UNITS: The Analog Output (Contact 35) with respect to Analog Ground (Contact 32) projects linearity to zero VDC at true absolute zero pressure. Analog output may be measured with respect to Analog Return or Analog Ground, but not both simultaneously.

3.2. B Barometric Pressure Controls & Connectors

IMPORTANT - These instructions apply to barometric pressure units only, where the system is designed to measure pressures about ambient atmosphere. For absolute pressue units, measuring to full vacuum, refer to instructions (3.2A).

ZERO ADJUST.

A zero adjust control is conveniently located on the front panel, and is reached by inserting a small screw-driver into the slotted screw that is recessed behind the hole. This control adjusts true analog zero output, but does not adjust a zero display. It will adjust the bottom -of-scale display reading. For example, 800 mbar for a unit with 800 to 1100 mbar calibration.

OTHER ADJUSTMENTS.

There is a black tape on the right side of the case, when looking at the front of the unit. Removal of this tape allows access to the various circuit adjustments through holes in the case, as shown in attached drawing. The tape should be replaced with Scotch type 472 tape or equivalent.

If in checking full scale output, it is found that the display error is greater than ±0.1%FS, several adjustments are available. Refer to Table 1 for Full Scale voltage for your barometric unit, and be sure to measure relative to Output Return. Please keep in mind that the analog signal will not be perfectly set to the digital reading, as there are A/D errors. These errors are minimized, but do not attempt to make both "perfect". Our final calibration gives best digital output. If adjustments are needed:

CAUTION: Use a high accuracy dead-weight pressure calibration source.

By word of explanation, the analog circuit gain is factory-set for an output according to Table 1, measured into a 1 Megohm (or greater) load. If output sensitivity error is greater than ±0.1%FS (±5 mv DC), adjust the Analog Sensitivity for the full scale output applicable in Table 1.

If the pressure display now is in error beyond ±0.1%FS, adjust the Digital Sensitivity control to give the specific digital full scale output. This control only affects the digital display (and BCD output); it does not affect the analog output. CAUTION: This adjustment will affect the bottom-of-scale reading as well as the Full Scale reading, so caution must be observed to avoid unnoticed interaction of adjustments. Note that if scaling is to full 19999, there may be a slight error beyond 19993. Therefore, for highest accuracy in calibration it may be best to do the high pressure adjustment at some known pressure slightly below 19993, such as perhaps at 2% below full scale.

The Linearity has been adjusted at the factory using a high accuracy pressure source with calibration traceable to the NBS, so it is not recommended that the Linearity adjustment be touched. The Linearity Adjust is in the analog full scale output, and you will need to go back and readjust the Analog Sensitivity again.

IV. ELECTRICAL SIGNALS ON THE I/O CONNECTOR, INCLUDING ANALOG AND PARALLEL BCD.

4.1 Digital signals

BCD output option (factory installed) will have the following form: each of the five digits will have four parallel BCD data lines and one enable line, all CMOS or LS-TTL compatible. When the enable line for a digit is LOW, that digit's BCD lines will be enabled. If HIGH, the BCD lines will be in a high impedance state, and may be bussed together with other data lines. The Most Significant Digit (MSD) has only three data lines: 0/1, Sign, and Data Valid. Thus, at least five modes of operation are possible:

1. All digits permanently enabled - parallel BCD is always present on the connector.

2. For connection to a 4-bit data bus all digits may be tied together, and the five digits will appear in whatever sequence the enables are strobed.

3. For connection to an 8-bit data bus, the enables may be strobed in pairs.

4. For connection to a 16-bit data bus, first four enables may be strobed, then the other one.

5. Two or more Model 361 Gages may be connected together on a single bus for connection to a computer.

ENABLES

In order to read the BCD data of a particular digit, the enable line for that digit must be LOW. As the five enable lines all have internal 10KΩ pullup resistors, no connection to these lines is equivalent to a HI level. No digits, all digits, or any number of digits may be enabled simultaneously.

DISPLAY HOLD

In normal operation, the data will change every 400 ms. This continuous conversion may be stopped if desired. The DISPLAY HOLD line will prevent further conversions while it is held in a LOW state, for example, by connecting edge connector contacts 2 and 30. The conversion currently in progress will be completed, however. This line may be used, for example, to synchronize the Model 360 with a slower external data recorder. If unconnected, it will read as HI, and continuous conversions will be performed.

DATA VALID

If the Most Significant Digit (MSD) is enabled, the DATA VALID output may be read. This is LOW for 100ms every 400 ms cycle. During this time, the data are guaranteed valid. Either the leading or the trailing edge may be used to clock data into an external device. In the event of a pressure over-range condition, the DATA VALID output will remain continuously high.

SIGN

When the MSD is enabled and DATA VALID IS LOW, this output indicates the polarity of the reading: a HI will indicate a negative reading, and a LOW a positive reading.

1,2,4,8,...8000,10000

These are the parallel BCD outputs, active HI. Each is enabled by the appropriate digit enable line. They are all valid while DATA VALID is LOW.

DIGITAL GROUND

All digital signals are measured with respect to this ground. It is connected internally to ANALOG GROUND. Either Analog Ground or Digital Ground (or neither) may be connected to earth ground, but if both are connected to earth ground externally, a ground loop error may result.

SIGNAL LEVELS

All digital outputs are CMOS 3-state. They are capable of driving CMOS or two LS-TTL loads. "HI" is 4.5 to 5.0 volts; "LO" is 0.0 to 0.5 volts. Inputs are CMOS or LS-TTL compatible, with 10KΩ pullups to 5V. Drivers must sink one LS-TTL load, plus the resistor.

DISPLAY TEST

This input may be connected to DIGITAL GROUND to force the display to read " -18888". This input serves as a segment test, and is automatically held LOW for about 30 seconds after turn-on.

+5V

Up to 30mA may be drawn from this output. If needed, DIGITAL GROUND should be used as the return.

4.2 ANALOG SIGNALS

The ANALOG OUTPUT described in Table 1 is measured with respect to the commond mode voltage, (or "Out Return"). It is calibrated with a 1 Megohm load but it will drive as much as 5Kohm load. Although the analog and digital grounds are connected internally, analog measurements must be made with respect to the analog ground or a serious loss of accuracy may result. The ANALOG GROUND is floating with respect to both the power lines and the power ground. It should be connected to ground at an external data recorder, if one is used. It may be left floating otherwise.

CALIBRATION SIGNALS

The analog signals on the edge connector marked with asterisks are for factory calibration use only. Nothing should be connected to these points when the Setra-supplied connector and ribbon cable is used: the wires in the cable corresponding to these calib ration signals must be left unconnected at the user end.

V. PERFORMANCE CHECK AND CALIBRATION ADJUSTMENTS

5.1 Introduction

On absolute pressure units, the zero can be reset only by having a high vacuum on the pressure sensor. On barometric pressure units, a high accuracy reference must be used to set the bottom-of-range value at partial vacuum, according to the calibrated pressure range of your Model 361.

For all other adjustments, you will need an accurate pressure source, calibrated to better than twice the accuracy of the digital pressure gage specifications.

5.2 Test equipment

Use of a high accuracy dead weight tester is recommended.

Calibration should be made at constant temperature, preferably at a well-controlled temperature such as in a calibration laboratory.

5.3 Performance check

Zero.

Set the zero at the correct zero output (gage or absolute pressure).

Full Scale.

Check full scale output. If within ±0.1% of the known pressure, we suggest that you leave the digital pressure gage alone and make no further adjustments. You may wish to check the pressure display at several intermediate points, but again, do not turn any adjustments as long as the unit is within the ±0.1% full scale accuracy.

5.4 Adjustments

Recognize that if you adjust the full scale output you may throw the output in mid-range pressures beyond the ±0.1% full scale accuracy.

I. TROUBLESHOOTING

6.1 Overpressure

Overpressure is a common abuse to which the digital pressure gage may be subjected. This may damage the pressure sensor. If the unit has been so abused, it will be apparent in a zero shift, or unit failure. If this zero shift is adjustable to zero from the front panel adjustment screw, the sensor probably has not been damaged, and you may continue to use the Digital Pressure Gage.

If the unit has been overpressured to the extent that the zero can no longer be reset to zero, it is probable that the sensor has been damaged and that you should consult the factory for repair.

6.2 Blown Fuse

If the digital display does not light up it is most likely that the AC power fuse has blown. (Probably from aging). Replace it with a ½ ampere fuse type 3AG.

CAUTION

Be sure the power plug has been removed from the AC power source before opening the unit.

To open the Model 361, loosen the 2 socket capscrews in the rear panel (the upper screws, not the lower screws).

Carefully slide the rear plate-electronic assembly outward, noting that the pc board slides in tracks affixed to the interior walls of the case.

CAUTION. Do not touch or otherwise change or disturb the wire connecting the sensor to the pc board.

When reinserting the electronic assembly into the case, be sure:

1. The electrical power is off by removing the power plug from the AC power source, because contact of certain pc board conductors to the case could damage the circuit.

2. Be sure to guide the front end of the assembly into the slides properly, and carefully guide the digital display into the window on the front face of the case.

If there is any further fuse burnout, we would suggest that the digital pressure gage be sent back to Setra for repair. Contact our Customer Service Department in advance, as in (2.2), Claims, above.

BCD Output

BCD Output can malfunction without damaging the rest of the digital pressure gage. Contact the Setra Repair Department if you suspect malfunction.

Grounded Analog Output

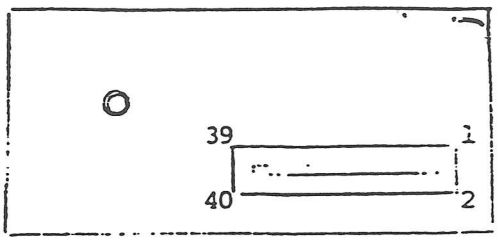
If you are connecting the analog output to other analog instrumentation via pins 35 and 37 on the edge connector, the output (pin 35) must not be grounded, but must go into a 5K ohm load or greater. If this output is grounded, it might result in a zero reading on the digital pressure display. Remove the grounded analog output and the unit should revert to satisfactory operation.

Unsatisfactory Pressure Display

A very dim or jittery display would indicate that the gage is not getting its correct AC power excitation. The voltage may be low, or perhaps there is a local brownout condition. Or possibly the voltage switch inside the gage may be set for the wrong voltage.

ADJUSTMENTS - MODEL 361 DIGITAL PRESSURE GAGE

CAUTION: DO NOT TOUCH ANY OTHER ADJUSTMENTS.
FACTORY-SET. TURNING VOIDS WARRANTY.



TOP		BOTTOM		
1.	Digital Ground	2.	DISPLAY HOLD	
3.	100	4.	Units enable	
5.	200	6.	1	
7.	400	8.	2	
9.	800	10.	4	
11.	Hundreds enable	12.	8	
13.	Thousands enable	14.	Tens enable	
15.	1000	16.	10	BCD
17.	2000	18.	20	
19.	4000	20.	40	
21.	8000	22.	80	
23.	MSD enable	24.	10,000	
25.	Data Valid	26.	Sign	
27.	Display Test	28.	+5V	
29.	+ds (*)	30.	Digital Ground	
31.	-ds (*)	32.	Analog Ground	
33.	VE (*)	34.	Calibration Output (*)	ANALOG + TEST/CALIBRATION
35.	Analog Output	36.	+dz (*)	
37.	Analog Output Return	38.	-dz (*)	
39.	FB (*)	40.	V_t (*)	

NOTES:

1. As viewed from the rear, signals 1 and 2 are located nearest the right side of the meter; signals 39 and 40 are located near the center of the meter.

2. Signals marked (*) are for factory calibration only, and should not be terminated or otherwise loaded by the user of the instrument.

3. Matching connector with 5 feet of 40-conductor ribbon cable may be purchased from Setra as part number 360930.

4. If the BCD option is not installed, the parallel BCD outputs and the enable inputs will have no internal connections (except for 100Ω pullups to +5V on the enables).

5. If it is desired to use only two or three signals on this connector, such as analog only, it may be preferable to hardwire to an edge connector, with solder tabs; Viking Connector #3VH20/1JN12 or equivalent may be used. To insure proper orientation, a polarizing key (Viking #091-0071-000 or equivalent) should be inserted between the (31-32) and (33-34) contact pairs.

EDGE CONNECTOR SIGNALS

MODEL 361 DIGITAL PRESSURE GAGE

APPENDICE B. SOFTWARE DI GESTIONE.

Partendo da un programma base, gia' presente nel FS, si e' sviluppato un nuovo programma funzionante con la versione attuale del MET SENSOR. Questo, oltre a garantire le funzioni svolte dalla versione originale FS, offre alcune possibilita' in piu', come il SET ed il RESET della MAT, la rimozione degli stati di allarme, la rilettura degli ultimi parametri misurati ed immagazzinati in memoria (MAT MODULE FUNCTIONS), e la visualizzazione di tutti i parametri supplementari (vento, DVM, ecc), sempre compatibilmente con le specifiche FS.

Di seguito viene riportato il listato del programma utilizzato, come segmento di QUIKR, nella gestione del MET SENSOR tramite FS.

```
FTN4,X
C@WXMET
C
      SUBROUTINE WXMET(IP),AUTOMATIC WEATHER MODULE C#900926:08:21#
C
C 1.1.   WX controls the weather module
C
C     INPUT VARIABLES:
C
      DIMENSION IP(5)
C        IP(1)  - class number of input parameter buffer.
C
C     OUTPUT VARIABLES:
C
C        IP(1) - class
C        IP(2) - number of records
C        IP(3) - error
C        IP(4) - who we are
C
C 2.2.   COMMON BLOCKS USED
C
      INCLUDE #FSCOM::FS
C
C 2.5.   SUBROUTINE INTERFACE:
C
C     CALLING SUBROUTINES:
C
C     CALLED SUBROUTINES: GTPRM,ICHAR
C
C 3.  LOCAL VARIABLES
C
C        NCHAR  - number of characters in buffer
C        IMMODE - mode for MAT
C        ICH    - character counter
C        IC     - code index for input parameters
C        NDECI  - number of decimals for out param.
C        OLDBAR - flag for ver. of barometer in use. 1= old version.
      DIMENSION IBUF2(40),IBUF(45),IBUF1(10)
C               - input & output buffers
      DIMENSION LCHAR(9)
C               - array for MET strobes.
```

```
C       DIMENSION IPARM(2)
C                 - parameters returned from GTPRM
        DIMENSION VALUE(8)
rbturn buf.       - array for the processed value extract from
        DIMENSION NDECI(8)
C                 - array for number of out decimal
        DIMENSION IREG(2)
        INTEGER OLDBAR
C                 - registers from EXEC calls
        EQUIVALENCE (REG,IREG(1))
C
C 4.  CONSTANTS USED
C
C 5. INITIALIZED VARIABLES
C
        DATA ILEN/90/,ILEN2/80/
,2H; /DATA IL/10/,LCHAR/2H? ,2H+ ,2H! ,2H% ,2H( ,2H- ,2H) ,2H.
        DATA NDECI/1,1,1,0,1,1,3,0/
C  Flag for barometer version in use (1=old version).
        DATA OLDBAR/0/
C
C 6.  PROGRAMMER: NRV
C     LAST MODIFIED:  880513
C     WHO    WHEN  WHAT
C     GMM    880513 Modified for Medicina weather module
sensorGMM    881122 Modified to insert software limit for hum.
wind GMM   900918 Increased time between measurements.Inserted
MET           direction on DVM2.Arranged factor scale for new
C      SENSOR DAS version.User transfer control for new SETRA.
C# LAST COMPC'ED  900926:08:21 #
C
C     PROGRAM STRUCTURE
C
C     We have been requested to read the WX module.
C
      IC=4
      ICLCM = IP(1)
      IF (ICLCM.NE.0) GOTO 10
      IERR = -1
      ICLASS = 0
      NREC = 0
      GOTO 990
 10   REG = EXEC(21,ICLCM,IBUF2,-ILEN2)
      NCHAR = IREG(2)
      IEQ = ISCNC(IBUF2,1,NCHAR,75B)
C                   Scan for "="
      IF (IEQ.EQ.0) GOTO 200
the          If user doesn'tspecify any parameter, go to read
C                   out temp., the RH and pressure.
C
C.Read the input parameter and prepare the buffer to be sent
C      MATCN.
C
      IF (ICHCM(IBUF2,IEQ+1,1H?,1,1).EQ.0) GOTO 400
```

```
C                    An '?' means a request of common param..
C
  110 IF (ICHCM(IBUF2,IEQ+1,LTSRS,1,ILENTS).EQ.0) GOTO 600
C                           TEST/RESET MAT standard command
C
      IF (ICHCM(IBUF2,IEQ+1,LALRM,1,ILENAL).EQ.0) GOTO 610
C                           ALARM MAT standard command
C
      ICH=IEQ+1
  120 DO 130 I=1,5
      IC=IC+1
      CALL GTPRM(IBUF2,ICH,NCHAR,0,PARM)
      IF (ICHCM(PARM,1,4HALL ,1,3).EQ.0) GOTO 140
      LCHAR(IC)=-99
      IF (ICHCM(PARM,1,4HTEM1,1,4).EQ.0) LCHAR(IC)=2H-
      IF (ICHCM(PARM,1,4HTEM2,1,4).EQ.0) LCHAR(IC)=2H)
      IF (ICHCM(PARM,1,4HDVLM,1,4).EQ.0) LCHAR(IC)=2H.
      IF (ICHCM(PARM,1,4HWNDD,1,4).EQ.0) LCHAR(IC)=2H;
      IF (ICHCM(PARM,1,4HWNDS,1,4).EQ.0) LCHAR(IC)=2H(
      IF (ICHCM(PARM,1,4H,   ,1,2).EQ.0) IC=IC-1
      IF (LCHAR(IC).EQ.-99) GOTO 980
  130 CONTINUE
      GOTO 200
  140 IC=9
C
C2.Fill up a req.for the input par.: + (temp), % (humidity),
C     and ! (pressure) are the default values.
C
200   IBUF(2) = 2HWX
      NCH = 5
      NREC = 1
      IBUF(1) = 8
      DO 210 I=2,IC
        ICLASS = 0
        IBUF(3) = LCHAR(I)
        CALL EXEC(20,0,IBUF,-NCH,2HFS,0,ICLASS)
        CALL EXEC(23,6HMATCN ,ICLASS,NREC)
        CALL RMPAR (IP)
        IF (LCHAR(I).NE.2H! .OR.OLDBAR.EQ.1) GOTO 205
            ICLASS=0
            IBUF(3)=2H
            CALL EXEC(20,0,IBUF,-NCH,2HFS,0,ICLASS)
            CALL EXEC(23,6HMATCN ,ICLASS,NREC)
            CALL RMPAR (IP)
            ICLASS=IP(1)
            IF (IP(1).NE.0) CALL EXEC (21,ICLASS,IBUF1,-10)
            IBUF(3)=2H/
            GOTO 206
205     CALL SUSP(2,1)
        IBUF(3) = LCHAR(1)
206     ICLASS=0
        CALL EXEC(20,0,IBUF,-NCH,2HFS,0,ICLASS)
        CALL EXEC(23,6HMATCN ,ICLASS,NREC)
        CALL RMPAR(IP)
```

```
        ICLASS=IP(1)
        IF (IP(3).GE.0) GOTO 207
C
C   If MET is down try to get informations manually.
C
        IP(1)=ICLCM
        CALL WXMAN(IP)
        RETURN
207     REG = EXEC(21,ICLASS,IBUF((I-1)*5+1),-IL)
210   CONTINUE
C
C
C 3. Now dec.the message to get temp, humid, pres. and others.
C     The temperature buffer:
C                    WX000atttt   (in degrees C*10)
C     where a=B for t>0, a=C for t<0
C     The humidity buffer:
C                    WX00000hhh   (in percent*10)
C     The pressure buffer:
C                    WX000Ppppp   (in mbars*10)
C     The temperature # 1:
C                    WX000atttt   (in degrees *10)
C     The temperature # 2:
C                    WX000atttt   (same as above)
C     The voltage of DVLM  :
C                    WX000avvvv   (in volts *1000)
C     The wind direction   :
C                    WX00000ddd   (in degrees)
C     The wind speed     :
C                    WX0000ssss   (in Km/h *10)
C     If the response is FFFFF, the instrument is down.
C     After conversion, store Text.,Press,RH in common.
C
      DO 300 I=2,IC
      FACT=10.
C
C  For DVLM the f.scale is 1000, 1 for WNDD, 10 the others.
C
      IF (LCHAR(I).NE.2H. ) GOTO 302
      FACT=1000.
      GOTO 303
  302 IF (LCHAR(I).NE.2H; ) GOTO 303
      FACT=1.
  303 VALUE(I-1)= DAS2B(IBUF,I*10-3,4,IERR)/FACT
1)    IF (ICHCM(IBUF,I*10-4,1HC,1,1).EQ.0) VALUE(I-1)=-VALUE(I-
1)+1001F (ICHCM(IBUF,I*10-4,1H1,1,1).EQ.0) VALUE(I-1)=VALUE(I-
      IF (IERR.EQ.0) GOTO 300
      IERR = -202
      ICLASS=0
      NREC=0
      GOTO 990
300   CONTINUE
      TEMPWX=VALUE(1)
      PRESWX=VALUE(2)+.001
```

```
      HUMIWX=VALUE(3)
      IF (HUMIWX.GT.98.5.OR.HUMIWX.LT.10.0) HUMIWX=1.0E20
C  Software limit for humidity.
C
C
C4.Finally, code up the mess.for BOSS and display and log.
C
400   NCH = ICHMV(IBUF2,3,2H/ ,1,1)
      NCH = NCH + IR2AS(TEMPWX,IBUF2,NCH,5,1)
      NCH = MCOMA(IBUF2,NCH)
      NCH = NCH + IR2AS(PRESWX,IBUF2,NCH,6,1)
      NCH = MCOMA(IBUF2,NCH)
      NCH = NCH + IR2AS(HUMIWX,IBUF2,NCH,5,1)
      IF (IC.EQ.4) GOTO 420
      DO 410 I=4,IC-1
      NCH=MCOMA(IBUF2,NCH)
      NCH=NCH+IR2AS(VALUE(I),IBUF2,NCH,5,NDECI(I))
 410  CONTINUE
C
420   ICLASS = 0
      NCH = NCH - 1
      CALL EXEC(20,0,IBUF2,-NCH,2HFS,0,ICLASS)
      IERR=0
      NREC = 1
      GOTO 990
C
980   IERR=-201
990   IP(1) = ICLASS
      IP(2) = NREC
      IP(3) = IERR
      IP(4) = 2HQX
999   RETURN
C
C  6. Process an TEST/RESET or ALARM request.
C
600   IMMODE=6
      GOTO 620
610   IMMODE=7
620   NREC=1
      IBUF(1)=IMMODE
      IBUF(2)=2HWX
      ICLASS=0
      CALL EXEC(20,0,IBUF,-4,2HFS,0,ICLASS)
      CALL EXEC(23,6HMATCN ,ICLASS,NREC)
      CALL RMPAR(IP)
      RETURN
      END
```

APPENDICE C. MODIFICHE AL CIRCUITO STAMPATO.

A causa di vari errori piu' o meno evitabili, si e' reso necessario effettuare alcune modifiche al circuito stampato denominato MET SENSOR BOARD, che vengono riassunte qui di seguito:

* 1 Collegare il piedino a massa di R15, con l'ingresso OUT-L della morsettiera delle alimentazioni, in modo da ridurre al minimo le cadute di tensione.
  Fare lo stesso per R37, R43 R18,R32.

* 2 Tagliare l'ingresso REF-H al pin 26 dell'U11 (DG507). Il segnale non deve essere di 2.37V ma di 237mV in modo che possa essere visualizzato dal DVM. Montare quindi un partitore volante da 1/10 costituito da due resistenze di 100K (.1%), e 11.1K(.1%), montate in serie fra REF-H (100K) e OUT-L (11.1K) col punto in comune sul pin 26 di U11. Collegare poi il pin a massa di R = 11.1K con OUT-L sulla morsettiera delle alimentazioni, in modo da ridurre la caduta di tensione.

* 3 Mettere ad OUT-L (massa) il pin 20 di MS6, utilizzato come shermo per il cavetto del sensore RT.

* 4 Collegare il catodo del'U12 (LM336) con il capo lasciato libero di R6 (eventualmente anche R13).

* 5 Invertire l'U12 (LM336), catodo con anodo.

* 6 Invertire le alimentazioni che vanno ai rele' K1 e K2.In pratica i pin 14 vanno a +5V mentre i pin 1 vanno ai buffer ULN2803.

* 7 Tagliare il segnale WS-H che parte da R33,C18,U13B-7,e collegarlo al punto di unione di R38 con R41

* 8 Collegare una resitenza di 75K fra i pin 7 e 1 di U9B (LM339) cosi' da creare un'isteresi sul comparatore di RT.

* 9 Aggiungere una resistenza di pull-down (1K) fra MS3 pin 24 e massa.

* 10 Aggiungere sulla scheda o sul tumblewheel, 3 resistenze di pull-down da 1K ognuna, collegate fra le tre linee A0,A1,A2 e massa.

* 11 Collegare a massa il pin 15 di U5.

* 12 Collegare il pin 4 di U2B con U2A-3, e MS3-4.

* 13 Tagliare la pista che unisce MS4-24 con BJ2-34. Unire MS4-24 con BJ2-36 e BJ2-37.

* 14 Collegare A0 (U5-4) con U14-4, A1 (U5-7) con U14-6 e A2 (U5-9) con U14-6. Tagliare le piste che uniscono U3-9 con U7-3 e U6-1 sui pin U7-3 e U6-1,

U3-7 con U6-2 e U6-10 sui pin U6-2 e U6-10, U3-6 con U7-1 e U6-9 sui pin U7-1 e U6-9. Collegare quindi U14-15 con U6-1 e U7-3, U14-14 con U6-2 e U6-10, U14-13 con U7-1 U6-9.

* 15 Collegare a +5V U3-4.

* 16 Il pin 6 di MS5 e il RETURN della +24V vanno collegati ad OUT-L.

* 17 Tagliare la pista che unisce U6-1 con U4-2, ed unire U3-9 con U4-2.