Modificación del OL del Rx.S/CH del Radiotelescopio de 40m del CAY

I.Malo, J.A.L.Pérez, D.Cordobés, J.A.Abad, J.Fernández,
J.A.L. Fernández.

IT OAN 2009 - 3

Centro Astronómico de Yebes
Apdo. 148. 19080 Guadalajara. SPAIN
Phone: +34 949 29 03 11 ext.208
Fax: +34 949 29 00 63

Sustitución del oscilador fijo a 2555MHz del receptor CH por un sintetizador en la banda 2.5-2.6GHz, con paso 10Hz.

Fecha de creación miércoles, 25 de marzo de 2009
Fecha de guardado lunes, 30 de marzo de 2009
Fecha de impresión martes, 31 de marzo de 2009

Indice

1 Introducción. 4
2 Submódulo OL del Rx. S/CH. 5
  2.1 Sintetizador. 5
  2.2 Control del sintetizador. 5
    2.2.1 Conexiones del sintetizador. 6
    2.2.2 Tarjeta ADR101 para el control serie del sintetizador 6
    2.2.3 Alimentación 7
3 Referencias 8
Anexo A. Sintetizador: TD-BBS-2330, Herley CTI. 9
Anexo B. Fuente de +5V. 13
Anexo C. Tarjeta ADR101. 14

1 Introducción.

En la observación de líneas espectrales en antena única se debe compensar el corrimiento al rojo de la línea observada, producido por diversos motivos:

1. El movimiento del propio objeto celeste.
2. El movimiento de rotación y translación de la Tierra.

Cuyos valores máximos, que solo se darán en algunas direcciones, son los siguientes:

- por rotación de la Tierra: $-0.5 < V < 0.5$ km/s (Anuario pg.333)
- por traslación de la Tierra alrededor del Sol: $-30.3 < V < 30.3$ km/s (Anuario pg.183)
- por movimiento del Sol respecto del LSR: $-20 < V < 20$ km/s (Anuario pg.128)
- movimientos en la galaxia respecto del LSR: $-280 < V < 280$ km/s

También se ha de tener en cuenta la anchura entre nulos de la línea a observar, como uno de los parámetros que fijan la banda instantánea mínima.

En la observación continua durante 12 horas de UNA sola radiofuente galáctica o extragaláctica, las variaciones que son significativas son sólo las debidas a los dos movimientos de la Tierra, las demás se pueden considerar constantes:

- Por rotación de la Tierra, a la latitud de Yebes, la variación total en 12 horas no excederá 0.7 km/s.
- Por traslación de la Tierra la variación total en 12 horas no excederá 0.3 km/s.

Por supuesto, las correcciones serán distintas en días distintos o si se cambia de radiofuente, y sobretodo en este caso, pues la proyección de tal velocidad sobre la dirección en que se encuentra cada radiofuente puede ser muy distinta.

Estas consideraciones son relevantes en la observación de cualquier fuente en que se necesite una precisión mejor que 1 km/s en la velocidad, y mucho más en aquellos casos de líneas espectrales estrechas. También es relevante en la observación de cualquier astro en el sistema solar, en cuyo caso hay que considerar también la velocidad de tal astro.

En un futuro se tendrán anchos de banda de resolución del backend de 2KHz por lo que el sintetizador debería moverse en saltos de 0.2 KHz o menores, para que el salto no se aprecie al repetir la observación o a lo largo de la misma. La velocidad máxima a corregir en 12h será de 1km/s, que a 3GHz supone un desplazamiento en frecuencia de 10KHz.

Por tanto, para no limitar las necesidades del receptor CH, se decide sustituir el oscilador fijo (Ref.2) por un sintetizador cuya resolución en frecuencia es de 10Hz, y el ancho de banda de sintonía de 100MHz de 2.5-2.6GHz.

2 Submódulo OL del Rx. S/CH.

El submódulo OL del receptor S/CH, tras las modificaciones, queda del siguiente modo:

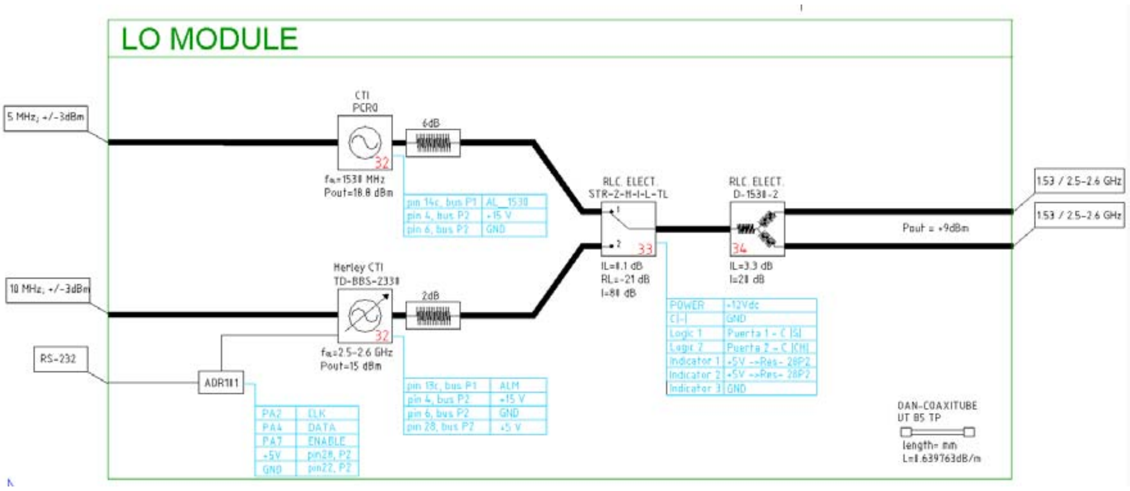

LO MODULE
5 MHz; +/-3dBm
10 MHz; +/-3dBm
RS-232
CTI
PCRO
fo=1530 MHz
Pout=18.8 dBm
6dB
32
pin 14c, bus P1 | AL_1530
pin 4, bus P2 | +15 V
pin 6, bus P2 | GND
Herley CTI
TD-BBS-2330
fo=2.5-2.6 GHz
Pout=15 dBm
2dB
ADR101
PA2 | CLK
PA4 | DATA
PA7 | ENABLE
+5V | pin28, P2
GND | pin22, P2
pin 13c, bus P1 | ALM
pin 4, bus P2 | +15 V
pin 6, bus P2 | GND
pin 28, bus P2 | +5 V
RLC ELECT.
STR-2-M-I-L-TL
1
2
33
IL=0.1 dB
RL=-21 dB
I=80 dB
POWER | +12Vdc
C(-) | GND
Logic 1 | Puerta 1 - C (S)
Logic 2 | Puerta 2 - C (CH)
Indicator 1 | +5V -->Res- 28P2
Indicator 2 | +5V -->Res- 28P2
Indicator 3 | GND
RLC ELECT.
D-1530-2
34
IL=3.3 dB
I=20 dB
Pout = +9dBm
153 / 2.5-2.6 GHz
153 / 2.5-2.6 GHz
DAN-COAXITUBE
UT 85 TP
length= mm
L=0.639763dB/m

Figura 1. Submódulo OL, rx S/CH.

El esquema del submódulo OL previo se encuentra en Ref.1 y Ref.2.

2.1 Sintetizador.

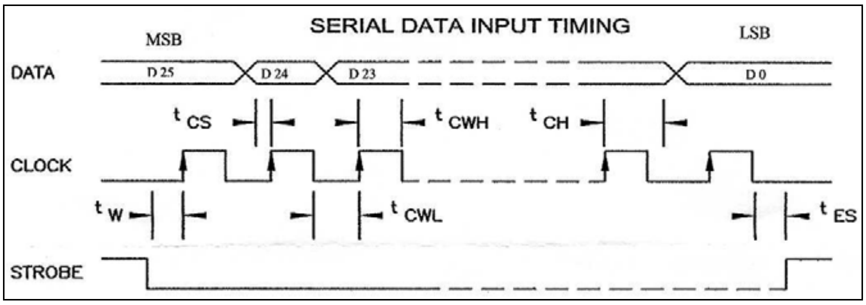
El sintetizador elegido es el **TD-BBS-2330**, del fabricante **Herley CTI.** La banda de sintonía es de 2.5-2.6 GHz en pasos de 10Hz (aunque el sintetizador tiene una banda de 2.1-2.6GHz). La hoja de características del sintetizador se incluye en el anexo.

La potencia mínima de salida (especificada por el fabricante) en toda la banda es +15dBm. El oscilador fijo tenía una potencia de salida de +16dBm y se utilizaba un atenuador fijo de 3dB para conseguir una potencia media en el mezclador de unos 9.5dBm. Por tanto, se coloca un **atenuador de 2dB** a la salida del nuevo sintetizador.

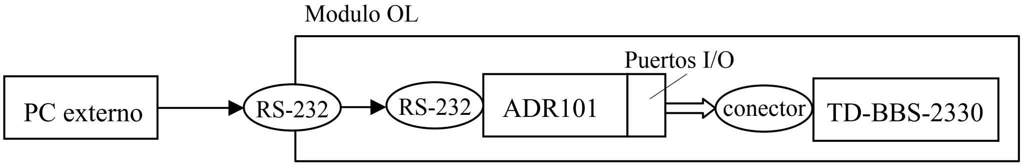
La **señal de referencia** de entrada al sintetizador es de **10MHz** @ +/-3dBm, en vez de 5MHz, por error del fabricante. Se coloca un nuevo conector BNC en el frontal para inyectar esta señal. Se elimina así el divisor para la señal de 5MHz.

2.2 Control del sintetizador.

La frecuencia del tono de salida del sintetizador se controla mediante interfaz RS-232. Debido al gran número de frecuencias en que puede sintonizarse el sintetizador (500MHz/10Hz = 50.000.000 frecuencias posibles), es necesario enviar al sintetizador un número de 26 bits (el binario más cercano, 226 = 67.108.864). El sintetizador utiliza una línea de datos, por la que se envía la ristra de 26 bits, una señal de reloj cuyo flanco ascendente indica que debe leerse un bit, y una línea de strobe o enable que se mantiene activa mientras se envían los 26 bits y que indica al sintetizador que está recibiendo el código con el que debe establecer la frecuencia.


SERIAL DATA INPUT TIMING
MSB
LSB
DATA
D 25
D 24
D 23
D 0
tCS
tCWH
tCH
CLOCK
tW
tCWL
tES
STROBE

El control de esta interfaz se realiza mediante una tarjeta ADR101 (analógico/digital/RS232 interface). El esquema es el siguiente:


Modulo OL
PC externo
RS-232
RS-232
ADR101
Puertos I/O
conector
TD-BBS-2330

2.2.1 Conexiones del sintetizador

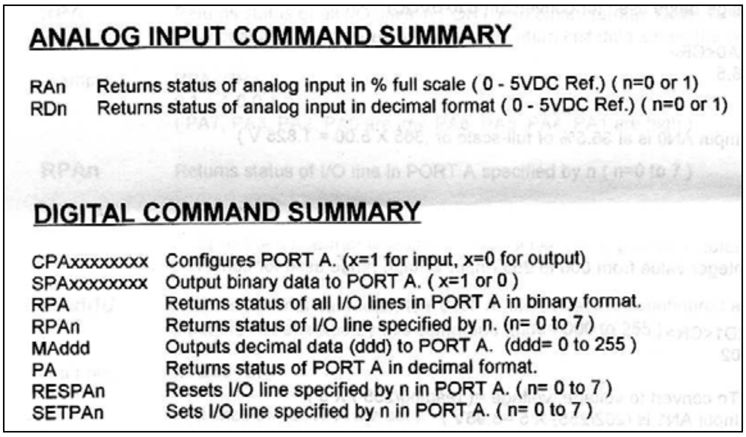
Las conexiones del sintetizador a la FI se detallan en la siguiente tabla:

Conector sintetizador	*Cable*	*Función*	*Conexión Bus P2*	*Conexión Tarjeta RS232*	*Conexión Bus P1*
Pin 1	Marrón	GND	Pin 6	-	
Pin 2	Rojo				
Pin 3	Naranja	+5V	Pin 28	-	
Pin 4	Amarillo				
Pin 5	Verde	+15V	Pin 4	-	
Pin 6	Azul	libre			
Pin 7	Violeta	Alarma	-	(*)	13c
Pin 8	Gris	Clock	-	PA2 (digital I/O)	
Pin 9	Blanco	Datos	-	PA4 (digital I/O)	
Pin 10	Negro	Enable o Strobe	-	PA7 (digital I/O)	

(*) *La alarma del sintetizador se mantiene en el mismo pin de control del bus P1, para que el MicroIOC lo controle de la misma manera que hacía con el oscilador fijo.*

2.2.2 Tarjeta ADR101 para el control serie del sintetizador

Esta tarjeta tiene una serie de comandos para manejar el puerto serie del sintetizador.



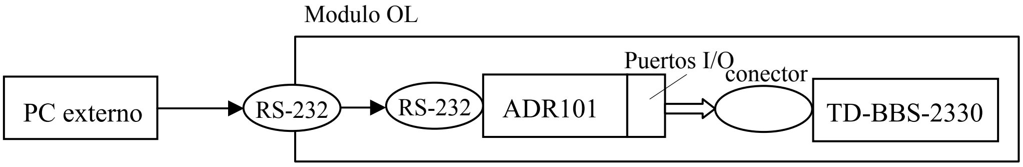
ANALOG INPUT COMMAND SUMMARY

RAn	Returns status of analog input in % full scale (0 - 5VDC Ref.) (n=0 or 1)
RDn	Returns status of analog input in decimal format (0 - 5VDC Ref.) (n=0 or 1)

DIGITAL COMMAND SUMMARY

CPAxxxxxxxx	Configures PORT A. (x=1 for input, x=0 for output)
SPAxxxxxxxx	Output binary data to PORT A. (x=1 or 0)
RPA	Returns status of all I/O lines in PORT A in binary format.
RPAn	Returns status of I/O line specified by n. (n= 0 to 7)
MAddd	Outputs decimal data (ddd) to PORT A. (ddd= 0 to 255)
PA	Returns status of PORT A in decimal format.
RESPAn	Resets I/O line specified by n in PORT A. (n= 0 to 7)
SETPAn	Sets I/O line specified by n in PORT A. (n= 0 to 7)

Un programa externo (que se adjunta en el anexo) envía la frecuencia del sintetizador por el puerto RS232 del ADR101 utilizando estos comandos. La tarjeta ADR101 envía la frecuencia al sintetizador por el puerto serie (conector de 10 pines) del sintetizador, siguiendo la interfaz serie del sintetizador. El esquema es el siguiente:



Para que el conector del frontal sea una interfaz RS-232 habitual, se realiza la siguiente conexión:

Frontal	*Color cable*	*ADR101*
TX 3	white	TX 7
RC 2	red	RC 3
GND 5	black	GND 2

2.2.3 Alimentación

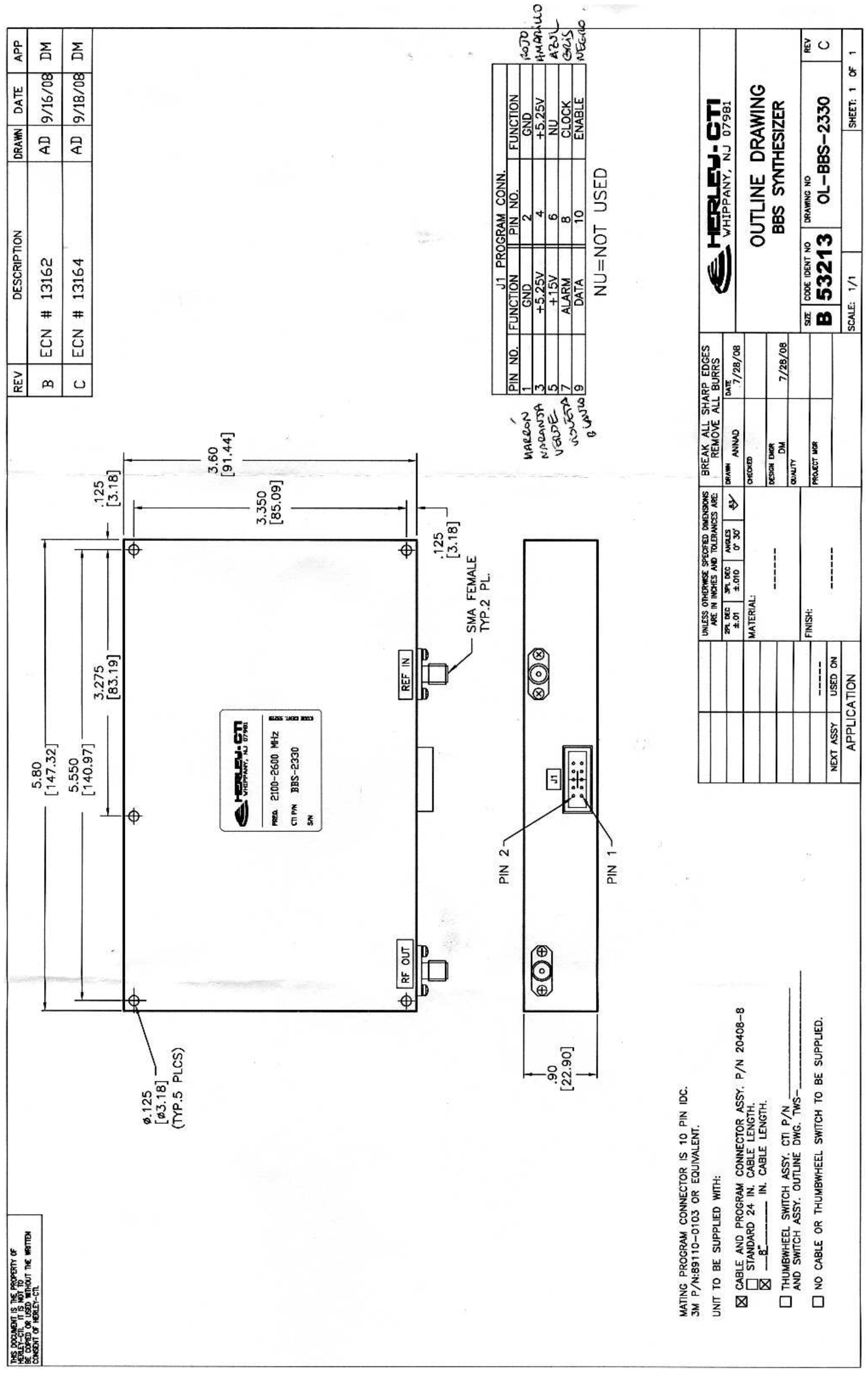
Para alimentar el sintetizador la corriente que suministra la tarjeta de reguladores no es suficiente debido al consumo adicional del sintetizador (+5V@ 700mA). Se sustituye la tarjeta de reguladores por una fuente lineal de +5V@4A (cuya hoja de características se adjunta en el anexo) que suministra suficiente corriente para toda la FI, incluido el sintetizador. Los +5V de la tarjeta de reguladores se conducía al bus P2 por el pin 20. Los +5V de la fuente de alimentación llegan al bus P2 por el pin 28. Por esta razón, tanto en el módulo de ruido como en el módulo RF RCP se modifica el cable de alimentación de +5V, situado en el pin 20, bus P2, recolocándolo en el pin 28. Se actualiza este cambio en los informes Ref.1 y Ref.2.

3 Referencias

Ref. 1. Medidas de la FI del Receptor S del Radiotelescopio de 40m del CAY. IT OAN 2006-17. I.Malo, A.Miguel, J.Fernández, J.A.Abad, S.Henche, J.A.L.Pérez, J.M.Serna, J.A.L.Fernández.

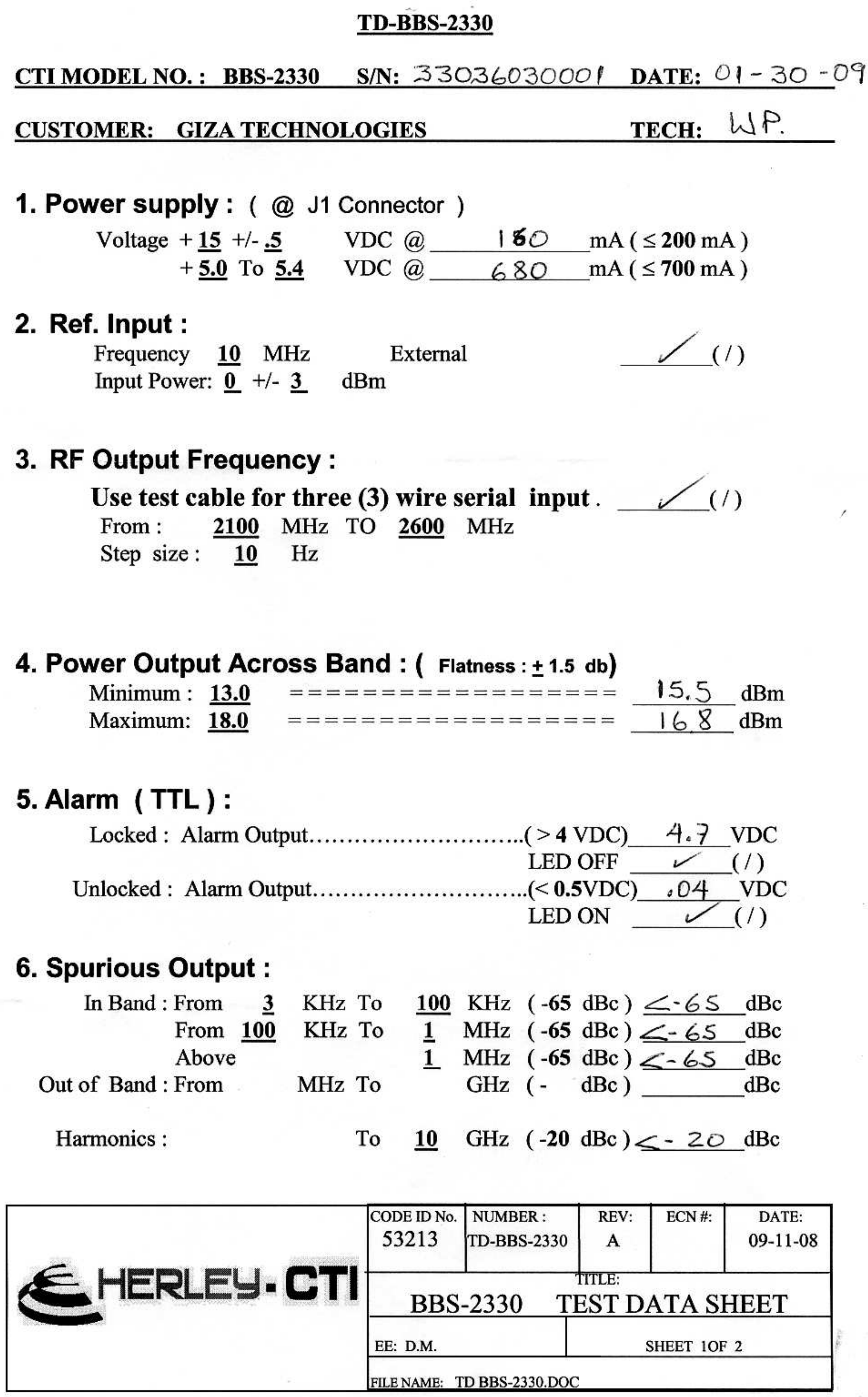
Ref. 2. Medidas de la FI del Receptor CH del Radiotelescopio de 40m del CAY. IT OAN 2006-17. I.Malo, A.Miguel, J.Fernández, J.A.Abad, S.Henche, J.A.L.Pérez, J.M.Serna, J.A.L.Fernández.

Anexo A. Sintetizador: TD-BBS-2330, Herley CTI.



PIN NO.	FUNCTION	PIN NO.	FUNCTION
1	GND	2	GND
3	+5.25V	4	+5.25V
5	+15V	6	NU
7	ALARM	8	CLOCK
9	DATA	10	ENABLE

REV | DESCRIPTION | DRAWN | DATE | APP
B | ECN # 13162 | AD | 9/16/08 | DM
C | ECN # 13164 | AD | 9/18/08 | DM
J1 PROGRAM CONN.
NU=NOT USED
MARRON
NARANJA
VERDE
VIOLETA
BLANCO
ROJO
AMARILLO
AZUL
GRIS
NEGRO
3.60 [91.44]
3.350 [85.09]
.125 [3.18]
.125 [3.18]
5.80 [147.32]
5.550 [140.97]
3.275 [83.19]
SMA FEMALE TYP.2 PL.
REF IN
RF OUT
HERLEY-CTI WHIPPANY, NJ 07981
FREQ. 2100-2600 MHz
CTI P/N BBS-2330
S/N
ø.125 [ø3.18] (TYP.5 PLCS)
J1
PIN 2
PIN 1
.90 [22.90]
MATING PROGRAM CONNECTOR IS 10 PIN IDC.
3M P/N:89110-0103 OR EQUIVALENT.
UNIT TO BE SUPPLIED WITH:
☒ CABLE AND PROGRAM CONNECTOR ASSY. P/N 20408-8
☐ STANDARD 24 IN. CABLE LENGTH.
☒ 8" IN. CABLE LENGTH.
☐ THUMBWHEEL SWITCH ASSY. CTI P/N
AND SWITCH ASSY. OUTLINE DWG. TWS-
☐ NO CABLE OR THUMBWHEEL SWITCH TO BE SUPPLIED.
THIS DOCUMENT IS THE PROPERTY OF HERLEY-CTI. IT IS NOT TO BE COPIED OR USED WITHOUT THE WRITTEN CONSENT OF HERLEY-CTI.
NEXT ASSY | USED ON
APPLICATION
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND TOLERANCES ARE:
2PL DEC ±.01 | 3PL DEC ±.010 | ANGLES 0° 30'
MATERIAL:
FINISH:
BREAK ALL SHARP EDGES REMOVE ALL BURRS
DRAWN ANNAD | DATE 7/28/08
CHECKED
DESIGN ENGR DM | 7/28/08
QUALITY
PROJECT MGR
HERLEY-CTI WHIPPANY, NJ 07981
OUTLINE DRAWING
BBS SYNTHESIZER
SIZE B | CODE IDENT NO 53213 | DRAWING NO OL-BBS-2330 | REV C
SCALE: 1/1 | SHEET: 1 OF 1



TD-BBS-2330

CTI MODEL NO. : BBS-2330 S/N: 33036030001 **DATE:** 01-30-09

CUSTOMER: GIZA TECHNOLOGIES TECH: WP.

1. Power supply : (@ J1 Connector)

Voltage + **15** +/- **.5** VDC @ 180 mA (≤ **200** mA)
+ **5.0** To **5.4** VDC @ 680 mA (≤ **700** mA)

2. Ref. Input :

Frequency **10** MHz External ✓ (/)
Input Power: **0** +/- **3** dBm

3. RF Output Frequency :

Use test cable for three (3) wire serial input . ✓ (/)
From : **2100** MHz TO **2600** MHz
Step size : **10** Hz

4. Power Output Across Band : (Flatness : ± 1.5 db)

Minimum : **13.0** ================== 15.5 dBm
Maximum: **18.0** ================== 16.8 dBm

5. Alarm (TTL) :

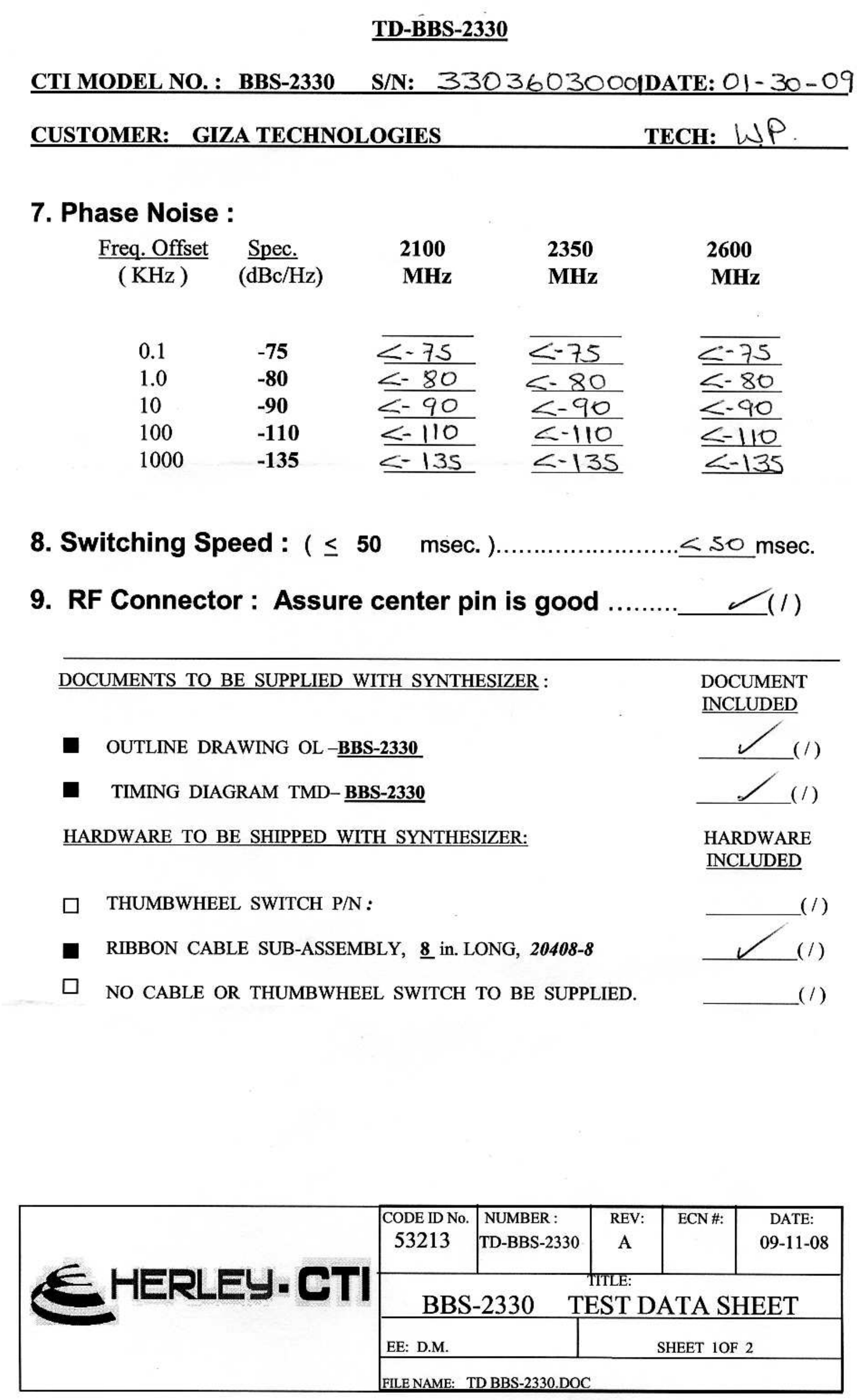
Locked : Alarm Output……………………….(> **4** VDC) 4.7 VDC
LED OFF ✓ (/)
Unlocked : Alarm Output……………………….(< **0.5**VDC) .04 VDC
LED ON ✓ (/)

6. Spurious Output :

In Band : From **3** KHz To **100** KHz (**-65** dBc) ≤-65 dBc
From **100** KHz To **1** MHz (**-65** dBc) ≤-65 dBc
Above **1** MHz (**-65** dBc) ≤-65 dBc
Out of Band : From MHz To GHz (- dBc) ____ dBc

Harmonics : To **10** GHz (**-20** dBc) ≤-20 dBc

HERLEY-CTI	CODE ID No.	NUMBER :	REV:	ECN #:	DATE:
	53213	TD-BBS-2330	A		09-11-08
	TITLE: BBS-2330 TEST DATA SHEET				
	EE: D.M.		SHEET 1OF 2		
	FILE NAME: TD BBS-2330.DOC				



TD-BBS-2330

CTI MODEL NO. : BBS-2330 S/N: 330360300001 **DATE:** 01-30-09

CUSTOMER: GIZA TECHNOLOGIES **TECH:** WP.

7. Phase Noise :

Freq. Offset (KHz)	Spec. (dBc/Hz)	2100 MHz	2350 MHz	2600 MHz
0.1	-75	≤-75	≤-75	≤-75
1.0	-80	≤-80	≤-80	≤-80
10	-90	≤-90	≤-90	≤-90
100	-110	≤-110	≤-110	≤-110
1000	-135	≤-135	≤-135	≤-135

8. Switching Speed : (≤ 50 msec.)........................≤50 msec.

9. RF Connector : Assure center pin is good ....✓(/)

DOCUMENTS TO BE SUPPLIED WITH SYNTHESIZER : — DOCUMENT INCLUDED

- ■ OUTLINE DRAWING OL –**BBS-2330** ✓(/)
- ■ TIMING DIAGRAM TMD– **BBS-2330** ✓(/)

HARDWARE TO BE SHIPPED WITH SYNTHESIZER: — HARDWARE INCLUDED

- ☐ THUMBWHEEL SWITCH P/N : ________(/)
- ■ RIBBON CABLE SUB-ASSEMBLY, 8 in. LONG, *20408-8* ✓(/)
- ☐ NO CABLE OR THUMBWHEEL SWITCH TO BE SUPPLIED. ________(/)

HERLEY-CTI	CODE ID No. 53213	NUMBER : TD-BBS-2330	REV: A	ECN #:	DATE: 09-11-08

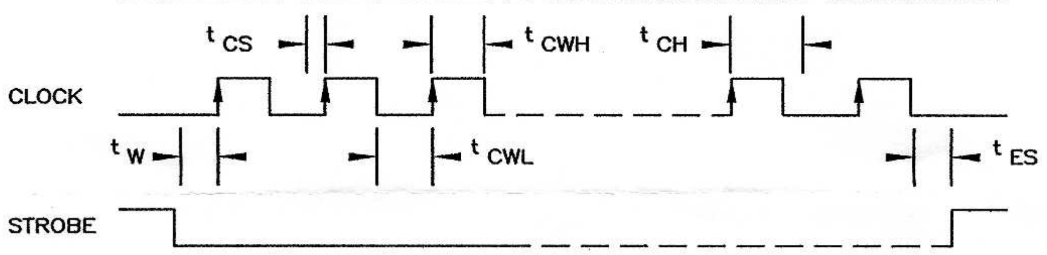
TITLE: BBS-2330 TEST DATA SHEET

EE: D.M. SHEET 1OF 2

FILE NAME: TD BBS-2330.DOC

BBS-2330

SERIAL DATA INPUT TIMING



t_{CS}	DATA TO CLOCK SETUP TIME	SEE DATA INPUT TIMING	50 US MINIMUM
t_{CH}	DATA TO CLOCK HOLD TIME	SEE DATA INPUT TIMING	50 US MINIMUM
t_{CWH}	CLOCK PULSE WIDTH HIGH	SEE DATA INPUT TIMING	50 US MINIMUM
t_{CWL}	CLOCK PULSE WIDTH LOW	SEE DATA INPUT TIMING	50 US MINIMUM
t_{ES}	CLOCK TO ENABLE SET UP TIME	SEE DATA INPUT TIMING	50 US MINIMUM
t_W	STROBE TO FIRST CLOCK	SEE DATA INPUT TIMING	1000 US MINIMUM

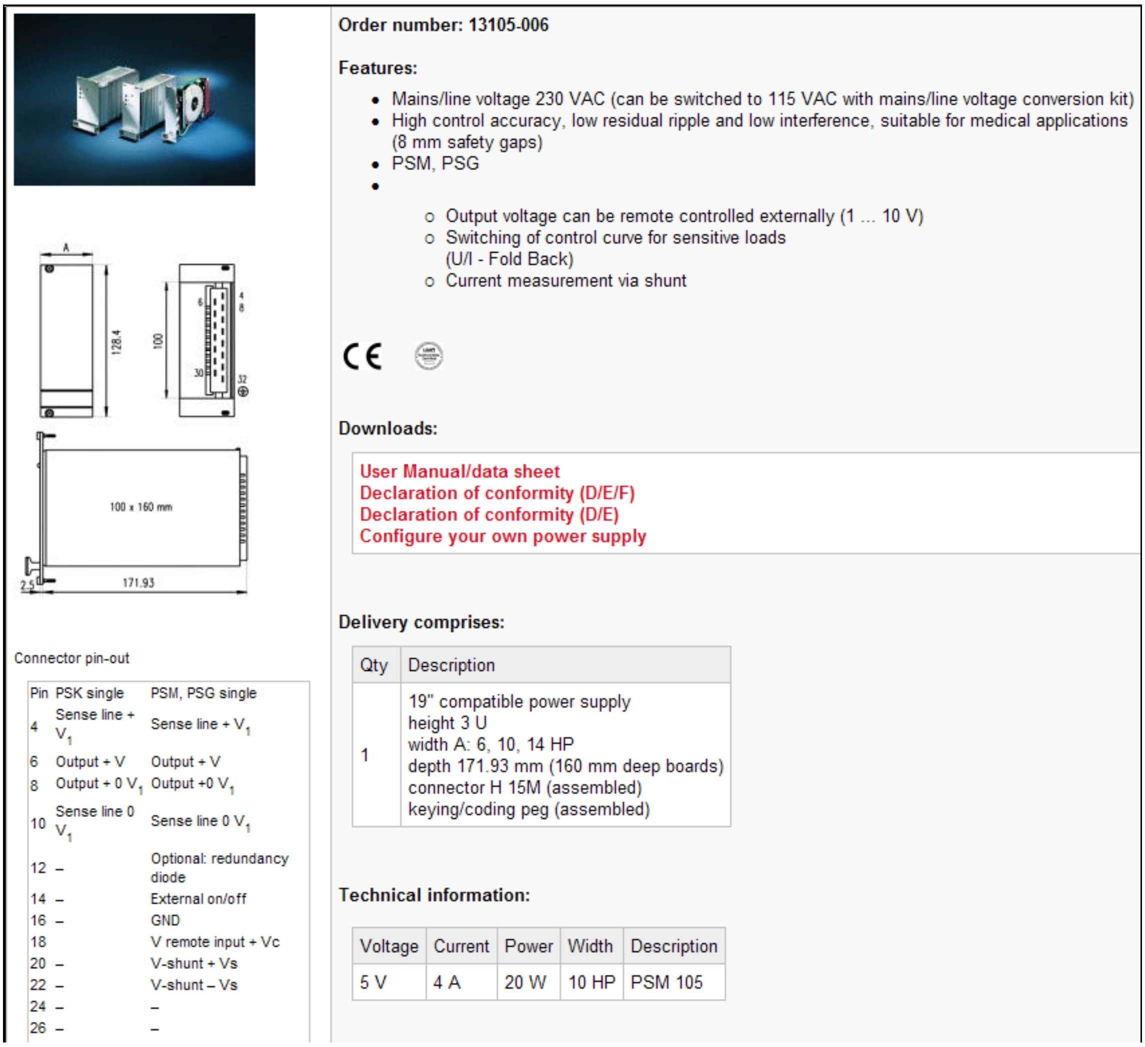
SERIAL DATA FORMAT

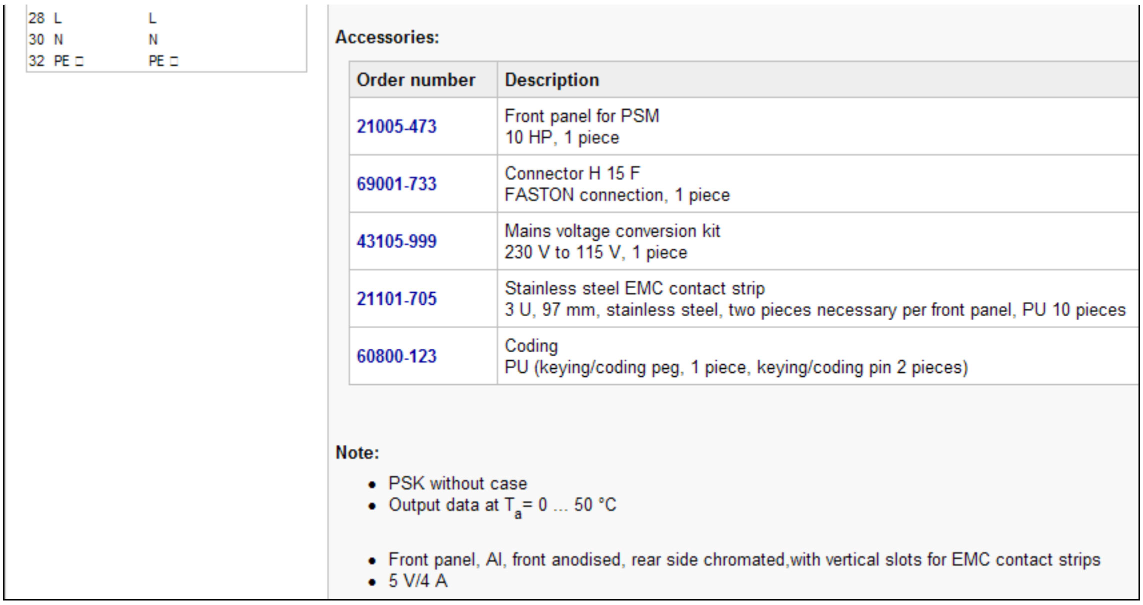
DATA IS SHIFTED MSB FIRST

		MSB																									LSB
OUTPUT	CHANNEL	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
FREQUENCY	NUMBER	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
2100.00000 MHz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2100.00001 MHz	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2600.00000 MHz	50000000	1	0	1	1	1	1	1	0	1	0	1	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0

DM
07-22-08

Anexo B. Fuente de +5V.





Connector pin-out

Pin	PSK single	PSM, PSG single
4	Sense line + V_1	Sense line + V_1
6	Output + V	Output + V
8	Output + 0 V_1	Output +0 V_1
10	Sense line 0 V_1	Sense line 0 V_1
12	–	Optional: redundancy diode
14	–	External on/off
16	–	GND
18		V remote input + Vc
20	–	V-shunt + Vs
22	–	V-shunt – Vs
24	–	–
26	–	–
28	L	L
30	N	N
32	PE ⏚	PE ⏚

Order number: 13105-006

Features:

- Mains/line voltage 230 VAC (can be switched to 115 VAC with mains/line voltage conversion kit)
- High control accuracy, low residual ripple and low interference, suitable for medical applications (8 mm safety gaps)
- PSM, PSG
-
    - Output voltage can be remote controlled externally (1 ... 10 V)
    - Switching of control curve for sensitive loads (U/I - Fold Back)
    - Current measurement via shunt

CE

Downloads:

User Manual/data sheet
Declaration of conformity (D/E/F)
Declaration of conformity (D/E)
Configure your own power supply

Delivery comprises:

Qty	Description
1	19" compatible power supply height 3 U width A: 6, 10, 14 HP depth 171.93 mm (160 mm deep boards) connector H 15M (assembled) keying/coding peg (assembled)

Technical information:

Voltage	Current	Power	Width	Description
5 V	4 A	20 W	10 HP	PSM 105

Accessories:

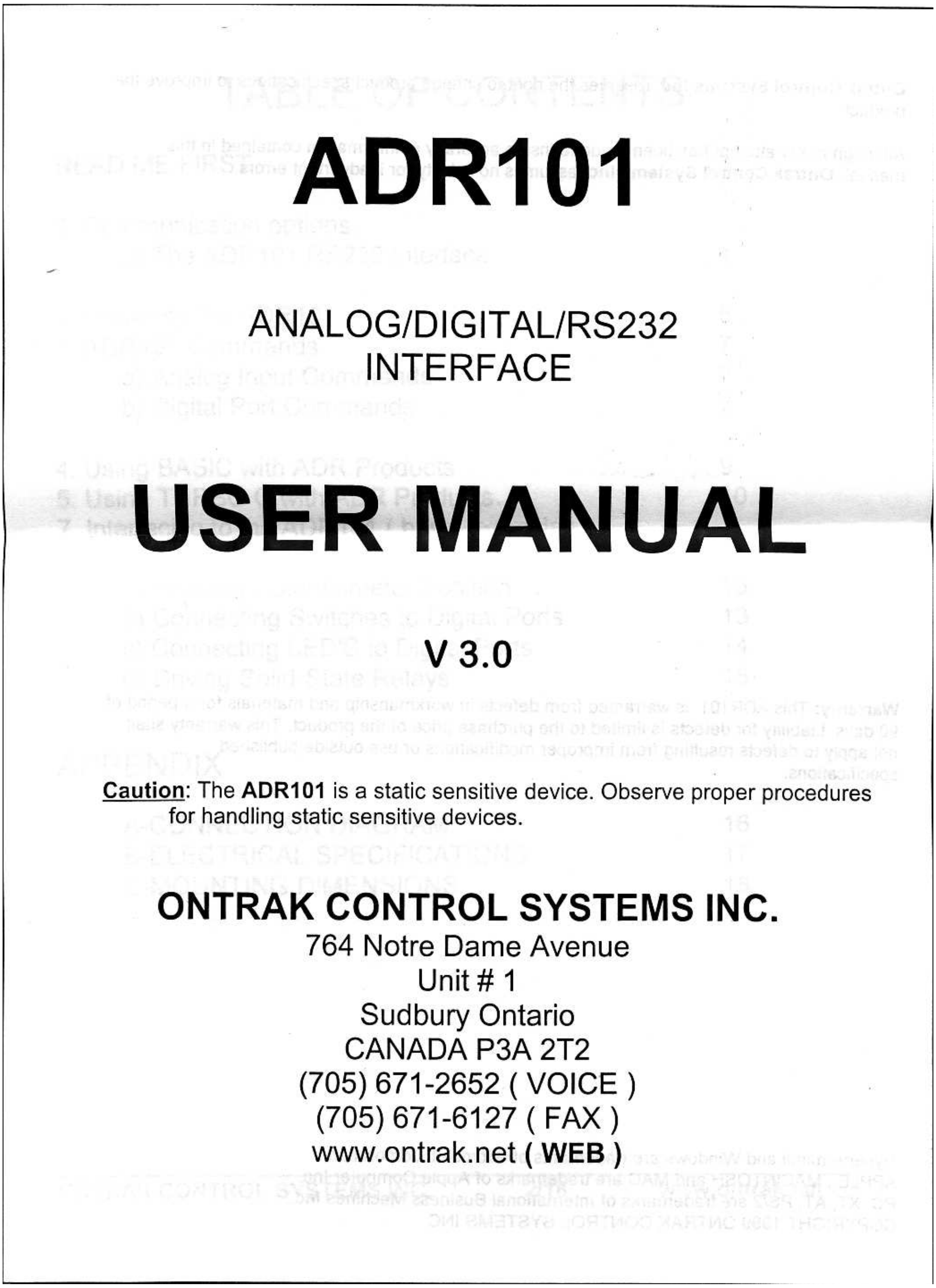
Order number	Description
21005-473	Front panel for PSM 10 HP, 1 piece
69001-733	Connector H 15 F FASTON connection, 1 piece
43105-999	Mains voltage conversion kit 230 V to 115 V, 1 piece
21101-705	Stainless steel EMC contact strip 3 U, 97 mm, stainless steel, two pieces necessary per front panel, PU 10 pieces
60800-123	Coding PU (keying/coding peg, 1 piece, keying/coding pin 2 pieces)

Note:

- PSK without case
- Output data at T_a = 0 ... 50 °C

- Front panel, Al, front anodised, rear side chromated,with vertical slots for EMC contact strips
- 5 V/4 A

Anexo C. Tarjeta ADR101.



ADR101

ANALOG/DIGITAL/RS232
INTERFACE

USER MANUAL

V 3.0

Caution: The **ADR101** is a static sensitive device. Observe proper procedures for handling static sensitive devices.

ONTRAK CONTROL SYSTEMS INC.
764 Notre Dame Avenue
Unit # 1
Sudbury Ontario
CANADA P3A 2T2
(705) 671-2652 (VOICE)
(705) 671-6127 (FAX)
www.ontrak.net (**WEB**)

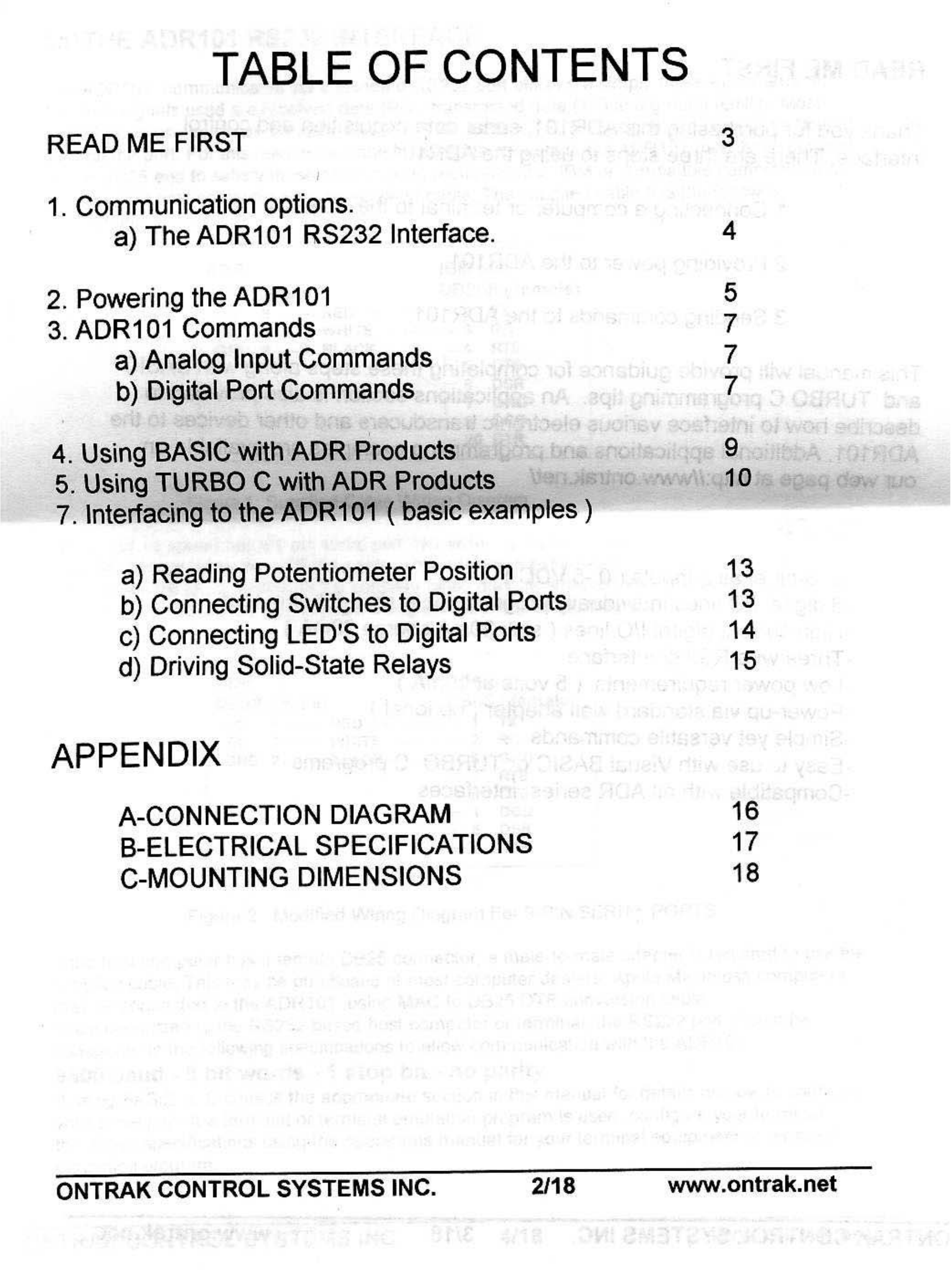


TABLE OF CONTENTS

READ ME FIRST 3

1. Communication options.
    a) The ADR101 RS232 Interface. 4

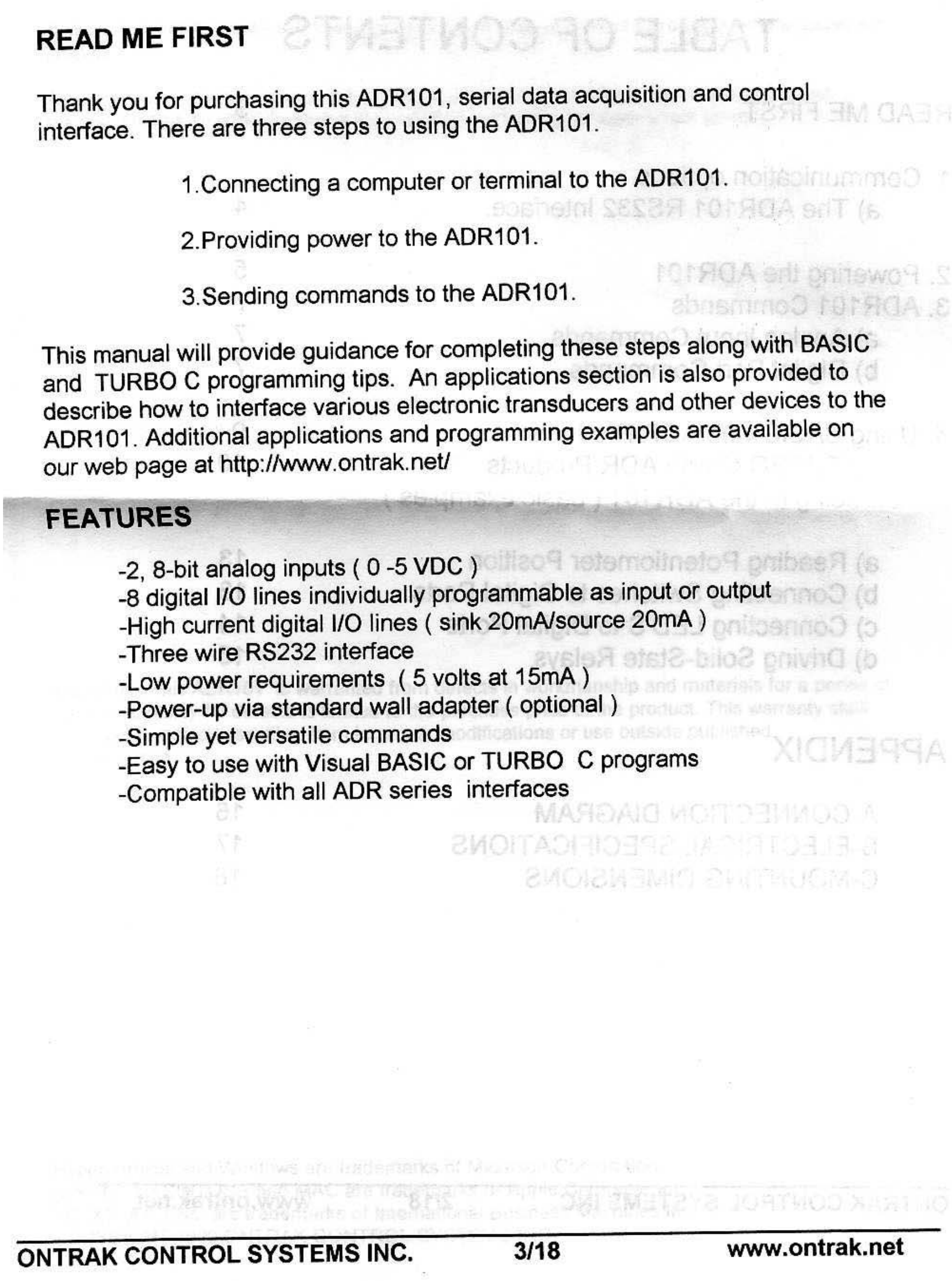
2. Powering the ADR101 5
3. ADR101 Commands 7
    a) Analog Input Commands 7
    b) Digital Port Commands 7

4. Using BASIC with ADR Products 9
5. Using TURBO C with ADR Products 10
7. Interfacing to the ADR101 (basic examples)

    a) Reading Potentiometer Position 13
    b) Connecting Switches to Digital Ports 13
    c) Connecting LED'S to Digital Ports 14
    d) Driving Solid-State Relays 15

APPENDIX

A-CONNECTION DIAGRAM 16
B-ELECTRICAL SPECIFICATIONS 17
C-MOUNTING DIMENSIONS 18



READ ME FIRST

Thank you for purchasing this ADR101, serial data acquisition and control interface. There are three steps to using the ADR101.

1. Connecting a computer or terminal to the ADR101.
2. Providing power to the ADR101.
3. Sending commands to the ADR101.

This manual will provide guidance for completing these steps along with BASIC and TURBO C programming tips. An applications section is also provided to describe how to interface various electronic transducers and other devices to the ADR101. Additional applications and programming examples are available on our web page at http://www.ontrak.net/

FEATURES

-2, 8-bit analog inputs (0 -5 VDC)
-8 digital I/O lines individually programmable as input or output
-High current digital I/O lines (sink 20mA/source 20mA)
-Three wire RS232 interface
-Low power requirements (5 volts at 15mA)
-Power-up via standard wall adapter (optional)
-Simple yet versatile commands
-Easy to use with Visual BASIC or TURBO C programs
-Compatible with all ADR series interfaces

ONTRAK CONTROL SYSTEMS INC. 3/18 www.ontrak.net

1a)THE ADR101 RS232 INTERFACE

The ADR101 communicates via a standard RS232 port utilizing a simple three-wire interface. The only signals used are received data (RC), transmitted data (TX) and ground (GND). Most RS232 ports use hardware handshaking (i.e. DTR, DSR, CTS, RTS) signals to control the flow of data on the port. For this reason the cable required to connect to the ADR101 must have jumpers on the DB25 end to satisfy these handshaking requirements. IBM or compatible computers may be used as a host computer with the supplied cable. The supplied cable has the following connections;

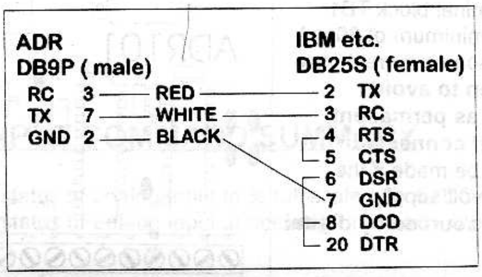


Figure 1: Supplied Cable Wiring Diagram

If the host computer has a 9-pin serial port connector, a 9-pin to 25-pin adapter cable will be required to connect to the ADR101 cable. This adaptor is available at most computer dealers. If desired, the DB25 connector on the supplied cable may be removed and a female DB9S connector can be soldered in its place using the following wiring diagram;

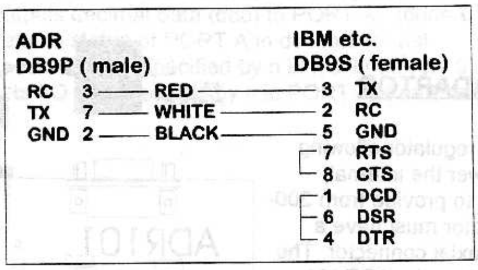


Figure 2 : Modified Wiring Diagram For 9-PIN SERIAL PORTS

If the host computer has a female DB25 connector, a male-to-male adapter is required to use the supplied cable. This may be purchased at most computer dealers. Apple Macintosh computers may be connected to the ADR101 using MAC to DB25 DTE conversion cable.
Once connected to the RS232 based host computer or terminal, the RS232 port should be configured to the following specifications to allow communication with the ADR101.

9600 baud - 8 bit words - 1 stop bit - no parity

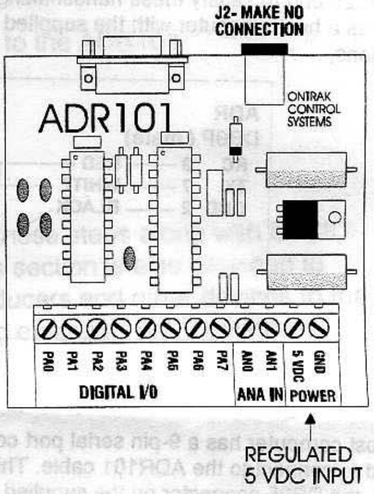
If using BASIC or C consult the appropriate section in this manual for details on how to configure your serial port. If a terminal or terminal emulation program is used, configure your terminal to the above specifications using the operations manual for your terminal equipment or terminal emulation program.

2.PROVIDING POWER TO THE ADR101

The ADR101 may be powered using a regulated 5 volt power supply or a suitable wall adaptor.

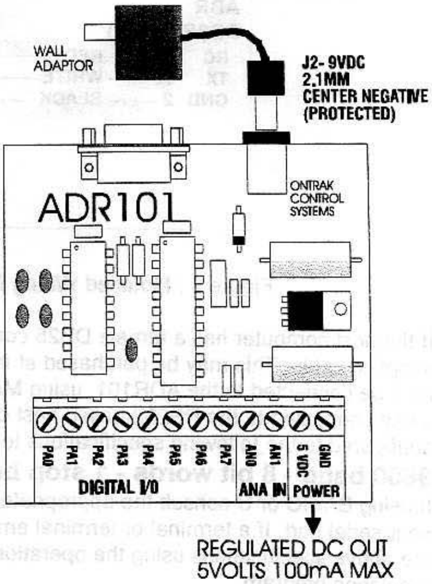
POWER-UP USING A 5 VOLT REGULATED SUPPLY

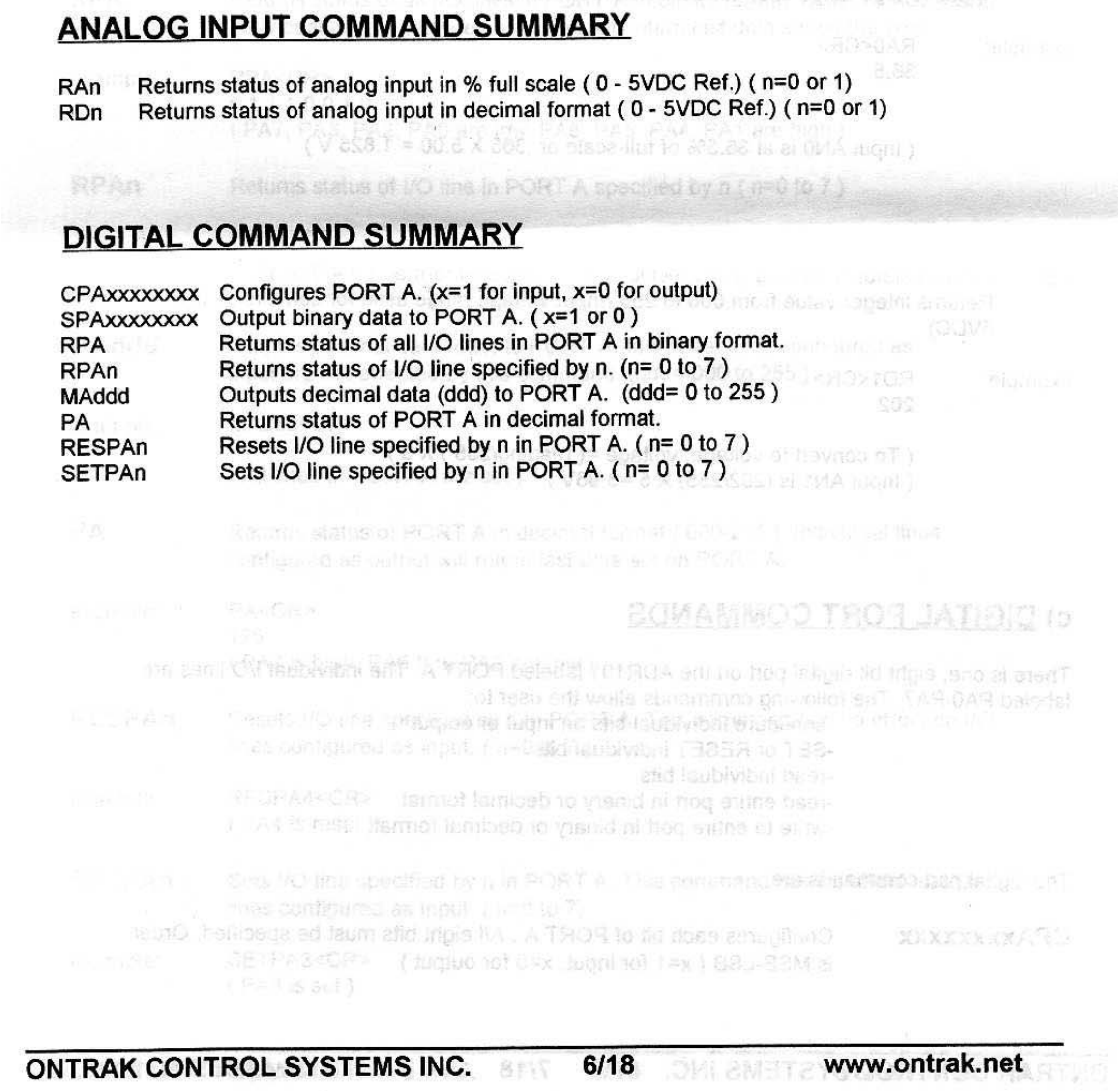
If the ADR101 is to be powered using a regulated 5 volt power supply, the 5VDC and GND connections are to be made to the ADR101 via the main terminal block TB1. The supply must be able to provide a minimum of 30 mA and up to 130mA if the ADR101 is to source current from the digital outputs. **Care must be taken to avoid improper power supply connection as permanent damage to the ADR101 may result if connected improperly.** No connection to J2 is to be made if the ADR101 is powered by a regulated 5 volt supply. **For safe operation the total current sourced by digital I/O should not exceed 100mA.**


J2- MAKE NO CONNECTION
ADR101
ONTRAK CONTROL SYSTEMS
PA0
PA1
PA2
PA3
PA4
PA5
PA6
PA7
AN0
AN1
5 VDC
GND
DIGITAL I/O
ANA IN
POWER
REGULATED 5 VDC INPUT

POWER-UP USING A WALL ADAPTOR

The ADR101 has an on-board 5 volt regulator allowing the use of a 9-volt wall adaptor to power the internal circuits. The regulator should be able to provide from 200-500mA .(MODE 68-950-1) The regulator must have a standard 2.1mm, center negative, coaxial connector. The connector can then be inserted into J2 on the ADR101. When the ADR101 is powered by a wall adaptor, the on-board regulator also may provide a regulated 5 volts DC out to provide power to external circuits. This 5 volt supply is available on TB1. The amount of current available depends on the amount of current sourced by the digital ports. **For safe operation the total current sourced by digital I/O and the power terminals should not exceed 100mA.**


WALL ADAPTOR
J2- 9VDC 2.1MM CENTER NEGATIVE (PROTECTED)
ADR101
ONTRAK CONTROL SYSTEMS
PA0
PA1
PA2
PA3
PA4
PA5
PA6
PA7
AN0
AN1
5 VDC
GND
DIGITAL I/O
ANA IN
POWER
REGULATED DC OUT 5VOLTS 100mA MAX



ANALOG INPUT COMMAND SUMMARY

RAn	Returns status of analog input in % full scale (0 - 5VDC Ref.) (n=0 or 1)
RDn	Returns status of analog input in decimal format (0 - 5VDC Ref.) (n=0 or 1)

DIGITAL COMMAND SUMMARY

CPAxxxxxxxx	Configures PORT A. (x=1 for input, x=0 for output)
SPAxxxxxxxx	Output binary data to PORT A. (x=1 or 0)
RPA	Returns status of all I/O lines in PORT A in binary format.
RPAn	Returns status of I/O line specified by n. (n= 0 to 7)
MAddd	Outputs decimal data (ddd) to PORT A. (ddd= 0 to 255)
PA	Returns status of PORT A in decimal format.
RESPAn	Resets I/O line specified by n in PORT A. (n= 0 to 7)
SETPAn	Sets I/O line specified by n in PORT A. (n= 0 to 7)

ONTRAK CONTROL SYSTEMS INC. 6/18 www.ontrak.net

3. ADR101 COMMANDS

a) ANALOG INPUT COMMANDS

There are 2 analog inputs, with a resolution of 8-bits, on the ADR101 labeled AN0 to AN1. The analog input range is 0 to 5 VDC. The commands used to read analog inputs allow data to be retrieved in two formats.

RAn Returns status of analog port specified by n in % full scale format. (n = 0 or 1) (Input voltage range used for conversion 0 to 5VDC)

example;
```
RA0<CR>
36.5
```

(Input AN0 is at 36.5% of full-scale or .365 X 5.00 = 1.825 V)

RDn Returns status of analog port specified by n in decimal format. (n = 0 or 1) Returns integer value from 000 to 255.(Input voltage range used for conversion is 0 to 5VDC)

example;
```
RD1<CR>
202
```

(To convert to voltage; voltage =(reading/255) X 5)
(Input AN1 is (202/255) X 5 =3.96V)

c) DIGITAL PORT COMMANDS

There is one, eight bit digital port on the ADR101 labeled PORT A. The individual I/O lines are labeled PA0-PA7. The following commands allow the user to;

-configure individual bits an input or output
-SET or RESET individual bits
-read individual bits
-read entire port in binary or decimal format
-write to entire port in binary or decimal format.

The digital port commands are;

CPAxxxxxxxx Configures each bit of PORT A . All eight bits must be specified. Order is MSB-LSB (x=1 for input, x=0 for output) example; CPA11110000<CR>

(PA7 ,PA6, PA5, PA4 are configured as inputs and PA3, PA2, PA1, PA0 are configured as outputs)

SPAxxxxxxxx Outputs binary data to PORT A. All eight bits must be specified. Order is MSB-LSB. Individual bits configured as input are not effected by this command. (x=1 or 0)

example; SPA10101000<CR>

(PA7, PA5, PA3 are set, PA6, PA4, PA2, PA1, PA0 are reset)

RPA Returns status of all I/O lines in PORT A in binary format. Order is MSB-LSB. Individual lines configured as output will return last data set on the port.

example; RPA<CR>
0 1 1 1 0 0 1 0
(PA7, PA3, PA2, PA0 are low, PA6, PA5 ,PA4, PA1 are high)

RPAn Returns status of I/O line in PORT A specified by n.(n=0 to 7)

example; RPA4<CR>
1
(PA4 is high)

MAddd Outputs decimal data (ddd) to PORT A. Individual lines configured as input are not effected by this command. (ddd= 000 to 255)

example; MA255<CR>

(All lines of PORT A are set)

PA Returns status of PORT A in decimal format (000-255). Individual lines configured as output will return last data set on PORT A.

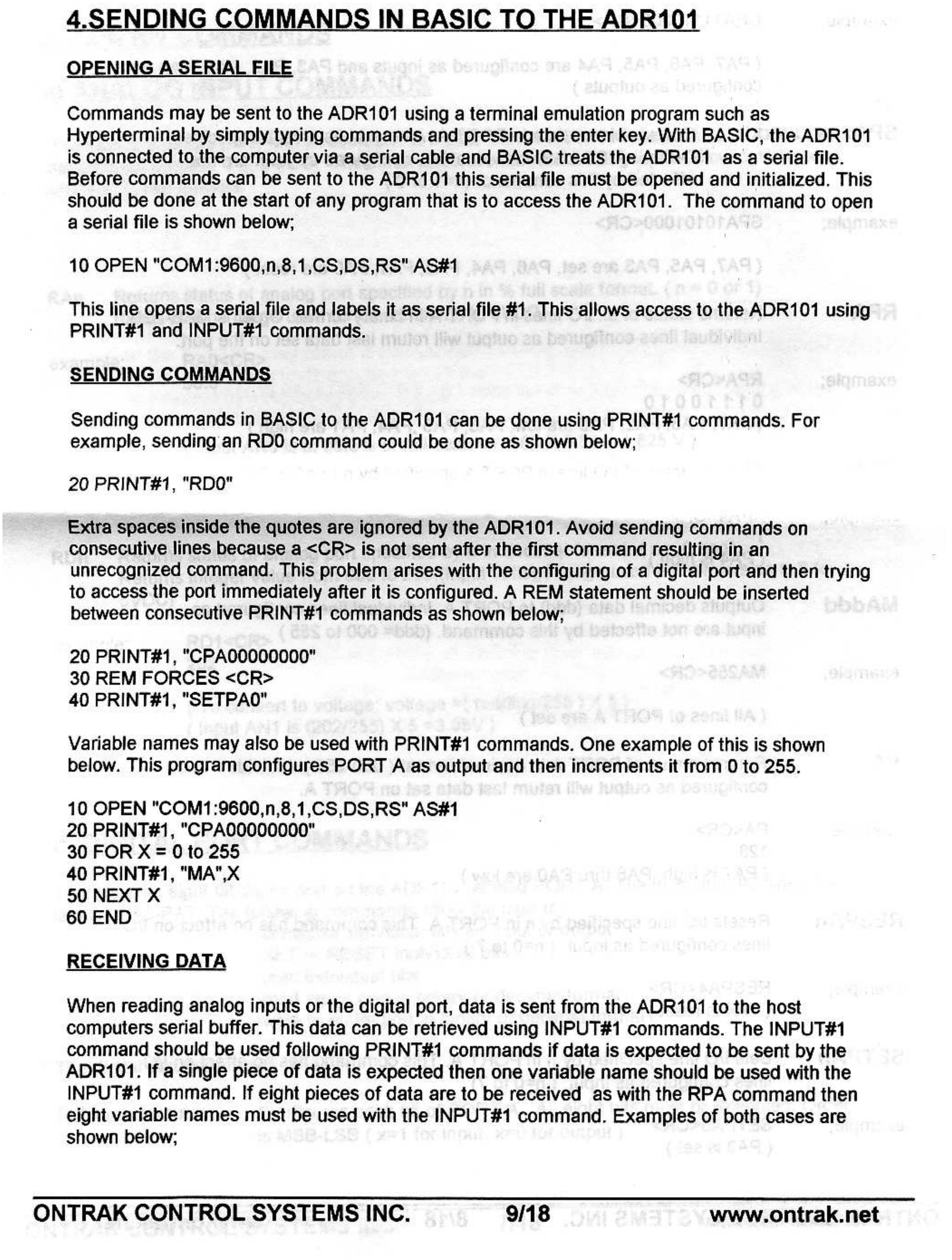
example; PA<CR>
128
(PA7 is high, PA6 thru PA0 are low)

RESPAn Resets I/O line specified by n in PORT A. This command has no effect on I/O lines configured as input. (n=0 to 7)

example; RESPA4<CR>
(PA4 is reset)

SETPAn Sets I/O line specified by n in PORT A. This command has no effect on I/O lines configured as input. (n=0 to 7)

example; SETPA3<CR>
(PA3 is set)



4.SENDING COMMANDS IN BASIC TO THE ADR101

OPENING A SERIAL FILE

Commands may be sent to the ADR101 using a terminal emulation program such as Hyperterminal by simply typing commands and pressing the enter key. With BASIC, the ADR101 is connected to the computer via a serial cable and BASIC treats the ADR101 as a serial file. Before commands can be sent to the ADR101 this serial file must be opened and initialized. This should be done at the start of any program that is to access the ADR101. The command to open a serial file is shown below;

```
10 OPEN "COM1:9600,n,8,1,CS,DS,RS" AS#1
```

This line opens a serial file and labels it as serial file #1. This allows access to the ADR101 using PRINT#1 and INPUT#1 commands.

SENDING COMMANDS

Sending commands in BASIC to the ADR101 can be done using PRINT#1 commands. For example, sending an RD0 command could be done as shown below;

```
20 PRINT#1, "RD0"
```

Extra spaces inside the quotes are ignored by the ADR101. Avoid sending commands on consecutive lines because a <CR> is not sent after the first command resulting in an unrecognized command. This problem arises with the configuring of a digital port and then trying to access the port immediately after it is configured. A REM statement should be inserted between consecutive PRINT#1 commands as shown below;

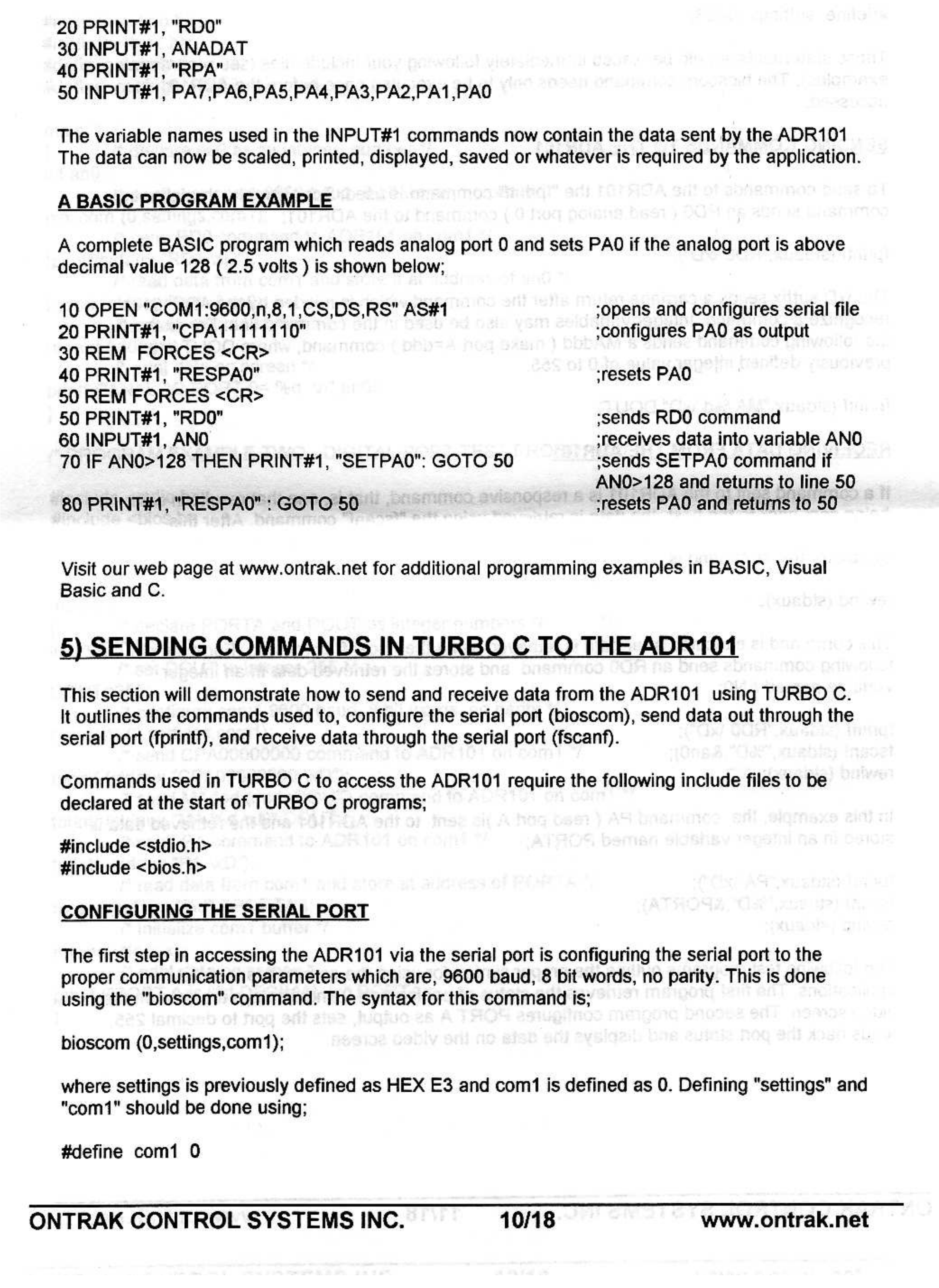
```
20 PRINT#1, "CPA00000000"
30 REM FORCES <CR>
40 PRINT#1, "SETPA0"
```

Variable names may also be used with PRINT#1 commands. One example of this is shown below. This program configures PORT A as output and then increments it from 0 to 255.

```
10 OPEN "COM1:9600,n,8,1,CS,DS,RS" AS#1
20 PRINT#1, "CPA00000000"
30 FOR X = 0 to 255
40 PRINT#1, "MA",X
50 NEXT X
60 END
```

RECEIVING DATA

When reading analog inputs or the digital port, data is sent from the ADR101 to the host computers serial buffer. This data can be retrieved using INPUT#1 commands. The INPUT#1 command should be used following PRINT#1 commands if data is expected to be sent by the ADR101. If a single piece of data is expected then one variable name should be used with the INPUT#1 command. If eight pieces of data are to be received as with the RPA command then eight variable names must be used with the INPUT#1 command. Examples of both cases are shown below;



```
20 PRINT#1, "RD0"
30 INPUT#1, ANADAT
40 PRINT#1, "RPA"
50 INPUT#1, PA7,PA6,PA5,PA4,PA3,PA2,PA1,PA0
```

The variable names used in the INPUT#1 commands now contain the data sent by the ADR101 The data can now be scaled, printed, displayed, saved or whatever is required by the application.

A BASIC PROGRAM EXAMPLE

A complete BASIC program which reads analog port 0 and sets PA0 if the analog port is above decimal value 128 (2.5 volts) is shown below;

```
10 OPEN "COM1:9600,n,8,1,CS,DS,RS" AS#1          ;opens and configures serial file
20 PRINT#1, "CPA11111110"                          ;configures PA0 as output
30 REM  FORCES <CR>
40 PRINT#1, "RESPA0"                                ;resets PA0
50 REM FORCES <CR>
50 PRINT#1, "RD0"                                   ;sends RD0 command
60 INPUT#1, AN0                                     ;receives data into variable AN0
70 IF AN0>128 THEN PRINT#1, "SETPA0": GOTO 50       ;sends SETPA0 command if
                                                    AN0>128 and returns to line 50
80 PRINT#1, "RESPA0" : GOTO 50                      ;resets PA0 and returns to 50
```

Visit our web page at www.ontrak.net for additional programming examples in BASIC, Visual Basic and C.

5) SENDING COMMANDS IN TURBO C TO THE ADR101

This section will demonstrate how to send and receive data from the ADR101 using TURBO C. It outlines the commands used to, configure the serial port (bioscom), send data out through the serial port (fprintf), and receive data through the serial port (fscanf).

Commands used in TURBO C to access the ADR101 require the following include files to be declared at the start of TURBO C programs;

```
#include <stdio.h>
#include <bios.h>
```

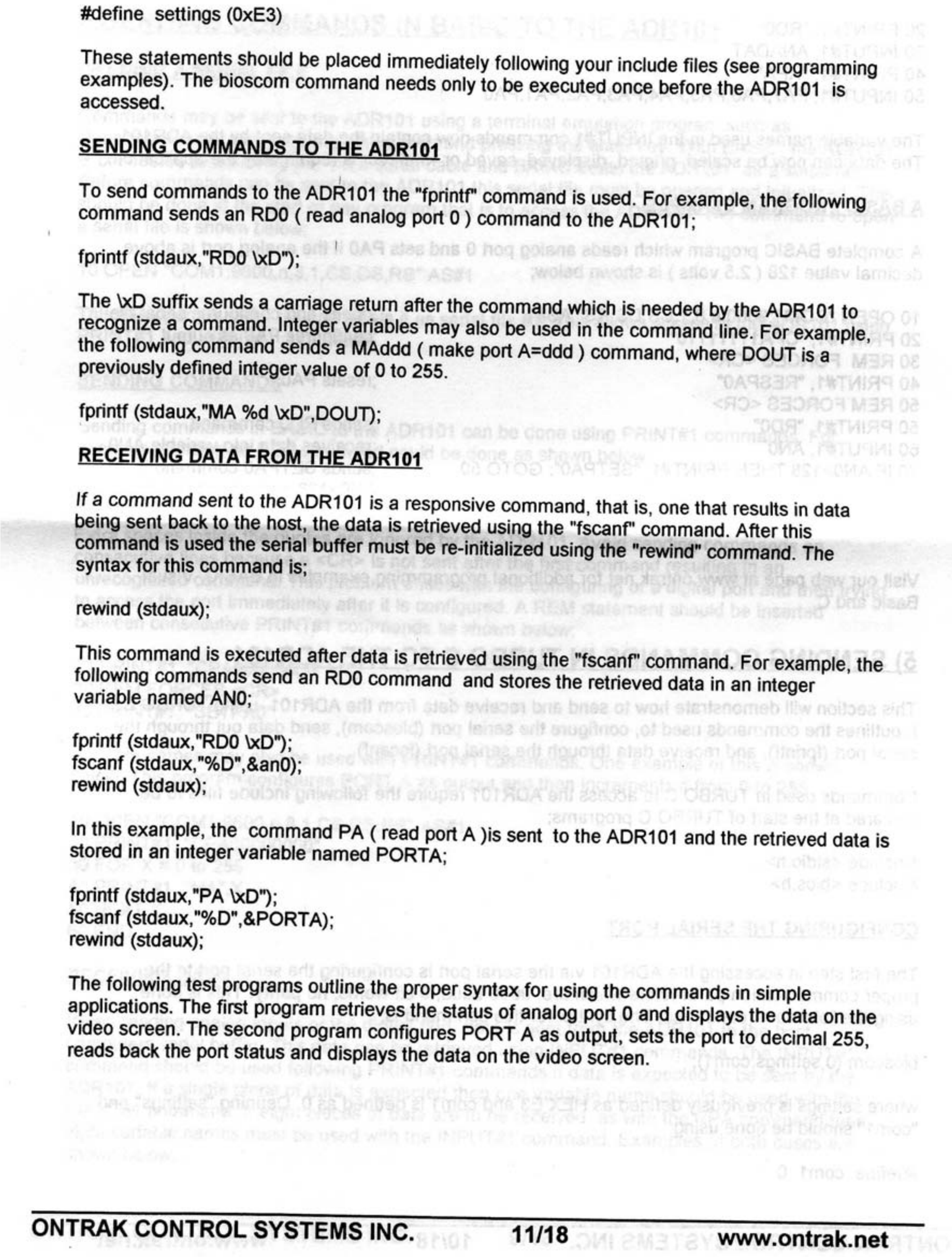
CONFIGURING THE SERIAL PORT

The first step in accessing the ADR101 via the serial port is configuring the serial port to the proper communication parameters which are, 9600 baud, 8 bit words, no parity. This is done using the "bioscom" command. The syntax for this command is;

```
bioscom (0,settings,com1);
```

where settings is previously defined as HEX E3 and com1 is defined as 0. Defining "settings" and "com1" should be done using;

```
#define  com1  0
```



```
#define settings (0xE3)
```

These statements should be placed immediately following your include files (see programming examples). The bioscom command needs only to be executed once before the ADR101 is accessed.

SENDING COMMANDS TO THE ADR101

To send commands to the ADR101 the "fprintf" command is used. For example, the following command sends an RD0 (read analog port 0) command to the ADR101;

```
fprintf (stdaux,"RD0 \xD");
```

The \xD suffix sends a carriage return after the command which is needed by the ADR101 to recognize a command. Integer variables may also be used in the command line. For example, the following command sends a MAddd (make port A=ddd) command, where DOUT is a previously defined integer value of 0 to 255.

```
fprintf (stdaux,"MA %d \xD",DOUT);
```

RECEIVING DATA FROM THE ADR101

If a command sent to the ADR101 is a responsive command, that is, one that results in data being sent back to the host, the data is retrieved using the "fscanf" command. After this command is used the serial buffer must be re-initialized using the "rewind" command. The syntax for this command is;

```
rewind (stdaux);
```

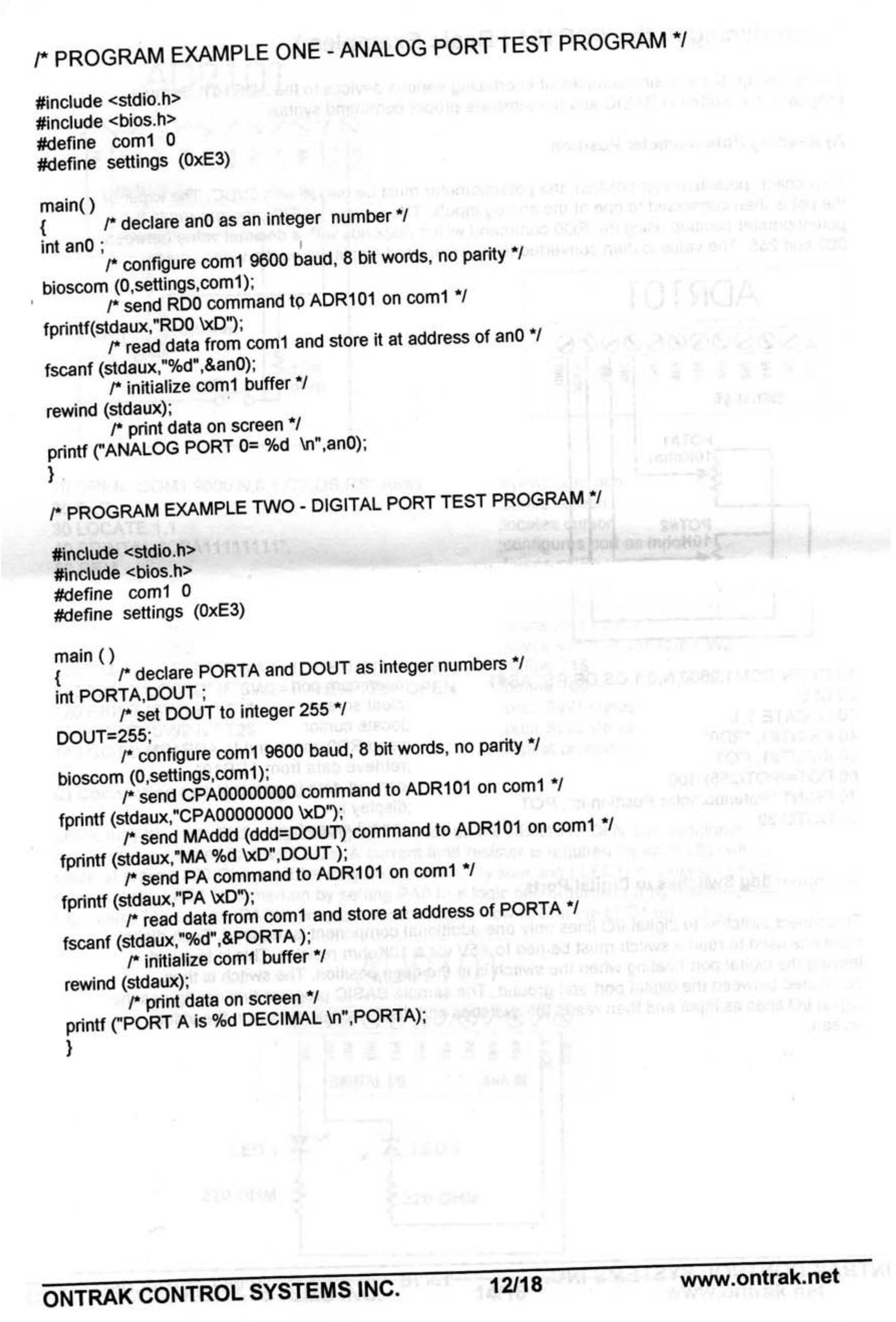
This command is executed after data is retrieved using the "fscanf" command. For example, the following commands send an RD0 command and stores the retrieved data in an integer variable named AN0;

```
fprintf (stdaux,"RD0 \xD");
fscanf (stdaux,"%D",&an0);
rewind (stdaux);
```

In this example, the command PA (read port A)is sent to the ADR101 and the retrieved data is stored in an integer variable named PORTA;

```
fprintf (stdaux,"PA \xD");
fscanf (stdaux,"%D",&PORTA);
rewind (stdaux);
```

The following test programs outline the proper syntax for using the commands in simple applications. The first program retrieves the status of analog port 0 and displays the data on the video screen. The second program configures PORT A as output, sets the port to decimal 255, reads back the port status and displays the data on the video screen.



```
/* PROGRAM EXAMPLE ONE - ANALOG PORT TEST PROGRAM */

#include <stdio.h>
#include <bios.h>
#define  com1  0
#define  settings  (0xE3)

main( )
{          /* declare an0 as an integer  number */
int an0 ;
           /* configure com1 9600 baud, 8 bit words, no parity */
bioscom (0,settings,com1);
           /* send RD0 command to ADR101 on com1 */
fprintf(stdaux,"RD0 \xD");
           /* read data from com1 and store it at address of an0 */
fscanf (stdaux,"%d",&an0);
           /* initialize com1 buffer */
rewind (stdaux);
           /* print data on screen */
printf ("ANALOG PORT 0= %d  \n",an0);
}

/* PROGRAM EXAMPLE TWO - DIGITAL PORT TEST PROGRAM */

#include <stdio.h>
#include <bios.h>
#define   com1  0
#define  settings  (0xE3)

main ( )
{          /* declare PORTA and DOUT as integer numbers */
int PORTA,DOUT ;
           /* set DOUT to integer 255 */
DOUT=255;
           /* configure com1 9600 baud, 8 bit words, no parity */
bioscom (0,settings,com1);
           /* send CPA00000000 command to ADR101 on com1 */
fprintf (stdaux,"CPA00000000 \xD");
           /* send MAddd (ddd=DOUT) command to ADR101 on com1 */
fprintf (stdaux,"MA %d \xD",DOUT);
           /* send PA command to ADR101 on com1 */
fprintf (stdaux,"PA \xD");
           /* read data from com1 and store at address of PORTA */
fscanf (stdaux,"%d",&PORTA);
           /* initialize com1 buffer */
rewind (stdaux);
           /* print data on screen */
printf ("PORT A is %d DECIMAL \n",PORTA);
}
```

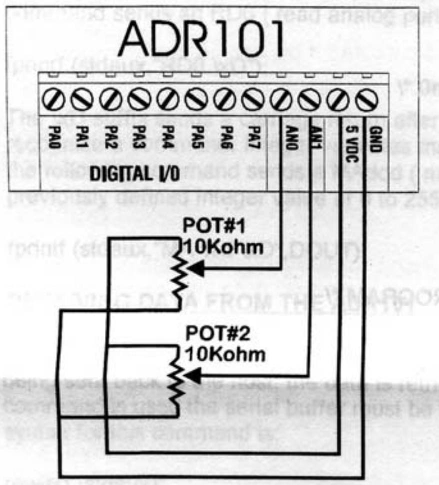
ONTRAK CONTROL SYSTEMS INC. 12/18 www.ontrak.net

7. Interfacing to the ADR101 (Basic Examples)

The following, show basic examples of interfacing various devices to the ADR101. Sample programs are written in BASIC and demonstrate proper command syntax.

A) Reading Potentiometer Position

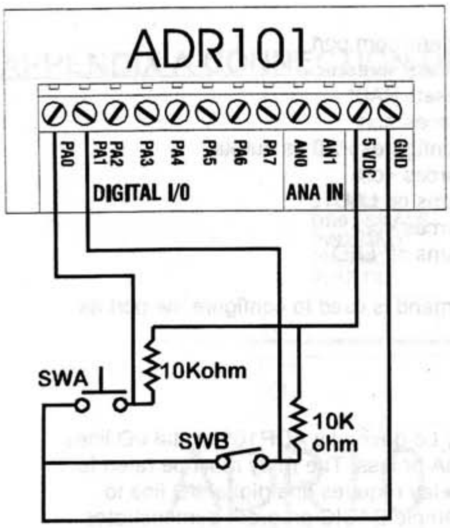
To monitor potentiometer position, the potentiometer must be biased with 5VDC. The wiper of the pot is then connected to one of the analog inputs. The sample BASIC program reads the potentiometer position using the RD0 command which responds with a decimal value between 000 and 255. The value is then converted to a percent and displayed on the video screen.



```
10 OPEN”COM1:9600,N,8,1,CS,DS,RS” AS#1          ;open com port
20 CLS                                          ;clear screen
30 LOCATE 1,1                                   ;locate cursor
40 PRINT#1, “RD0”                               ;send RD0 command to ADR101
50 INPUT#1, POT                                 ;retrieve data from ADR101
60 POT=(POT/255)*100                            ;convert data to percent
70 PRINT “Potentiometer Position is”, POT       ;display it
80 GOTO 30                                      ;repeat procedure
```

B) Connecting Switches to Digital Ports

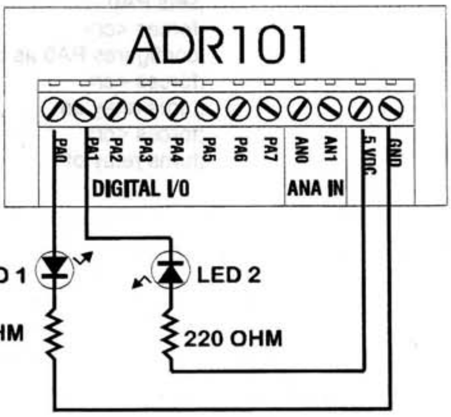
To connect switches to digital I/O lines only one additional component is required. Each digital input line used to read a switch must be tied to +5V via a 10Kohm resistor. This is to avoid leaving the digital port floating when the switch is in the open position. The switch is then connected between the digital port and ground. The sample BASIC program first configures the digital I/O lines as input and then reads the switches and displays their status on the video screen.


ADR101
PA0
PA1
PA2
PA3
PA4
PA5
PA6
PA7
AN0
AN1
5 VDC
GND
DIGITAL I/O
ANA IN
10Kohm
SWA
10K ohm
SWB

```
10 OPEN "COM1:9600,N,8,1,CS,DS,RS" AS#1                        ;opens com port
20 CLS                                                         ;clears screen
30 LOCATE 1,1                                                  ;locates cursor
40 PRINT#1, "CPA11111111"                                      ;configures port as input
50 REM                                                         ;forces <CR>
60 PRINT#1, "RPA0"                                             ;reads PA0 ( SW1 )
70 INPUT#1, SW1                                                ;saves status in variable SW1
80 PRINT#1, "RPA1"                                             ;reads PA1 ( SW2 )
90 INPUT#1,SW2                                                 ;saves status in variable SW2
100 T1$="CLOSED" IF SW1=1 THEN T1$="OPEN           " ;define T1$
110 T2$="CLOSED" IF SW2=1 THEN T2$="OPEN           " ;define T2$
120 PRINT "SW1 is " T1$                                        ;print SW1 status
130 PRINT "SW2 is " T2$                                        ;print SW2 status
140 GOTO 60                                                    ;repeat procedure
```

C) Connecting LED's to Digital Ports

LED's may be controlled using the digital I/O lines on the ADR101. Only one additional component is needed to drive LED's. A current limit resistor is required for each LED with a value of around 220 Ohms. LED's may be controlled by sourcing (LED1) or sinking (LED2) drive current. LED1 is turned on by setting PA0 to a logic one or turned off by resetting PA0 to a logic zero. The sample BASIC program demonstrates how to turn the LED1 on and off.

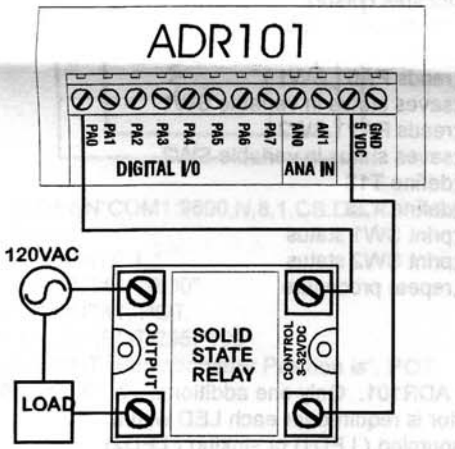

ADR101
PA0
PA1
PA2
PA3
PA4
PA5
PA6
PA7
AN0
AN1
5 VDC
GND
DIGITAL I/O
ANA IN
LED 1
LED 2
220 OHM
220 OHM

```
10 OPEN “COM1:9600,N,8,1,CS,DS,RS” AS#1          ;opens com port
20 CLS                                           ;clears screen
30 PRINT#1, “RESPA0"                             ;resets PA0*
40 REM                                           ;forces <cr>
50 PRINT#1, “CPA11111110"                        ;configures PA0 as output
60 REM Turn on LED                               ;forces <cr>
70 PRINT#1, “SETPA0"                             ;turns on LED
80 REM Turn off LED                              ;forces <cr>
90 PRINT#1, “RESPA0"                             ;turns off LED
100 END
```

* PA0 remains in high impedance state until the CPA command is used to configure the port as output.

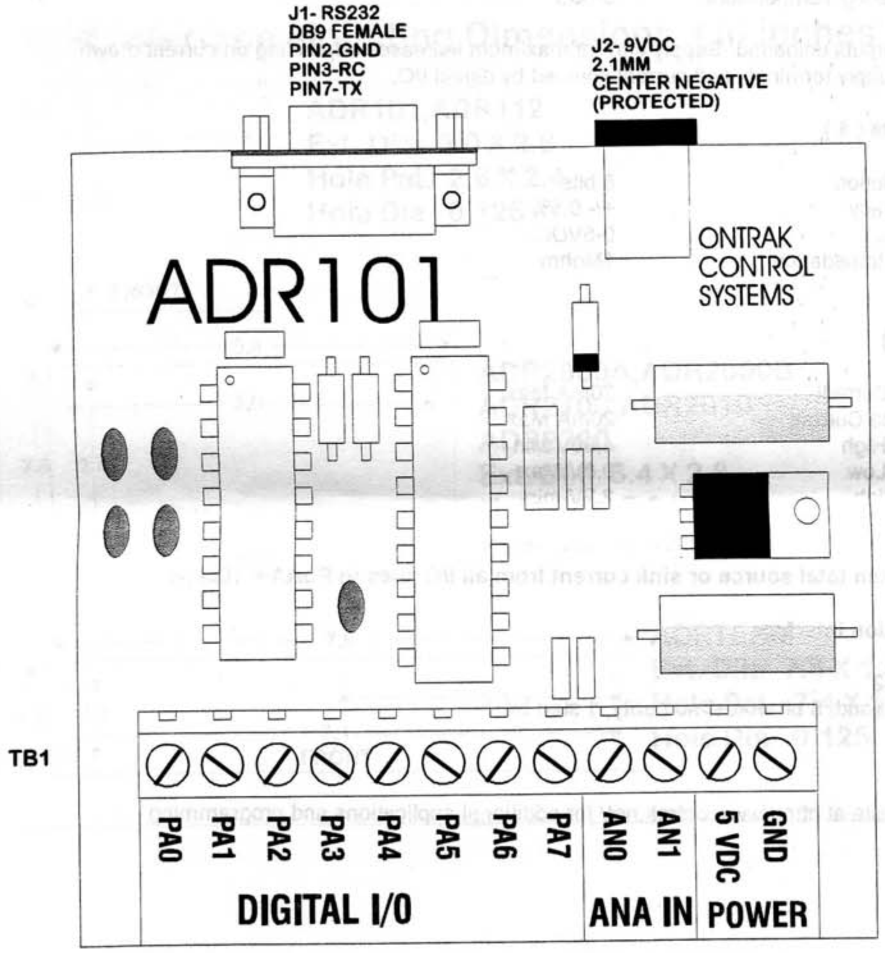
D) Driving Solid State Relays

Solid-State relays that require a DC voltage to operate may be driven by ADR101 digital I/O lines directly if the current input specification for the relay is 20mA or less. The relay must be rated for the proper voltage and current required by the load. Each relay requires one digital I/O line to operate and requires no other external components. The sample BASIC program demonstrates how the relay is turned on. In this configuration the digital I/O line sinks the relay drive current. Note that the I/O line is SET before the CPA command is used to configure the port as output to avoid the relay turning on unexpectedly when the port is configured.

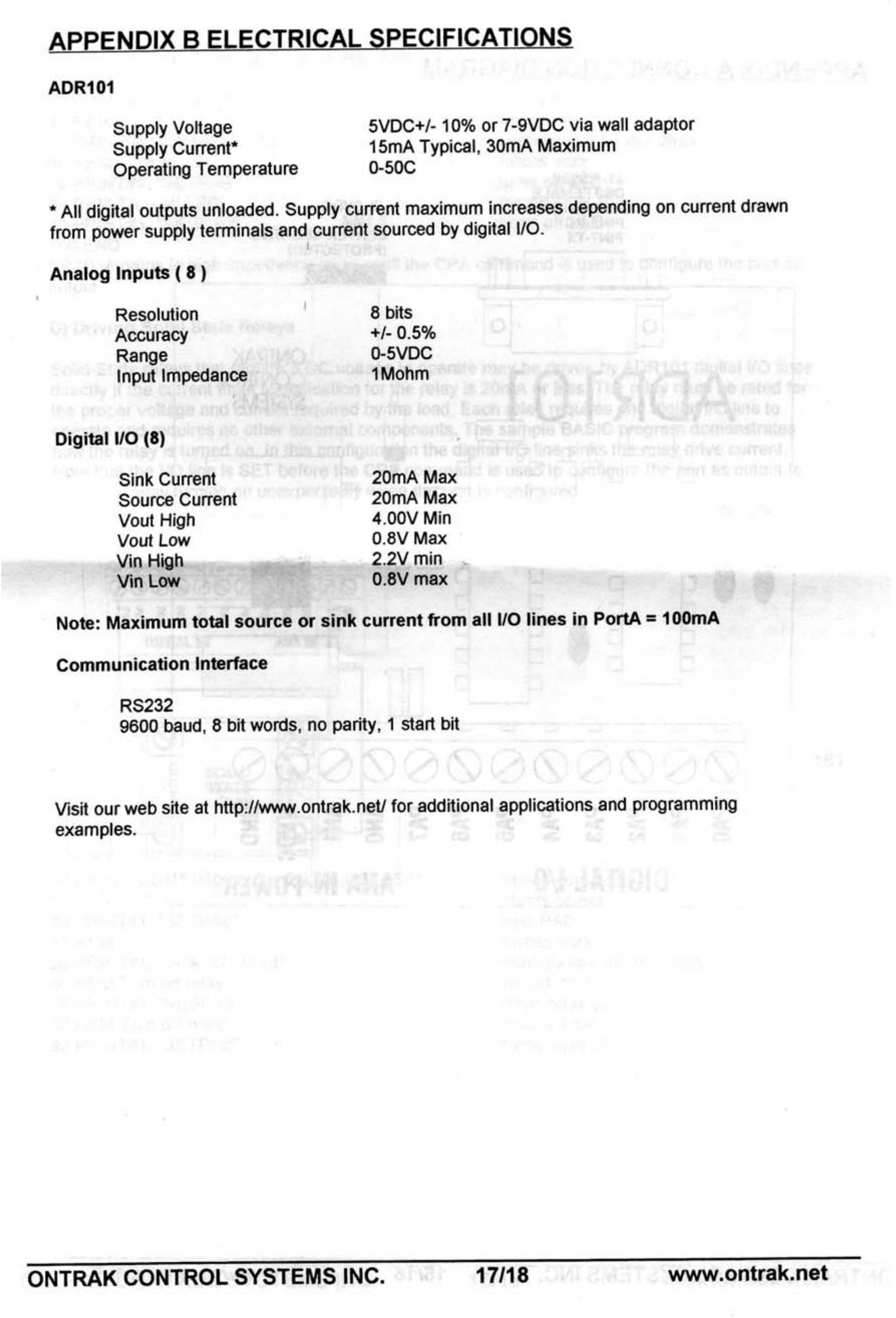


```
10 OPEN “COM1:9600,N,8,1,CS,DS,RS” AS#1          ;opens com port
20 CLS                                           ;clears screen
30 PRINT#1, “SETPA0"                             ;sets PA0
40 REM                                           ;forces <cr>
50 PRINT#1, “CPA11111110"                        ;configures PA0 as output
60 REM Turn on relay                             ;forces <cr>
70 PRINT#1, “RESPA0"                             ;turns relay on
80 REM Turn off relay                            ;forces <cr>
90 PRINT#1, “SETPA0"                             ;turns relay of
```

APPENDIX A CONNECTION DIAGRAM


J1- RS232
DB9 FEMALE
PIN2-GND
PIN3-RC
PIN7-TX
J2- 9VDC
2.1MM
CENTER NEGATIVE
(PROTECTED)
ADR101
ONTRAK
CONTROL
SYSTEMS
TB1
PA0
PA1
PA2
PA3
PA4
PA5
PA6
PA7
AN0
AN1
5 VDC
GND
DIGITAL I/O
ANA IN
POWER

ONTRAK CONTROL SYSTEMS INC. 16/18 www.ontrak.net



APPENDIX B ELECTRICAL SPECIFICATIONS

ADR101

Supply Voltage	5VDC+/- 10% or 7-9VDC via wall adaptor
Supply Current*	15mA Typical, 30mA Maximum
Operating Temperature	0-50C

*** All digital outputs unloaded. Supply current maximum increases depending on current drawn from power supply terminals and current sourced by digital I/O.**

Analog Inputs (8)

Resolution	8 bits
Accuracy	+/- 0.5%
Range	0-5VDC
Input Impedance	1Mohm

Digital I/O (8)

Sink Current	20mA Max
Source Current	20mA Max
Vout High	4.00V Min
Vout Low	0.8V Max
Vin High	2.2V min
Vin Low	0.8V max

Note: Maximum total source or sink current from all I/O lines in PortA = 100mA

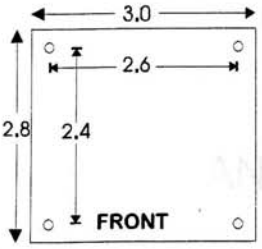
Communication Interface

RS232
9600 baud, 8 bit words, no parity, 1 start bit

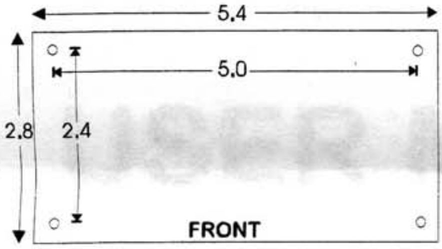
Visit our web site at http://www.ontrak.net/ for additional applications and programming examples.

APPENDIX C MOUNTING DIMENSIONS

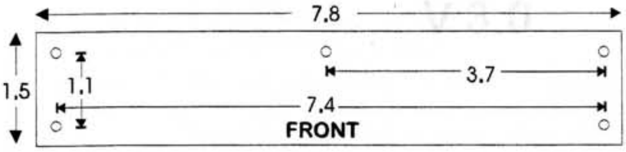
ADR Interface Mounting Dimensions (in inches)



ADR101,ADR112
Ext. Dim 3.0 X 2.8
Hole Pat. 2.6 X 2.4
Hole Dia 0.125



ADR2000A,ADR2000B
ADR2100,ADR2010
ADR2200
Ext. Dim 5.4 X 2.8
Hole Pat. 5.0 X 2.4
Hole Dia 0.125



ADRTERM
Ext. Dim 7.8 X 1.5
Hole Pat. 7.4 X 1.1
Hole Dia 0.125