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INITIAL INFORMATION

**PF1616M/W OPERATION GUIDE
PF1616M/W RS485/RS232/USB/ETHERNET/
900Mhz RF/Fiber Optic REMOTE IO BOARD
(Software Version 1.2A-20050715)
Manual updated August 25, 2005**

INTRODUCTION

The PF1616W Remote Relay Board has 16 Opto-Isolated Inputs (AC/DC) and 16 relay outputs. The unit can be controlled by our simple/efficient command structure from a host computer (computer mode), such as a PC. Two units can be connected in a standalone mode, passing inputs to outputs on the adjacent unit. Using the optional MTMOD module on both units, will allow both power and data to be distributed via Cat-5 cable, at distances up to 4000ft., using a 24vdc power supply on one end only. If a single unit is connected to a PC an event-driven mode is available. The unit can communicate using RS485 or RS232, at data rates up to 115.2K bits/second, with optional communication modules the unit can operate over

10/100 Base-T Ethernet / Internet, Fiber Optic, Universal Serial Bus (USB1.1 and USB2.0), 900Mhz RF or Fiber Optics. The PF-series devices have the unique feature of being field upgraded to new or custom versions of firmware while installed in a network.

The PF1616W has an onboard switching regulator for 9-35VDC (7.5W max.) operation, LED indicators monitor data flow of the serial port and relay status. 8 jumpers for communications address, Baud rate, mode control, etc.

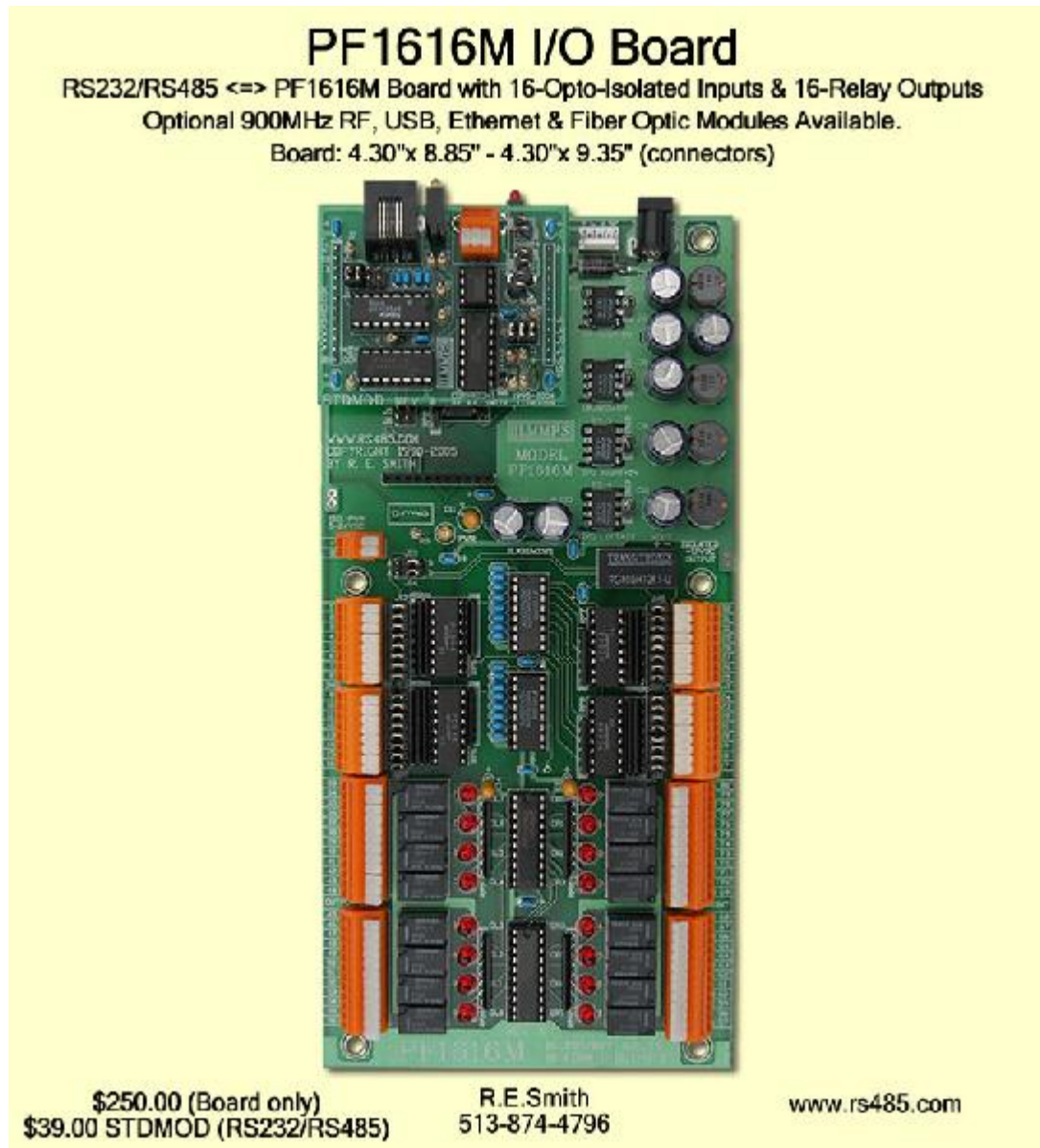


Figure 1. PF1616M

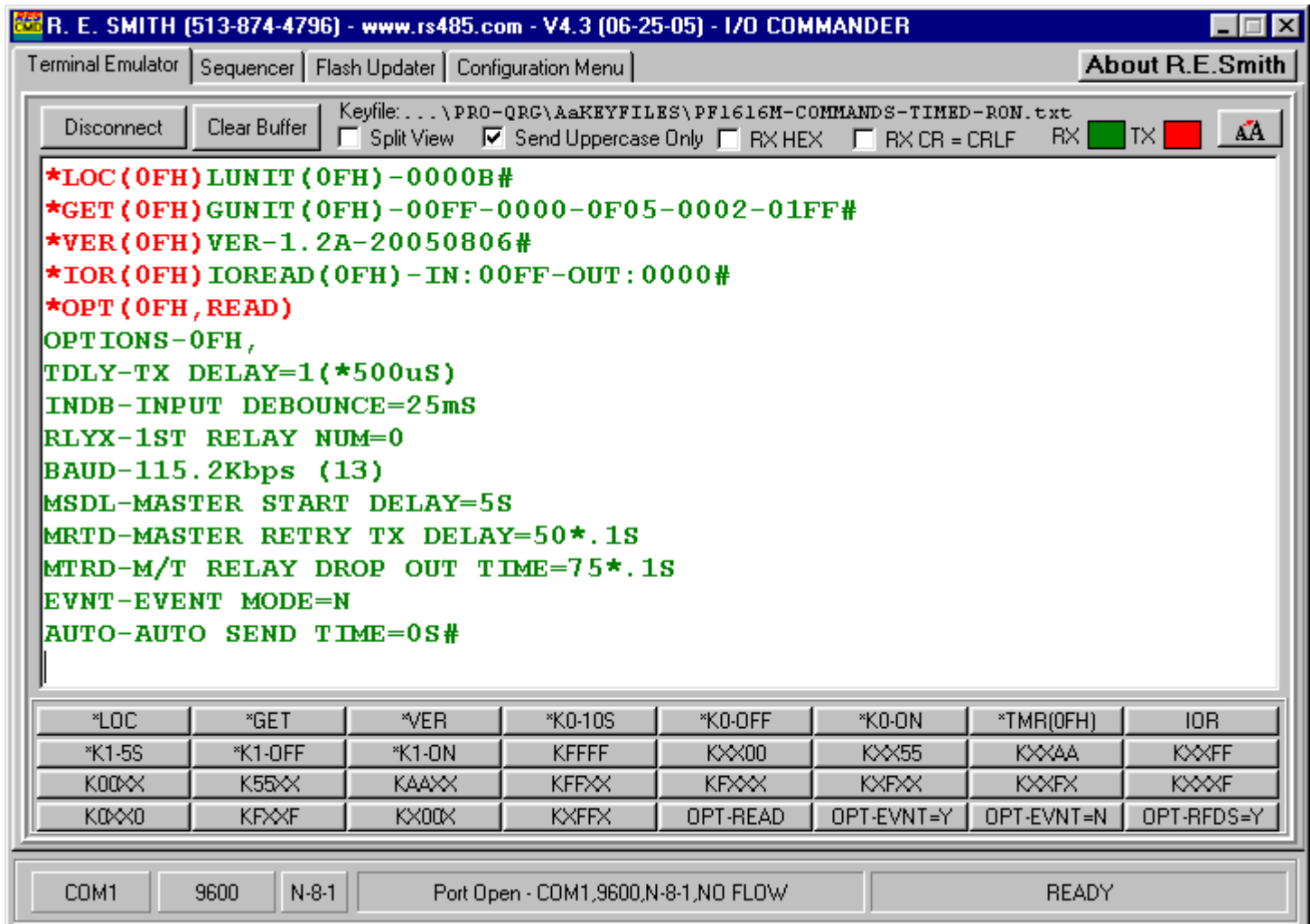


Figure 2. Typical Commands using the RES I/O Commander (Emulator)

Mode and Address Jumper summary:

- J2 = Address (16H) MSB
- J3 = Address (8H)
- J4 = Address (4H)
- J5 = Address (2H)
- J6 = Address (1H) LSB

Factory setting = J3=J4=J5=J6= installed = 0FH default address

J8 = Data Rate = installed = 9600bps*, removed = 115.2kbps (or option setting)

J9 = Test Mode = installed, Normal operation = removed

Note: **Do NOT use this mode if relays are connected to external devices!**

Each input is "transferred" to the corresponding relay output. This mode is for testing purposes only.

J10 = Stand-alone Master mode = installed

J11 = Stand-alone Target mode = installed

J10 and J11 installed = Stand-alone Master mode

WARNING: Always power down when changing mode jumpers or modules! Make sure that the module is aligned with the socket before power is reapplied.

I/O Summary and Specifications:

- 1) Onboard isolated power supply (12V@ 83mA) for inputs
- 2) Jumper selectable external isolated power supply (5-24vdc) for inputs
- 3) 16-inputs with independent jumper selection for each input
 - Input dry closure using onboard isolated supply (factory default) or external user provided supply
 - 5-24vdc non-polarity sensitive isolated input(s) via jumper selection
 - 12-24vac isolated input(s) via jumper selection
- 4) 16-relay outputs (Form-C, NO/NC)
 - Up to 30vdc @ 1A (resistive load, 100K operations)
 - Up to 30vac @ 1A (resistive load, 100K operations)
 - LED indicator for each relay output

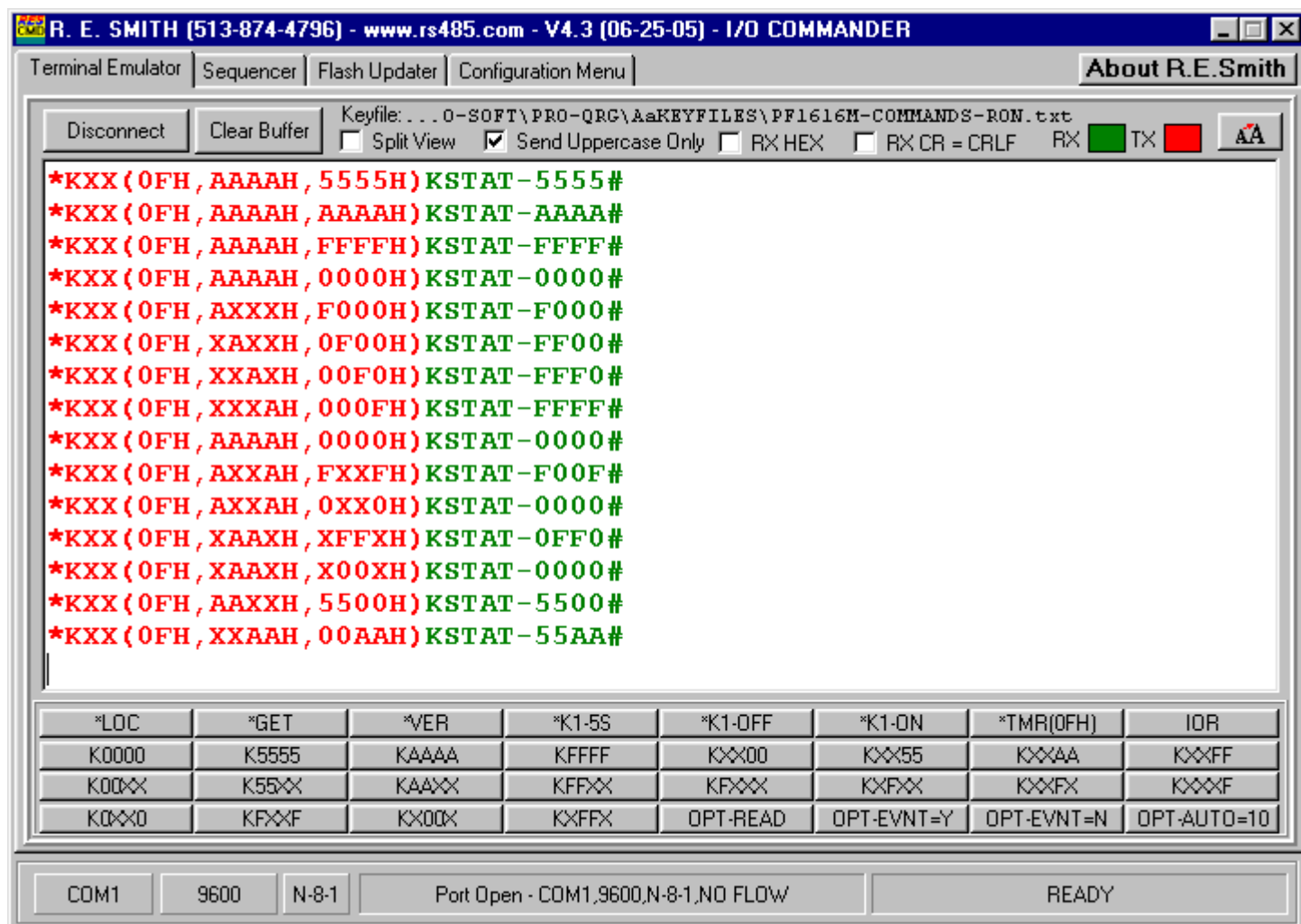


Figure 3. Typical “Parallel” Relay Commands using the RES I/O Commander (Emulator)

Typical Relay Commands (parallel):

Relay commands are very flexible in nature. Figure 3 shows methods of writing to the relay outputs in parallel format. The use of the parallel format will terminate any timed operations in progress on the bits/relays involved in the write operation. This format allows a write to any group of relays on a nibble (4-bit) basis. 1, 2 or 4 nibbles can be written at one time. Use Capital letters only! “*KXX(“ is the relay command, “0FH,” specifies the communications address of the PF1616M board, the next 4 characters (mask) specify the nibble(s) to be written to. Four characters must be specified. An “X” is a placeholder and “A” specifies “all” bit in the “target” nibble to be written to. The 4 mask characters are followed by “H,” and then a 4 character (data) “bit-pattern” followed by “H)” that terminates the command. 4 data characters must be entered. An “X” can be used in the data, in any position where a corresponding “X” has been use in the “mask.” For example: “AXXAH,1XX4H)” and/or “AXXAH,1234H)” are OK and only the “1 and 4” will be written to the relays. If an “X” is used in the data filed that corresponds to an “A”

in the mask field the “X” will be translated into a data “F.” For example: “AAAAH,12X4H)” would write 12F4 to the relays. The command “KXX(0FH,AAAAH,8000H)” will turn on MSB(KF-OL7) only and, the command “KXX(0FH,AAAAH,0001H)” will turn on LSB(K0-OR0) only.

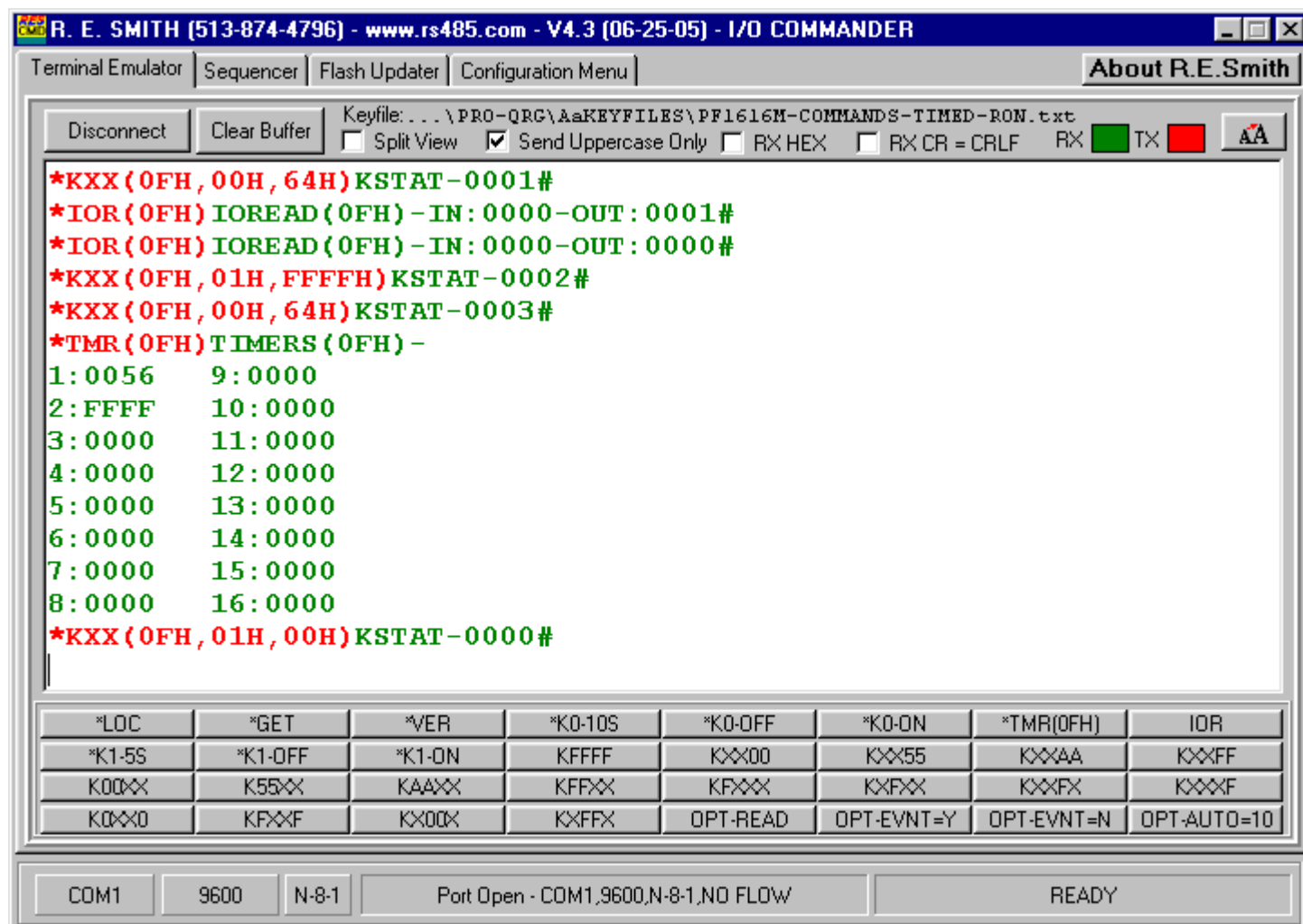


Figure 4. Typical “Individual” Relay Commands using the RES I/O Commander (Emulator)

Typical Relay Commands (individual control):

Figure 4 shows methods of controlling an individual relay. Relay #1 is the LSB (K0,OR0) and Relay #16 is the MSB (KF,OL7). Note: RLYX=0 (*OPT command). Note: Temporary designations pending changes to software.

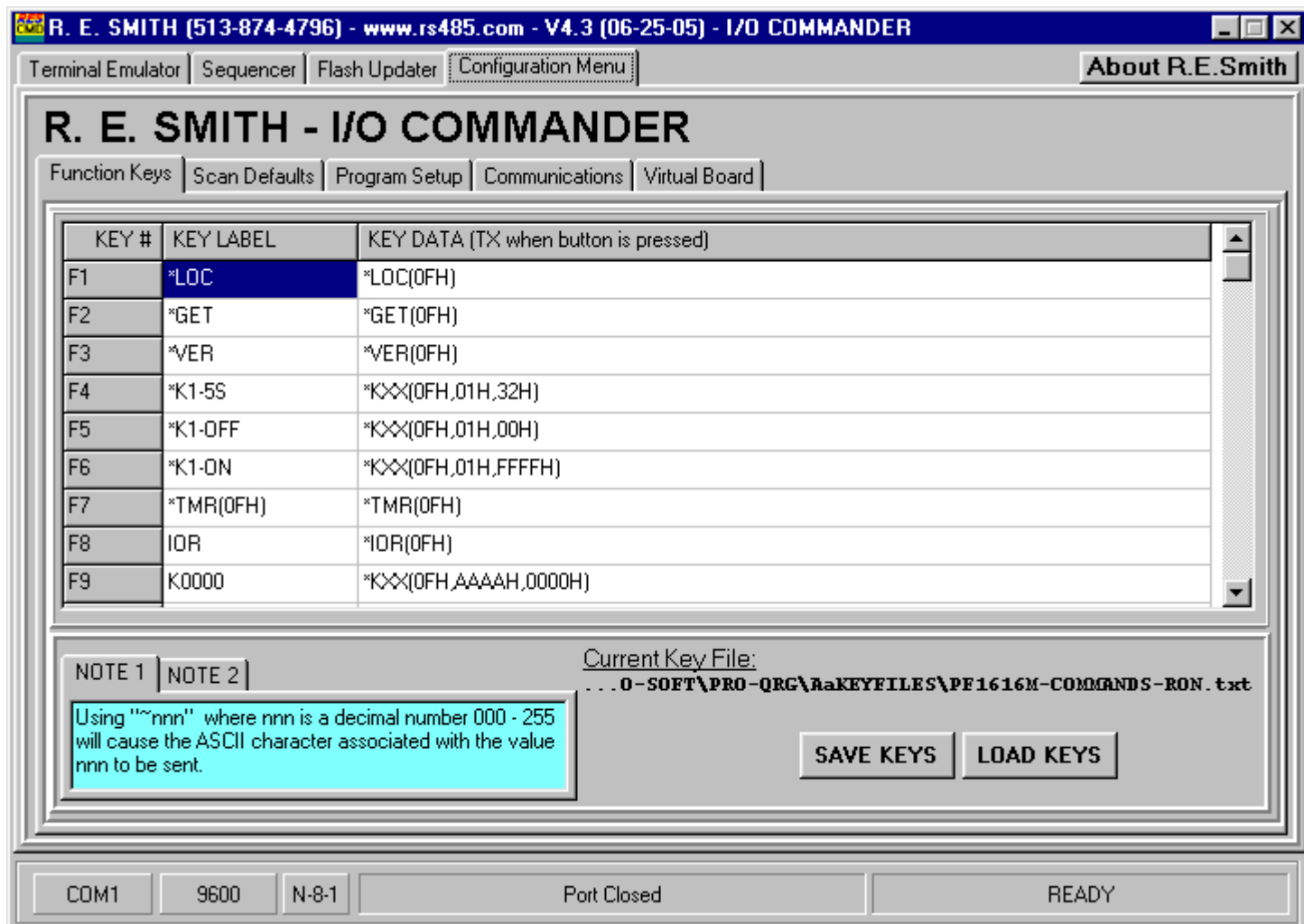


Figure 5. “Hot Key” configuration using the RES I/O Commander (Configuration Menu)

Hot Key strings:

Up to 32 “hot keys” (64 soon) can be setup for ease of sending commands while in the terminal emulator mode. This key data is saved in an .ini file and can be saved to a used file as well. Up to 12 characters can be used for the “Key Cap” and up to 1000 characters can be sent as key data. To enter data in a field, double click.

Setting Options:

Several options can be set and remembered by the onboard EEPROM.

*OPT(0FH,READ) will display the current option settings. Options are divided into four groups (basic, master/target mode, event driven mode, and hidden).

1) Basic settings:

- TX DELAY, *OPT(0FH,TDLY=XX) This option sets the transmit delay time in 500uSec. increments. If “0” is set the unit will respond to a command without delay. If “1” is set (factory default) the unit will delay 500uSec. before responding to a command. Delay is normally introduced to allow converters with slow “turn-around” time to revert back into receive mode in half-duplex networks. Full-duplex networks, in general, do not require delay, because the transmitter and receiver are on separate wires. This parameter is in decimal and can be set from “0” through “99.”
- INPUT DEBOUNCE, *OPT(0FH,INDB=XXXX) This option sets the input debounce time in mSeconds for the digital inputs. This parameter has a range for “0” through “4000” decimal. Factory default setting = 25mSec. This setting is for all 16 digital inputs.
- 1ST RELAY NUMBER, *OPT(0FH,RLYX=0) This option is used to offset the LSB designation for individual relay control. The first relay (LSB) can be set to “0” or “1.” The factory default setting is “0.” With a setting of “0” relay numbering for individual control is in the range of 0-F in hexadecimal. If the setting is “1” the numbering range is 1-10 in hexadecimal.
- DATA RATE (BAUD), *OPT(0FH,BAUD=XX) This option is used to set the data rate when jumper J8 is removed. If J8 is installed the data rate is fixed at 9600bps regardless of this option setting.

Setting #	Data rate	Setting#	Data rate
1	Reserved	9	28,800bps
2	Reserved	10	38,400bps
3	Reserved	11	57,600bps
4	2400bps	12	76,800bps
5	4800bps	13	115.2Kbps(default setting)
6	9600bps	14	230.4Kbps
7	14,400bps	15	460.8Kbps
8	28,800bps	16	921.6Kbps

The range of decimal input values is 0-99. Any reserved or out of range setting will default to 9600bps. The factory default setting is 115.2Kbps.

2) Master/Target mode settings (Stand-alone Mode):

- ❑ MASTER START DELAY, *OPT(0FH,MSDL=XX) This option sets the time delay on power-up to allow additional time for an ethernet module to establish communications with the network before transmitting the initial string from a master unit (jumper J10 installed). This parameter is in decimal and can be set from “1” through “99” Seconds. Factory default setting is 5 Seconds.
- ❑ MASTER RETRY TX DELAY, *OPT(0FH,MRTD=XXX) This option sets the time delay in 0.1Second increments to restore communications, if a target response is not received. This parameter can be used to allow additional time for ethernet communications, delays caused by speed of light limitations, radio warm-up delays, etc. This parameter only becomes active if communications between the master and target unit is “lost.” If the target device responds in a shorter time than the value set, the master will transmit the next string and reset this timer. If the communications from the target device is lost (or if the target did not receive a valid string from the master) the master will try to establish communications after the time out delay. This parameter is in decimal, and can have a range from 2 to 250 (0.2 - 25.0 Seconds). Factory default setting is 50 (5.0 Seconds).
- ❑ M / T RELAY DROP-OUT TIME, *OPT(0FH,MTRD=XXX) This option sets the time delay in 0.1Second increments to turn off any active relay(s), if a communications response is not received within the time set by this parameter. xxxxxxxxxxxx

3) Event Driven mode settings:

- ❑ Input dry closure using onboard isolated supply (factory default) or external user provided supply (work in progress!!!)

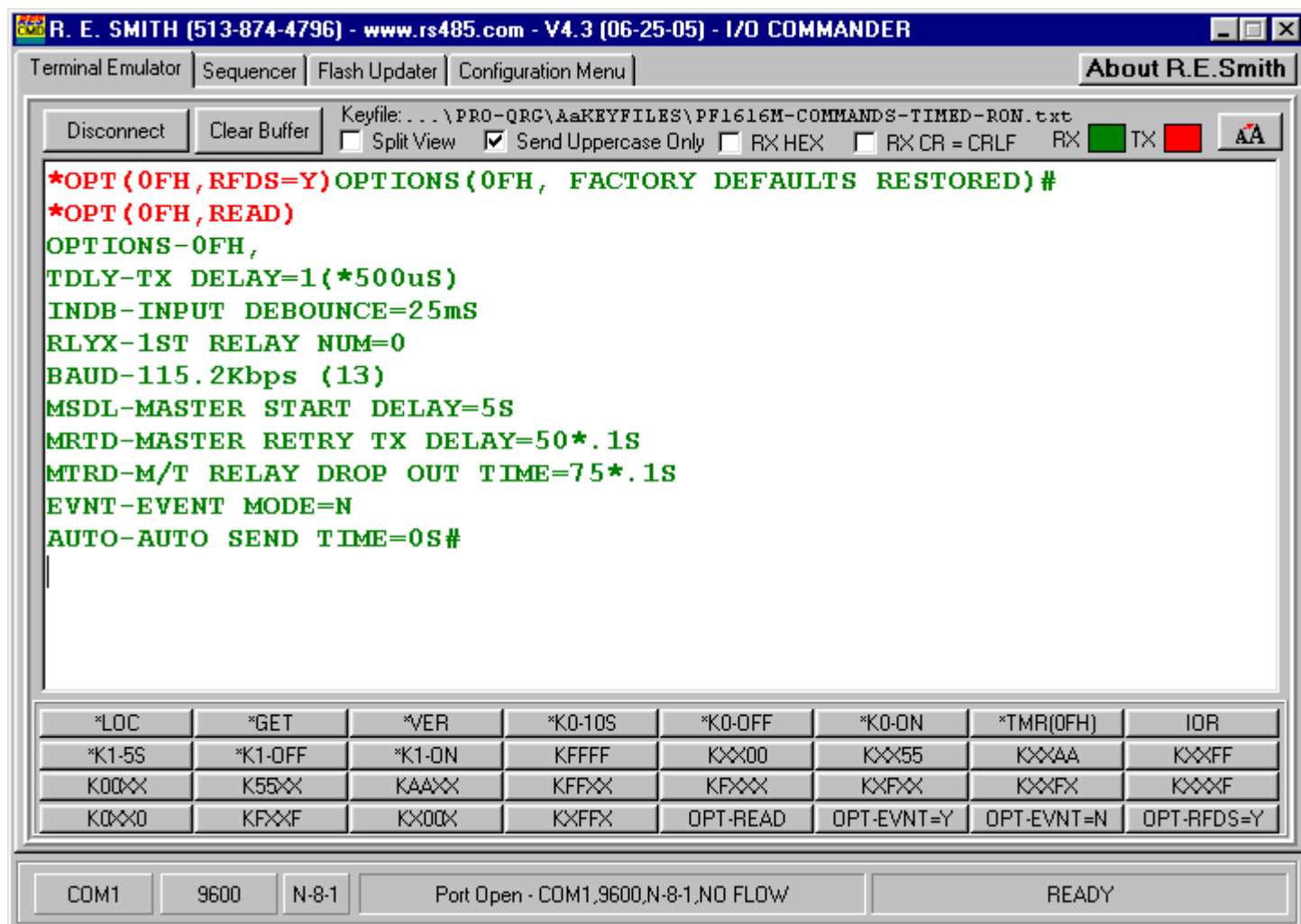


Figure 6. Option Read and Restore Factory Default Settings, using the RES I/O Commander (Emulator)

The information in this area is reasonably accurate; however, it needs to be updated.

PRELIMINARY

COMMAND STRUCTURE FOR

THE PF1616L UNIT AND OTHER PFxxxxx I/O BOARDS

(UPDATED 2-01-04)

COMMAND

RESPONSE (X=NIBBLE)

NOTES

***LOC(0FH) LUNIT(0FH) -XXXX#<CR><LF> XXXX=FLAGS**

The LOCate command returns any flags which might be defined, currently the PF1616L has no defined flags. This command is useful to scan a network to determine units present.

***GET(0FH) GUNIT(0FH) -XXXX-IIII-OOOO-JJJJ#<CR><LF>**

**X=FLAGS
I=INPUTS
O=OUTPUTS
J=JUMPERS**

The GET command returns the status of the unit, flags, inputs, outputs and jumpers are encoded and returned.

***VER(0FH) VER-1.3A-20040201<CR><LF>**

The VERsion command returns the version and date code of the software.

***TYP(0FH) TYPE-PFAHUB-REV-A<CR><LF>**

The TYPE command returns the unit type and hardware revision code.

***HLP(0FH) DISPLAY HELP PAGE<CR><LF>**

The HeLP command displays the help page.

----- I/O BOARD COMMANDS -----

***KXX(ADDRESS, MASK/RELAY, PARAMETER)**

The KXX command is useful to control the relay outputs, this command has two main forms. The mask mode which allows control of multiple relays and the individual mode which allows individual control over a relay.

When the **MASK/RELAY** value is AAH, AA00H, 0AA0H, or AAAAH multiple control is selected. When the **MASK/RELAY** value is a number 01H - 10H individual relay control is selected. Some examples follow.

***KXX(0FH,AAAAH,XXXXH) KALL-XXXX<CR><LF> XXXX=BIT PATTERN (HEX)**
(ADDRESS, ALL RELAYS, MASK VALUE) NOTE: TERMINATES ALL TIMERS

PF1616-Multiple simultaneous relay control

*KXX command to control multiple ON/OFF relay control simultaneously choices are:

1. To control all 16 relays ON/OFF state use the command - *KXX(addrH, AAAAH, ON/OFF-maskH[16bit mask])
2. To control upper 8 relays ON/OFF state use the command - *KXX(addrH, AA00H, ON/OFF-maskH[8bit mask])
3. To control lower 8 relays ON/OFF state use the command - *KXX(addrH, AAH, ON/OFF-maskH[8bit mask])
4. To control middle 8 relays ON/OFF state use the command - *KXX(addrH, AA0H, ON/OFF-maskH[8bit mask])

Examples (address = 0FH)

HI 5's would be - *KXX(0FH,AA00H,55H)KALL-5500

Result: K9-ON K10-OFF K11-ON K12-OFF K13-ON K14-OFF K15-ON K16-OFF

LO 5's would be - *KXX(0FH,AAH,55H)KALL-0055

Result: K1-ON K2-OFF K3-ON K4-OFF K5-ON K6-OFF K7-ON K8-OFF

MID 5's would be - *KXX(0FH,AA0H,55H)KALL-0550

Result: K4-ON K5-OFF K6-ON K7-OFF K8-ON K9-OFF K10-ON K11-OFF

ALL 0's would be - *KXX(0FH,AAAAH,0000H)KALL-0000

Result: K9-OFF K10-OFF K11-OFF K12-OFF K13-OFF K14-OFF K15-OFF K16-OFF
K1-OFF K2-OFF K3-OFF K4-OFF K5-OFF K6-OFF K7-OFF K8-OFF

ALL A's would be - *KXX(0FH,AAAAH,AAAAH)KALL-AAAA

Result: K9-OFF K10-ON K11-OFF K12-ON K13-OFF K14-ON K15-OFF K16-ON
K1-OFF K2-ON K3-OFF K4-ON K5-OFF K6-ON K7-OFF K8-ON

PF1616-Individual relay control

To control individual relays, the relay number is specified as the second parameter to the *KXX command and a time value is specified as the third parameter. If the time value is FFFFH the relay will be activated and remain activated until commanded otherwise. Any other value greater than zero specifies a time in .1S increments the relay should remain activated and then deactivate after the timeout automatically. Specifying a value of 0000H for the time value will deactivate the relay if active.

*KXX(0FH,01H,XXXXH) K01-DDDD<CR><LF> DDDD=XXXX=TIME (HEX) 0.1SEC.
(ADDRESS, RELAY#, TIMER) 0000H=OFF, FFFFH=ON

*KXX(0FH,01H,XXXH) K01-0DDD<CR><LF> " "

*KXX(0FH,01H,XXH) K01-00DD<CR><LF> " "

*KXX(0FH,01H,XH) K01-000D<CR><LF> " "

OPTION COMMANDS

***OPT(0FH,MSRTXDLY=50)** - This command sets the standalone master retransmit delay if the slave does not respond. The increments are in .1 seconds.

***OPT(0FH,MSRDO=50)** - This command sets the standalone Relay Drop Out time. The increments are in .1 seconds. A value of 0 specifies no drop mode is enabled.

***OPT(0FH,READ)** - This command reads the internal non-volatile option settings. The following output represents the boards response to this command:

```
OPTIONS(0FH,  
TRANSMIT DELAY=32H (*500uS)  
EVENT MODE=N  
INPUT DEBOUNCE=10 mS  
AUTO SEND TIME=0 S  
MASTER RETRY TX DELAY=50 *.1S  
MASTER/SLAVE RELAY DROP OUT DISABLED  
Internal 12-Bit Address = 022H  
Address Mode 8Bit External (J27-J34) [ACTIVE]
```

TIMER READING

***TMR(0FH)TIMERS(0FH)** -

```
1:0000    9:0000  
2:0000    10:0000  
3:0000    11:0000  
4:0000    12:0000  
5:0000    13:0000  
6:0000    14:0000  
7:0000    15:0000  
8:0000    16:0000
```

EVENT MODE COMMANDS

```
*OPT(0FH,TDLY=05H)OPTIONS(0FH,TRANSMIT DELAY=05H)  
*OPT(0FH,EVNT=N)OPTIONS(0FH,EVENT MODE=N)  
*OPT(0FH,EVNT=Y)OPTIONS(0FH,EVENT MODE=Y)  
*OPT(0FH,DBNC=200)OPTIONS(0FH,INPUT DEBOUNCE=200 milli-seconds)  
*OPT(0FH,AUTO=0)OPTIONS(0FH,AUTO SEND TIME=0 Seconds)  
*OPT(0FH,AUTO=5)OPTIONS(0FH,AUTO SEND TIME=5 Seconds)
```

NOTES:

TDLY=XXH, XX must be hex digits, 00,01,02,... 2 digits. 255 decimal max.
ADDR=XXH, Specify the internal address, default 0E hex.

BOARD ADDRESS COMMANDS

```
*OPT(0FH,IAS)OPTIONS(22H, 8-BIT INTERNAL ADDRESS)  -- Board internal  
address 8 bits  
*OPT(0FH,IAL)OPTIONS(022H, 12-BIT INTERNAL ADDRESS) -- Board internal  
address 12 bits
```

OPTION COMMANDS (continued)

*OPT(0FH, TDLY, 01H) -- OPTIONS(0FH,TDLY=01H)

Set the transmit delay increments of 250us per increment.

*OPT(0FH, I2CA, 01H) -- OPTIONS(0FH,I2CA=01H)

Set the base address of the I2C Display

Master/Slave Mode Description - Format 1

<M/S><Format><Flags><->*<Addr(2)><,><In-data><,><Out-data><*><Checksum(4)><CRLF(2)>

- <M/S>** Master/Slave tag. Tags the data so the display board knows where to put it.
- <Format>** Single character 0 to F. Allows for future data formats as they are dreamed up.
0=AT2424SAL Format <not supported in the PF1616L>
1=PF1616L Format

The balance of the packet depends upon the format defined by the **Format** byte above.

Format 1 Description:

Typical master transmission M10-0F,0001,0001*FCAC<cr><lf>

- <Flags>** Single character 0 to F to define 4 flag bits.
- | Bit | Definition |
|-----|--|
| 3 | Previous received packet error status. |
| 2 | Timeout Error. No response from slave |
| 1 | Reserved |
| 0 | Reserved |
- <->** Dash. Start of data field marker
- <Addr(2)>** Ascii Hex Data nibbles describing 8 bits of address data.
- <,>** Comma separating address and Input data
- <In-data>** Input data field. 2 to n Ascii Hex Data nibbles describing 8 to 24 bits or more of the sending units input status.
- <,>** Comma separating input data and output data.
- <Out-data>** Output data field. 2 to n Ascii Hex Data nibbles describing 8 to 24 bits or more of the sending units output status.
- <*>** Asterisk. End of data field marker.
- <Checksum(4)>** 16 bit two's complement of all characters up to, and including, the end of data field marker.
- <CRLF(2)>** Two characters, D(hex) and A(hex)

Configuration Tables

Notes and abbreviations:

I = Install jumper (JX), **R** = Remove Jumper (JX), **XX** = don't care,
M/S = Master or Slave Mode, **M** = Master Mode, **S** = Slave Mode,
TX = Transmit, **RX** = Receive, * = Factory Default Setting,
HW = Hardware Setup.

Table 1: RS232/RS485 Configuration

JX	MODE	JUMPER FUNCTION AND NOTES				
J1-4	HW	J1	J2	J3	J4	RS-232 Port Configuration
		I*	I*	R	R	Computer Mode
		R	R	I	I	Modem Mode
J5	HW					
J6	HW					
J14	SW	Standalone mode enabled if removed, computer mode if installed (default).				
J15	SW	Standalone mode unit selection master=installed, slave=removed.				
J16	SW	Dual parser enabled if removed, helpful to reload firmware or configuration. If removed the unit will respond to computer mode commands while standalone mode is paused by isolating one of the units.				
J17	SW	Internal/External Address Enable, External J27-J34 if installed, Internal 8bit or 12bit configurable with option command if removed.				
J18-J21	SW	Baud Rate Selection Jumpers See Table 2.				
J27-J34	SW	External Address (J27-msb : J34-lsb)				

This table does NOT apply to the PF1616M board!

Table 2: RS-232 BAUD RATE SETUP

Baud Rate Selection in any MODE (J18 – J21)

Note: Sampled on power-up only!

HEX	J18	J19	J20	J21	Baud
F	I*	I*	I*	I*	9600
E	I	I	I	R	115.2K
D	I	I	R	I	9600
C	I	I	R	R	57.6K
B	I	R	I	I	38.4K
A	I	R	I	R	28.8K
9	I	R	R	I	19.2K
8	I	R	R	R	14.4K
7	R	I	I	I	9600
6	R	I	I	R	4800
5	R	I	R	I	2400
4	R	I	R	R	9600
3	R	R	I	I	9600
2	R	R	I	R	9600
1	R	R	R	I	9600
0	R	R	R	R	9600

Table 6: TABLE OF SPECIFICATIONS FOR COMMON COMMUNICATIONS STANDARDS:

SPECIFICATIONS		RS232	RS423	RS422	RS485
Mode of Operation		SINGLE-ENDED	SINGLE-ENDED	DIFFERENTIAL	DIFFERENTIAL
Total Number of Drivers and Receivers on One Line		1 DRIVER 1 RECVR	1 DRIVER 1 RECVR	10 DRIVER 10 RECVR	32 DRIVER 32 RECVR
Maximum Cable Length		50 FT.	4000 FT.	4000 FT.	4000 FT.
Maximum Data Rate		20kb/s	100kb/s	10Mb/s	10Mb/s
Maximum Driver Output Voltage		±25V	±6V	-0.25V to +6V	-7V to +12V
Driver Output Signal Level (Loaded Min.), (Unloaded Max.)	Loaded	±5V to ±15V	±3.6V	±2.0V	±1.5V
	Unloaded	±25V	±6V	+/-6V	±6V
Driver Load Impedance (Ohms)		3k to 7k	≥450	100	54
Max. Driver Output Current in High Impedance State	Power On	N/A	N/A	N/A	±100uA
	Power Off	±6mA @ ±2v	±100uA	±100uA	±100uA
Slew Rate (Max.)		30V/uS	Adjustable	N/A	N/A
Receiver Input Voltage Range		±15V	±12V	-10V to +10V	-7V to +12V
Receiver Input Sensitivity		±3V	±200mV	±200mV	±200mV
Receiver Input Resistance (Ohms)		3k to 7k	4k min.	4k min.	≥12k