! "#$%&# ' ( )&*&+,-*& .& .&, /#+&*0-#/1%&2(3%-#'4#5,(3 UART

!""#$%&'(

)$% *$%$+(,%**-%./0%1$#2 '*3#4+.#0%"'' 3#*415#0%$14+"#6# #2#,75#0%"'(* FreeBSD.

8&+#'H0%3#

1. UART: 6-&7-&3)0) '0$&-0#-

8"'01,*%4+"/9 %*'":,#""/9 3,';<#31,15%$='- (UART) Ñ >$# -4?=10#9 -#<3#"1"$ 3#5*'*$1</ 3#*415#0%$14+"#9 31,15%=' 5%""/: -#<3+?$1,%. UART 3,'"'<%1$ 2%9$/ 5%""/: ' 31,15%;$ #$514+"/12'$/ 3#*415#0%$14+"#. @% *$#,#"1 3,';<"'-% 0$#,#9 UART *#2',%1$ 2'$/ #2,%$"#0 3#4"/12%9$/.

A#*415#0%$14+"%(31,15%=% 5%""/: #2/="# '*3#4+.71$*(* <#51<%<' ' 54("1 *1$10#6# 0.%'<#519*$0'(<1B57 -#<3+?$1,%<',$1,<'"%4%<' ' 5,76'<' 7*$,#9*$0%<'.

C7D1*071 501 #*"#0"/1 E#,</ 3#*415#0%$14+"#9 31,15%=' 5%""/:: *'":,#""%(' %*'":,#""%(. F .%0'*'<#*$' #$,1B'<#0, 3#551,B'0%1</: #2#,75#0%"'1<, "%.0%"'1 3#5*'*$1</ *0(.'#2/="#0-4?=%1$ 27-07 A, 1*4' #"% 3#551,B'0%1$ %*'":,#""7? 31,15%=7, ' 27-07 S, 1*4' 3#551,B'0%1$*(*'":,#""%(31,15%=%. G21 E#,</ #3'*%"/ "'B1.

@1-#$#,/1,%*3,#*$,%";""/1*#-,%D1"'(:

UART Universal Asynchronous Receiver/Transmitter Ñ 8"'01,*%4+"/9 %*'":,#""/9 3,';<#31,15%$='-

USART Universal Synchronous-Asynchronous Receiver/Transmitter Ñ 8"'01,*%4+"/9 *'":,#""#-%*'":,#""/9 3,';<#31,15%$='-

1.1. 83%9'&%%0: .&,/#+&*0-#/1%0: .#'#+0"0

C'":,#""%(3#*415#0%$14+"%(31,15%=% 5%""/: $,1271$, =$#2/ #$3,%0'$14+ ' 3#47=%$14+ '<14' #2D'9 $%-$#0/9 *'6"%4, 4'2# =$#2/ #$3,%0'$14+ 3,15#*$%04(4 *$,#2-*'6"%4 '4' 5,76#9 *'6"%4 *'":,#"'.%&'', =$#2/ 3#47=%$14+ ."%4, -#65% "*='$/0%$+" *4157?D'9 2'$ 5%""/:. F 2#4+H'"*$01 E#,< *'":,#""#9 3#*415#0%$14+"#9 *0(.', 1*4' 0 5%""/9 <#<1"$ "1$ 5#*$73"/: 5%""/: 54(31,15%=', 0<1*$# "': 5#4B1" 2/$+ #$3,%041" .%3#4"(?D'9 *'<0#4, =$#2/ 31,15%=% 5%""/: "1 3,1,/0%4%*+. C'":,#""%(*0(.+ #2/="# 2#411 >EE1-$'0"%, $%- -%- <1B57 #$3,%0'$141< ' 3#47=%$141< 31,15%?$*($#4+-# 2'$/ 5%""/:, #5"%-# #"% <#B1$ 2/$+ 2#411 .%$,%$"#9, 1*4' $,127?$*(5#3#4"'$14+"/1 3,#0#5% ' *:1</54(#2<1"%$%-$#0/< *'6"%4#< <1B57 #$3,%0'$141< ' 3#47=%$141<.

I#,<% *'":,#""#9 31,15%=' '*3#4+.71$*(* 3,'"$1,%<' ' 7*$,#9*$0%<' * B;*$-'<' 5'*-%<', 651 5%""/1 31,15%?$*(3# #5"#<7 "%2#,7 3,#0#5#0, %$%-$#0/9 *'6"%4 '4' *$,#2 Ñ 3# 5,76#<7 3,#0#57. A,'"$1,/ ' 7*$,#9*$0% * B;*$-'<' 5'*-%<' #2/="# "1 (04(?$*(3#*415#0%$14+"/<' 7*$,#9*$0%<', $%- -%- 2#4+H'"*$0# *$%"5%,$#0 '"$1,E19*#0 B;*$-': 5'*-#0 31,15%?$ &14#1*4#0# 5%""/: 54(-%B5#6# $%-$#0#6# *'6"%4% '4' *$,#2%, '*3#4+.7(#$514+"/9 3,#0#5 54(-%B5#6# 2'$% *4#0%. F '"57*$,'' AJ $%-'1 7*$,#9*$0% '.01*$"/ -%-3%,%4414+"/1.

C$%"5%,$"#1 #2#,75#0%"'1 54(3#*415#0%$14+"#9 *0(.' 0 AJ "1 3#551,B'0%1$ *'":,#""/1 #31,%&''.)$#$,1B'< #3'*%" .51*+ $#4+-# 54(*,%0"1"'(.

1.2. ;,3%9'&%%0: .&,/#+&*0-#/1%0: .#'#+0"0

!*'":,#""%(31,15%=% 3#.0#4(1$ 31,15%0%$+ 5%""/1 21. "1#2:#5'<#*$' #$3,%0-'$%-$#0#6# *'6"%4% #$ #$3,%0'$14(- 3#47=%$14?. F<1*$# >$#6# #$3,%0'$14+ ' 3#47=%$14+ .%,%"11 *#64%*#0/0%?$ 3%,%<1$,/ *'":,#"'.%&'', % - -%B5#<7 *4#07 5#2%04(?$*(*31&'%4+"/1 2'$/, -#$#,/1 '*3#4+.7?$*(54(*':,#"'.%&'' 31,15%?D16# ' 3,'"'<%?D16# 7*$,#9*$0.

A,' 31,15%=1 *4#0% =1,1. UART 0 %*'":,#""#< ,1B'<1 - "%=%47 -%B5#6# 31,15%0%1<#6# *4#0% 5#2%04(1$*(2'$, "%./0%1</9 "*$%,$#0/< 2'$#<". C$%,$#0/9 2'$ '*3#4+.71$*(54(#3#01D1"'(3,';<"'-% # "%=%41 31,15%=' *4#0% 5%""/:, % $%-B1 54(*'":,#"'.%&'' $%-$#0#6# *'6"%4% 3,';<"'-%*$%-$#0/< *'6"%4#< 31,15%$='-%.)$' 50% $%-$#0/:*'6"%4% 5#4B"/2/$+ 5#*$%$#="# $#="/<', =$#2/ ':,%*:#B51"'1 3# =%*$#$1 "1 3,10/H%4# 10% 0# 0,1<(31,15%=' #*$%0H':*(2'$#0 *4#0%. (K%""#1 $,12#0%"'1 2/4# 7*$%"#041"# 0# 0,1<1"%<1:%"'=1*-': 141%93#0 ' 416-# 0/3#4"(1$*(*#0,1<1""/< >41-$,#""/<#2#,75#0%"'1<.)

A#*41 *$%,$#0#6# 2'$% 31,15%?$*(#$514+"/1 2'$/ *4#0% 5%""/:, "%='"%(* <4%5H16#."%=%D16# 2'$% (LSB). J%B5/9 2'$ 31,15%;$*(0 $1=1"'1 $#="# $%-#6# B1 0,1<1"', -%- ' 0*1 #*$%4+"/1 2'$/, ' 3,'1<"'- "3,#01,(1$" *#*$#("'1 4'"'' 3,'<1,"# "% *1,15'"1 '"$1,0%4%, #$0151""#6# 54(-%B5#6# 2'$%, =$#2/ #3,1514'$+, (04(1$*(4' 2'$ 1 '4' 0. @%3,'<1,, 1*4' 31,15%=% -%B5#6# 2'$% ."%'<%1$ 501 *1-7"5/,3,'1<"'- 3,#01,'$ *'6"%4, =$#2/ #3,1514'$+, (04(1$*(4' #" 1 '4' 0, =1,1. #5"7 *1-7"57, .%$1< 3#5#B51$ 501 *1-7"5/' 3,#01,'$."%=1"'1 *4157?D16# 2'$%, ' $%- 5%411.

G$3,%0'$14+ "1 ."%1$, -#65% 3#47=%$14+ Ç3#*<#$,14È ."%=1"'1 2'$%. G$3,%0'$14+ ."%1$ $#4+-#, -#65% 3# $%-$#0#<7*'6"%47 "7B"# "%=%$+ 31,15%=7*4157?D16# 2'$%*4#0%.

J#65% 0*1*4#0# 5%""/: #$3,%041"#, 31,15%$='- <#B1$ 5#2%0'$+ 2'$ =;$"#*$', -#$#, /9 #" 61"1,',71$. L'$ =;$"#*$' <#B1$ 2/$+ '*3#4+.#0%" 3,'1<"'-#< 54(0/3#4"1"'(3,#*$#9 3,#01,-' "%#H'2-'.M%$1< 31,15%$='- #$3,%04(1$ -%- <'"'<7< #5'"*$#3#0/9 2'$.

J#65% 3,'1<"'- 3#47='4 0*1 2'$/ 0*4#01 5%""/:,#" <#B1$ 3,#01,'$+ 2'$/ =;$"#*$' (-%- #$3,%0'$14+, $%- ' 3,'1<"'- 5#4B"/ 5#6#0#,'$+*(# $#<, 2751$ 4' '*3#4+.#0%$+*(2'$ =;$"#*$'), % .%$1< 3,'1<"'- 'D1$ *$#3#0/9 2'$. N*4' *$#3#0/9 2'$ "1 3#(04(1$*(, -#65% 5#4B1", UART *='$%1$ 0*1*4#0# '*-%B1""/< ' *##2D'$#2 #H'2-1 -%5,',#0%"'(64%0"#<7 3,#&1**#,7 3,' =$1"'' *4#0% 5%""/:. G2/="%(3,'='"% #H'2-' -%5,',#0%"'(Ñ "1*#03%51"'1 *-#,#*$' $%-$#0/: *'6"%4#0 #$3,%0'$14(' 3,'1<"'-% '4' 3,1,/0%"'1 *'6"%4%.

@1.%0'*'<# #$ $#6#, 2/4' 4' 5%""/1 3#47=1"/ 3,%0'4+"# '4' "1$, UART %0$#<%$'=1*-' #$2,%*/0%1$ 2'$ =;$"#*$', *$%,$#0/9 ' *$#3#0/9 2'$/. N*4' #$3,%0'$14+ ' 3#47=%$14+ "%*$,#1"/ #5'"%-#0#,>$' 2'$/ "1 31,15%?$*(:#*$7.

N*4' 6#$#0# *4157?D11 *4#0# 54(31,15%=', *$%,$#0/9 2'$ "#0#6# *4#0% <#B1$ 2/$+ #$3,%041" *,%.7 3#*41 $#6#, -%- 2751$ #$3,%041" *$#3#0/9 2'$ 3,15/57D16# *4#0%.

A#*-#4+-7 %*'":,#""/1 5%""/1 (04(?$*("*%<#*'":,#"'.',7?D'<'*(", 1*4' "1$ 5%""/: 54(31,15%=',4'"'(31,15%=' <#B1$ 2/$+ "1%-$'0"%.

1.3. <'(=3# 4(%)>33 UART

A#<'<# #*"#0"#9 .%5%=' 3,1#2,%.#0%"'(5%""/: '. 3%,%4414+"#6# E#,<%$% 0 3#*415#0%$14+"/9 54(31,15%=' ' '. 3#*415#0%$14+"#6# 0 3%,%4414+"/9 3,' 3,'1<1, UART #2/="# 3,15#*$%04(1$ 5#3#4"'$14+"/1*:1</ 54(*'6"%4#0, -#$#, /1 <#67$ '*3#4+.#0%$+*(54(7-%.%"'(*#*$#("'(*,15/ 31,15%=' ' ,1674',#0%"'(3#$#-% 5%""/: 0*47=%1, 1*4' 75%41""#1 7*$,#9*$0# "1 6#$#0# 3,'"'<%$+ 2#4+H1 5%""/:. @%3,'<1,, -#65% 7*$,#9*$0#, 3#5-4?=1""#1 - UART, (04(1$*(<#51<#<, <#51< <#B1$ *##2D%$+ # "%4'='' "1*7D19 "% $141E#""#9 4'"'', 0 $# 0,1<(-%- -#<3+?$1, <#B1$ 5%$+ -#<%"57 <#51<7*2,#*'$+ *12('4' "1 3,'"'<%$+ 0/.#0/, 3#5"'<%('4' #37*-%(#5'" '4' "1*-#4+-# '. >$':5#3#4"'$14+"/:*'6"%4#0. I7"-&'(-%B5#6# '.>$':5#3#4"'$14+"/:*'6"%4#0 #3,15141"% 0*$%"5%,$1 EIA RS232-C.

1.4. 8-0%+0'-? RS232-C 3 V.24

F 2#4+H'"*$01 -#<3+?$1,"/: *'*$1< UART 3#5-4?=1" - *:1<1, -#$#,%(61"1,',71$ *'6"%4/, *##01*$07?D'1*31&'E'-%&'' EIA RS232-C. O%-B1*7D1*071 *$%"5%,$ CCITT 3#5 "%.0%"'1< V.24, -#$#, /9 #$,%B%1$*31&'E'-%&'',0-4?=1""/1 0 RS232-C.

1.4.1. @0A%0"#%3: $3-&* RS232-C (2#-)3 3 .'&$#/?)

F *$%"5%,$1 RS232-C ."%=1"'1 1 "%./0%1$*(!"#$%# (Mark), %."%=1"'1 0 Ñ &#'(%) (Space). J#65% 4'"'(*0(.' "%:#5'$*(0*#*$#("'' 3#-#(, 6#0#,($, =$# #"% "<%,-',71$" (Marking), $# 1*$+

31,15%;$ "13,1,/0"/1."%=1"'(1.

C$%,$#0/9 2'$ 0*165% '<11$."%=1"'1 0 (3,#214). C$#3#0/9 2'$ 0*165% '<11$."%=1"'1 1 (<1$-%).)$# #."%=%1$, =$# "% 4'"'' 0*165% 2751$ 31,1:#5 #$ <1$-' (1) - 3,#2147 (0) 0 "%=%41 -%B5#6# *4#0%, 5%B1 3,' 31,15%=1 "1*-#4+-': *4#0 3#5,(5.)$# 6%,%"$',71$, =$# #$3,%0'$14+ ' 3#47=%$14+ <#67$ *'":,#"'.',#0%$+ *0#' $%-$#0/1*'6"%4/ "1.%0'*'<# #$ *#51,B'<#6# 31,15%0%1</:2'$#0 5%""/:.

F,1<(3,#*$#(<1B57 *$#3#0/< ' *$%,$#0/<2'$%<' "1 #2(.%$14+"# 5#4B"# 2/$+ $#="/<-,%$"/<(0-4?=%("#4+) *-#,#*$' 31,15%=' 5%""/: -#<<7"'-%&'#""#6# -%"%4%, #5"%-# 2#4+H'"*$0# UART *3,#1-$',#0%"/ $%-'<#2,%.#<54(3,#*$#$/.

F *$%"5%,$1 RS232-C *'6"%4 ÇMarkingÈ (4#6'=1*-%(1) 3,15*$%041" "%3,(B1"'1< #$-2 F 5#-12 F,%*'6"%4 ÇSpacingÈ (4#6'=1*-'9 0) Ñ "%3,(B1"'1< #$ 0 F 5# +12 F. A1,15%$='-5#4B1" 0/5%0%$+ +12 F '4' -12 F,%3,';<"'-5#4B1" 7='$/0%$+ 0#.<#B"/1 3#$1,' "%3,(B1"'(0 54'""/: -%214(:. @1-#$#,/1 <%4#<#D"/1 31,15%$='-' ("%3,'<1,, 0 3#,$%$'0"/: -#<3+?$1,%:)'"#65% '*3#4+.7?$ $#4+-#+5 F '-5 F,"#>$' ."%=1"'(0*;1D;5#37*$'</54(3,';<"'-% RS232-C 3,' 7*4#0'' '*3#4+.#0%"'(-#,#$-': -%21419.

1.4.2. 83=%0/ Break * RS232-C

RS232-C $%-B1 #3,1514(1$ *'6"%4 3#5 "%.0%"'1< Break, -#$#,/9 0/./0%1$*(31,15%=19 "13,1,/0"/: ."%=1"'9 Spacing (21. *$%,$#0/: '4' *$#3#0/: 2'$#0). J#65% "% 4'"'' 5%""/: #$*7$*071 "%3,(B1"'1,*='$%1$*(,=$# 4'"'(31,15%;$ Break.

C'6"%4 Break 5#4B1" '<1$+ 54'$14+"#*$+ 2#4+H1,=1< 0,1<(, "1#2:#5'<#1 54(31,15%='3#4"#6# 2%9$%, 0-4?=%(*$%,$#0/9, *$#3#0/9 ' 2'$/ =;$"#*$'. L#4+H'"*$0# UART *3#*#2"/ ,%.4'='$+ #H'2-7 -%5,',#0%"'(' *'6"%4 Break, "# 1*4' UART "1 3#551,B'0%1$ >$7 E7"-&'?, 54(#3,15141"'(Break <#B"# '*3#4+.#0%$+ #2"%,7B1"'1 #H'2-' -%5,',#0%"'(.

F# 0,1<1"% 141%93#0, -#65% <"#B1*$0# 3,'"$1,#0 3# 0*19 *$,%"1 2/4' *#15'"1"/3#*415#0%$14+"# ("%3,'<1,, 0 *47B2%: "#0#*$19), 4?2#1 7*$,#9*$0# <#64# 0/.0%$+ Break, 0,1<1""# ,%.</-%(0*? &13+,=$#2/ $#- "1 3,#$1-%4.)$# '*3#4+.#0%4#*+ 54($#6#,=$#2/<1*$# * *,#="/<' "#0#*$(<' <#64# 3,1,0%$+ 7*$,#9*$0# 0 5,76#< <1*$1,-#$#,#1 0 5%""/9 <#<1"$ 31,15%0%4# '"E#,<%&'?.

F *#0,1<1""/: *'*$1<%: *7D1*$071$ 50% $'3% *'6"%4#0 Break. N*4' Break 54'$*(5#4+H1 1,6 *1-7"5,#" *='$%1$*("P#51<"/< Break", ' "1-#$#,/1 <#51</ <#B"# .%3,#6,%<<',#0%$+ "% .%01,H1"'1 *#15'"1"'(' 31,1:#5 0 ,1B'< #B'5%"'('4' 0:#5 0 -#<%"5"/9 ,1B'<<#51<% 3,' #2"%,7B1"'' >$#6# *'6"%4%. N*4' Break -#,#=1 1,6 *1-7"5,>$# #."%=%1$ "Break 5%""/:", ' 75%4;""/9 -#<3+?$1,5#4B1" ,1H'$+,-%- ,1%6',#0%$+ "% >$#$ *'6"%4. Q"#65% $%-%(E#,<% Break '*3#4+.71$*(-%- *'6"%4 "F"'<%"'1" '4' "A,1,/0%"'1", % '"#65% 3,'"'<%1$*(-%- .%<1"%*'<0#47 ASCII CONTROL-C.

P1$-' ' 3,#214/ $%-B1 >-0'0%41"$"/ "5/,-%<" ' "#$*7$*$0'? 5/,#-" 0 *'*$1<%: *27<%B"#9 41"$#9.

> **!** R%.,/0/ "1 <#67$ 2/$+ *61"1,',#0%"/ * 31,E#41"$/ '4' '. 4?2#6# 5,76#6#

2%9$#0#6# ."%=1"'(, 3#*-#4+-7 2%9$/ 0*165% #$3,%04(?$*(*# *$%,$#0/< '*$#3#0/< 2'$%<'. UART #2/="# *3#*#21" 61"1,',#0%$+ "13,1,/0"/9 *'6"%4 Spacing 0 #01 "%*31&'%4+"7? -#<%"57 #$ 64%0"#6# 73,%04(?D16# 7*$,#9*$0%(3,#&1**#,%31,15%=').

1.4.3. RS232-C (,-'&5,-*0 DTE 3 DCE

C31&'E'-%&'(RS232-C #3,1514(1$ 50% $'3% #2#,75#0%"'(:#-#"1="#1 #2#,75#0%"'15%""/: (DTE Ñ Data Terminal Equipment) ' #2#,75#0%"'1 31,15%=' 5%""/: (DCE Ñ Data Carrier Equipment). G2/="# 7*$,#9*$0# DTE Ñ >$# $1,<'"%4 ('4' -#<3+?$1,), % DCE Ñ <#51<. @% 5,76#< -#"&1 $141E#""#9 4'"'' 0 ,%.6#0#,1 3,'"'<%?D'9 <#51< $%-B1 (04(1$*(7*$,#9*$0#< DCE, % -#<3+?$1,, 3#5-4?=;""/9 - >$#<7 <#51<7, Ñ 7*$,#9*$0#< DTE. 8*$,#9*$0# DCE 3,'"'<%1$*'6"%4/ "%$1: -#"$%-$%:, "% -#$#,/: 7*$,#9*$0# DTE 31,15%;$, '"%#2#,#$.

J#65% 50% 7*$,#9*$0%, #2% (04(?D'1*(DTE '4' DCE, 5#4B"/ 2/$+ *#15'"1"/ 0<1*$1 21. <#51<% '4' %"%4#6'="#6# 3,1#2,%.#0%$14(*,15/ <1B57 "'<', "1#2:#5'<# '*3#4+.#0%$+ NULL <#51<. NULL <#51< >41-$,'=1*-' 31,1*$,%'0%1$ -%214+ $%-, =$# 0/:#5 31,15%$='-% 3#5-4?=%1$*(-# 0:#57 3,'1<"'-% "% 5,76#< 7*$,#9*$01, ' "%#2#,#$. !"%4#6'="/1 3,1#2,%.#0%"'(0/3#4"(?$*(54(0*1: 73,%04(?D':*'6"%4#0, =$#2/ -%B5#1 7*$,#9*$0# 0'514# $#, =$# #"#*='$%1$*'6"%4%<' DCE ('4' DTE) #$ 5,76#6# 7*$,#9*$0%.

J#4'=1*$0# *'6"%4#0, 61"1,',71</: 7*$,#9*$0%<' DTE ' DCE, "1*'<<1$,'="#. 8*$,#9*$0# DTE 61"1,',71$ <1"+H1*'6"%4#0 54(7*$,#9*$0% DCE, =1< 3#47=%1$ #$ "16#.

1.4.4. @0A%0"#%3#)&%-0)-&* RS232-C

C31&'E'-%&'(EIA RS232-C (' 1; >-0'0%41"$ ITU, V.24) 3,157*<%$,'0%1$ '*3#4+.#0%"'1 50%5&%$'3($'-#"$%-$"#6# ,%.S;<% (#2/="# DB25) ' #3,1514(1$ "%."%=1"'1 2#4+H'"*$0% -#"$%-$#0 0>$#< ,%.S;<1.

F IBM Personal Computer ' 3#5#2"/: *'*$1<%: 3#5<"#B1*$0# *'6"%4#0 RS232-C 3,15#*$%04(1$*(=1,1. 510($'-#"$%-$"/1 ,%.S1</ (DB9). C'6"%4/,-#$#,/1 "1 0-4?=1"/ 0 ,%.S1< AJ, 0 #*"#0"#< *0(.%"/ * *'":,#""#9 ,%2#$#9, ' >$#$,1B'< 31,15%=' "1 3#551,B'0%1$*(UART, 0/2,%""/< IBM 54('*3#4+.#0%"'(0 IBM PC.

F .%0'*'<#*$' #$ 3,#'.0#5'$14(-#<3+?$1,%, 54(*0(.' 3# RS232-C <#67$ '*3#4+.#0%$+*(,%.S1</ DB25, DB9 '4' #2% $'3%. (F IBM PC $%-B1 '*3#4+.71$*(,%.S1< DB25 54(3%,%4414+"#6# '"$1,E19*% 3,'"$1,%,=$# '"#65% 0/./0%1$ 37$%"'&7.)

@'B1 3,15*$%041"%$%24'&% "%."%=1"'9 *'6"%4#0 RS232-C 0 ,%.S1<%: DB25 ' DB9.

B&%-0)-* DB25 RS232-C	B&%-0)-* DB9 IBM PC	832*&/ >#.3 .& EIA	832*&/ >#.3 .& CCITT	C$D##32:	E,-&"%3) ,3=%0/0	C.3,0%3#
1	-	AA	101	PG/FG	-	M%D'$"#1 .%.1<41"'1 (Frame/Protective Ground)
2	3	BA	103	TD	DTE	A1,15%=% K%""/: (Transmit Data)
3	2	BB	104	RD	DCE	A,'1< 5%""/: (Receive Data)
4	7	CA	105	RTS	DTE	M%3,#* "% 31,15%=7 (Request to Send)
5	8	CB	106	CTS	DCE	T#$#0"#*$+ -3,';<7 (Clear to Send)
6	6	CC	107	DSR	DCE	T#$#0"#*$+ $1,<'"%4+ "#6# #2#,75#0%" '((Data Set Ready)
7	5	AV	102	SG/GND	-	C'6"%4+"%(.1<4((Signal Ground)
8	1	CF	109	DCD/CD	DCE	G2"%,7B1" '1"1*7D19 (Data Carrier Detect)
9	-	-	-	-	-	M%,1.1,0', #0%"#54(O1*$%

B&%-0)-* DB25 RS232-C	B&%-0)-* DB9 IBM PC	832*&/ >#.3 .& EIA	832*&/ >#.3 .& CCITT	C$D##32:	E,-&"%3) ,3=%0/0	C.3,0%3#
10	-	-	-	-	-	M%,1.1,0', #0%"#54(O1*$%
11	-	-	-	-	-	M%,1.1,0', #0%"#54(O1*$%
12	-	CI	122	SRLSD	DCE	K1$1-$#, *'6"%4% 0$#,'="#9 4'"'' 3,';<%
13	-	SCB	121	SCTS	DCE	F$#,'=" /9 *'6"%4 6#$#0"#*$' -3,';<7
14	-	SBA	118	STD	DTE	F$#,'="%(4'"'(31,15%=' 5%"" /:
15	-	DB	114	TSET	DCE	O%-$',#0%" '1 >41<1"$#0 *'6"%4% 31,15%$='-% (Trans. Sig. Element Timing)
16	-	SBB	119	SRD	DCE	F$#,'="%(4'"'(3,'1<% 5%"" /:
17	-	DD	115	RSET	DCE	O%-$',#0%" '1 >41<1"$#0 *'6"%4% 3,';<"'-% (Receiver Signal Element Timing)

B&%-0)-* DB25 RS232-C	B&%-0)-* DB9 IBM PC	832*&/ >#.3 .& EIA	832*&/ >#.3 .& CCITT	C$D##32:	E,-&"%3) ,3=%0/0	C.3,0%3#
18	-	-	141	LOOP	DTE	U#-%4+"%(31$4(
19	-	SCA	120	SRS	DTE	F$#,'=" /9 .%3,#* "% 31,15%=7
20	4	CD	108.2	DTR	DTE	T#$#0"#*$+ $1,<'"%4+ "#6# #2#,75#0%" '((Data Terminal Ready)
21	-	-	-	RDL	DTE	R1B'< 75%4;""#9 &'E,#0#9 31$4' (Remote Digital Loopback)
22	9	CE	125	RI	DCE	Q"5'-%$#, 31,15%='5%"" /: (Ring Indicator)
23	-	CH	111	DSRS	DTE	C141-$#, *-#,#*$' 31,15%='5%"" /:
24	-	DA	113	TSET	DTE	O%-$',#0%" '1 >41<1"$#0 *'6"%4% 31,15%$='-% (Trans. Sig. Element Timing)
25	-	-	142	-	DCE	R1B'< $1*$',#0%" '(

1.5. F3-?, $&+? 3 ,32*&/?

C-#,#*$+ 31,15%=' 5%""/: (Baud) Ñ >$# 15'"'&% '.<1,1"'(*-#,#*$' 31,15%=' 0 %*'":,#""#9 *0(.'. Q.-.% ,%.0'$'($1:"#4#6'9 <#51<"#9 *0(.' >$#$ $1,<'" =%*$# #H'2#="# '*3#4+.7?$ 54(#3'*%"'(*-#,#*$' 31,15%=' 5%""/: 0 *#0,1<1""/: 7*$,#9*$0%:.

O,%5'&'#""#, *-#,#*$+ 31,15%=' (Baud Rate) 3,15*$%04(1$ -#4'=1*$0# 2'$#0, E%-$'=1*-' 31,15%0%1</: 3# *,151, % "1 #2S;< 5%""/:, -#$#,/1 519*$0'$14+"# 31,1<1D%?$*(#$ #5"#6# 7*$,#9*$0% DTE - 5,76#<7. A#5*=1$ Baud 0-4?=%1$ *47B12"/1 2'$/ Ñ Start, Stop ' Parity, -#$#,/1 61"1,',7?$*(31,15%?D'< UART ' 75%4(?$*(3,'"'<%?D'< UART.)$# #."%=%1$, =$# 7-2'$"/1 *4#0% 5%""/: "% *%<#< 5141 .%"'<%?$ 10 2'$ 54(3#4"#9 31,15%='. C415#0%$14+"#, <#51<, *3#*#2"/9 31,15%0%$+ 300 2'$ 0 *1-7"57, #2/="# <#B1$ 31,15%0%$+ $#4+-# 30 7-2'$"/: *4#0, 1*4' '*3#4+.71$*(Parity ' 3,'*7$*$07?$ #5'" 2'$ Start ' #5'" 2'$ Stop.

N*4' '*3#4+.7?$*(8-2'$"/1 *4#0% 5%""/: ' 2'$/ =;$"#*$', *-#,#*$+ 31,15%=' 5%""/: *"'B%1$*(5# 27,27 *4#0 0 *1-7"57, $%- -%- $131,+ 54(31,15%=' 0#*+<'2'$"/: *4#0 $,1271$*(11 2'$,% <#51< 3#-3,1B"1<7 31,15%;$ $#4+-# 300 2'$ 0 *1-7"57.

I#,<74% 3,1#2,%.#0%"'(2%9$#0 0 *1-7"57 0 2#5#07? *-#,#*$+ ' "%#2#,#$ 2/4% 3,#*$#9 5# 3#(041"'(<#51<#0 * -#,,1-&'19 #H'2#-.)$' <#51</ 3,'"'<%?$ 3#*415#0%$14+"/9 3#$#- 2'$#0 #$ UART 0 -#<3+?$1,1 (5%B1 0"7$,1""'1 <#51</ =%*$# ,%2#$%?$ * 3#*415#0%$14+"/<' 5%""/<') ' 3,1#2,%.7?$ 2'$/ #2,%$"# 0 2%9$/. M%$1< >$' 2%9$/ #2S15'"(?$*(0 3%-1$/ ' 31,15%?$*(3# $141E#""#9 4'"'' * '*3#4+.#0%"'1< *'":,#""#6# <1$#5% 31,15%='.)$# #."%=%1$, =$# *$#3#0/1, *$%,$#0/1 ' 2'$/ =;$"#*$', 5#2%041""/1 UART 0 DTE (-#<3+?$1,1), 75%4(?$*(<#51<#< 31,15 31,15%=19 #$3,%04(?D'< <#51<#<. J#65% >$' 2%9$/ 3,'"'<%?$*(75%4;""/< <#51<#<, #" 5#2%04(1$ *$%,$#0/1, *$#3#0/1 ' 2'$/ =;$"#*$' - *4#0%<, 3,1#2,%.71$ ': 0 3#*415#0%$14+"/9 E#,<%$ ' #$3,%04(1$ "% 3,'"'<%?D'9 UART 0 75%4;""#< -#<3+?$1,1, -#$#,/9 .%$1< 75%4(1$ *$%,$#0/1, *$#3#0/1 ' 2'$/ =;$"#*$'.

A,'='"%, 3# -#$#,#9 0/3#4"(?$*(0*1>$' 5#3#4"'$14+"/1 3,1#2,%.#0%"'(, .%-4?=%1$*(0 $#<, =$#2/ 50% <#51<% <#64' #*7D1*$04($+ -#,,1-&'? #H'2#-.)$# #."%=%1$, =$# 3,'"'<%?D'9 <#51< <#B1$.%3,#*'$+ 7 31,15%?D16# <#51<% 3#0$#,"7? #$3,%0-7 24#-% 5%""/:, -#$#,/9 2/4 3#47=1" * "1-#,,1-$"#9 -#"$,#4+"#9 *7<<#9.)$% 3,#01,-% #2,%2%$/0%1$*(<#51<%<', ' 7*$,#9*$0% DTE #2/="# "1 #*#."%?$, =$# >$#$ 3,#&1** 3,#'*:#5'$.

85%4((*$%,$#0/1, *$#3#0/1 ' 2'$/ =;$"#*$', 5#3#4"'$14+"/1 2'$/ 5%""/:, -#$#,/1 50% <#51<% 5#4B"/ #2<1"'0%$+*(<1B57 *#2#9 54(0/3#4"1"'(-#,,1-&'' #H'2#-, 0 #*"#0"#< *-,/0%?$*(#$ >EE1-$'0"#9 *-#,#*$' 31,15%=', "%24?5%1<#9 #$3,%04(?D'< ' 3,'"'<%?D'< #2#,75#0%"'1< DTE. @%3,'<1,, 1*4' <#51< #$3,%04(1$ 51*($+ 7-2'$"/: *4#0 5,76#<7 <#51<7 21. 0-4?=1"'(*$%,$#0/:, *$#3#0/: ' 2'$#0 =;$"#*$', #$3,%04(?D'9 <#51< *<#B1$ 5#2%0'$+ 30 2'$ *0#19 *#2*$01""#9 '"E#,<%&'', -#$#,7? 3,'"'<%?D'9 <#51< <#B1$ '*3#4+.#0%$+ 54(-#,,1-&'' #H'2#-, "1 04'(("% *-#,#*$+ 31,15%=' ,1%4+"/: 5%""/:.

Q*3#4+.#0%"'1 $1,<'"% "L#5" 5#3#4"'$14+"# #*4#B"(1$*(<#51<%<', 0/3#4"(?D'<'

*B%$'1. G5"# 8-2'$"#1 *4#0#, 31,15%""#1 3# $141E#""#9 4'"'', <#B1$ 3,15*$%04($+ *#2#95?B'"7 *4#0, 31,15%""/: "% #$3,%04(?D'9 <#51<. A,'"'<%?D'9 <#51< ,%.01,";$5%""/1#2,%$"#0 ': '*:#5"#1*#51,B'<#1 ' 31,15%*$>$' 5%""/13,'"'<%?D1<7 DTE.

C#0,1<1""/1 <#51</ $%-B1 0-4?=%?$ 27E1,/, -#$#,/1 3#.0#4(?$ *-#,#*$' 31,15%='2'$#0 3# $141E#""#9 4'"'' (DCE - DCE) #$4'=%$+*(#$*-#,#*$' 31,15%=' 2'$#0 <1B57 DTE ' DCE "%#2#': -#"&%: *#15'"1"'(.G2/="#*-#,#*$+ <1B57 DTE ' DCE 0/H1, =1< *-#,#*$+ <1B57 DCE ' DCE, '.-.% '*3#4+.#0%"'(*B%$'(<#51<%<'.

A#*-#4+-7 -#4'=1*$0# 2'$#0, "1#2:#5'</: 54(#3'*%"'(2%9$%, <1"(4#*+ 0# 0,1<(31,15%=' <1B57 507<(<%H'"%<', % $%-B1 '.-.% ,%.4'=%?D':*(*-#,#*$19 31,15%=' 02'$%: 0*1-7"57 "%4'"'(: DTE-DCE ' DCE-DCE, '*3#4+.#0%"'1$1,<'"%ÇL#5È 54(#3'*%"'(#2D19 *-#,#*$' *0(.' 0/./0%1$ 3,#241</ ' <#B1$ '*-%B%$+ ,1%4+"7? *-#,#*$+ 31,15%='.O%-'<#2,%.#<,$1,<'"ÇL'$/ 0*1-7"57È (bps) (04(1$*(-#,,1-$"/< 54(#3'*%"'(*-#,#*$'31,15%=' "% '"$1,E19*1 DCE-DCE, %$1,<'"/ ÇL#5È '4' ÇL'$/ 0*1-7"57È 5#37*$'</, -#65%*#15'"1"'1 7*$%"%04'0%1$*(<1B57 507<(*'*$1<%<' * 3,#0#5"/< 3#5-4?=1"'1< '4''*3#4+.71$*(<#51<,"10/3#4"(?D'9 -#,,1-&'? #H'2#- '4' *B%$'1.

C#0,1<1""/10/*#-#*-#,#*$"/1 <#51</ (2400, 9600, 14,400 ' 19,200 2'$/*) "%*%<#< 5141 0*;1D; ,%2#$%?$ "% *-#,#*$' 2400 2#5 '4' "'B1, '4', $#="11, 2400 *'<0#4#0 0 *1-7"57.F/*#-#*-#,#*$"/1 <#51</ *3#*#2"/ -#5',#0%$+ 2#4+H1 2'$ 5%""/: 0 -%B5/9 *'<0#4 *'*3#4+.#0%"'1< $1:"'-', "%./0%1<#9 "M%3#4"1"'1 *#.01.5'((Constellation Stuffing)",3#>$#<7 >EE1-$'0"%(*-#,#*$+ 31,15%=' 5%""/: 0 2'$%: 0 *1-7"57 7 <#51<% 0/H1, "#<#51< 3,#5#4B%1$,%2#$%$+ 0 #6,%"'=1""#9 3#4#*1 3,#37*-%"'(.07-#0/: =%*$#$,3,15#*$%04(1<#9 $141E#""#9 *'*$1<#9. P#51</, ,%2#$%?D'1 "%*-#,#*$(: 28,800 ' 0/H1,'<1?$ 31,1<1""7? *-#,#*$+ 31,15%=' *'<0#4#0,"# $1:"'-%#*$%;$*($#9 B1.

1.6. UART * IBM PC

@%='"%(* #,'6'"%4+"#6# IBM Personal Computer, IBM 0/2,%4% UART INS8250 #$ National Semiconductor 54('*3#4+.#0%"'(0%5%3$1,1 Parallel/Serial IBM PC. A#*4157?D'1 3#-#41"'(*#0<1*$'</: -#<3+?$1,#0 #$ IBM ' 5,76': 3,#'.0#5'$1419 3,#5#4B%4' '*3#4+.#0%$+ INS8250 '4' 747=H1""/101,*'' UART '. *1<19*$0% National Semiconductor.

1.6.1. G#%#0/&=3"#,)&# +#'#*& National Semiconductor UART

C7D1*071 "1*-#4+-# 01,*'9 ' 3#*4157?D': 3#-#41"'9 UART INS8250. G*"#0"/101,*''#3'*%"/ "'B1.

```
INS8250  -> INS8250B
Ê \
Ê  \
Ê   \-> INS8250A -> INS82C50A
Ê           \
Ê            \
Ê             \-> NS16450 -> NS16C450
Ê                       \
Ê                        \
```

```
Ê                          \-> NS16550 -> NS16550A -> PC16550D
```

INS8250

)$% =%*$+ '*3#4+.#0%4%*+ 0 #,'6'"%4+"#< IBM PC ' IBM PC/XT. A1,0#"%=%4+"#1 "%.0%"'1 >$#9 =%*$' Ñ INS8250 ACE (Asynchronous Communications Element), ' #"% '.6#$#041"% 3# NMOS-$1:"#4#6''.

8250 '*3#4+.71$ 0#*1<+ 3#,$#0 00#5%-0/0#5% ' '<11$ #5"#2%9$#0/9 27E1, 31,15%=' ' #5"#2%9$#0/9 27E1, 3,'1<%.)$#$ #,'6'"%4+"/9 UART '<11$ "1*-#4+-# *#*$#(''96#"-' ' 5,76'1 "15#*$%$-'. G,'6'"%4+"/9 BIOS IBM 0-4?=%1$ -#5 54(#2:#5% >$':"15#*$%$-#0, "# >$# *514%4# BIOS .%0'*'</< #$ ': "%4'='(, 3#>$#<7 3#*4157?D'1 <#514', $%-'1 -%- 8250A, 16450 '4' 16550, "1 <#64' 2/$+ '*3#4+.#0%"/ 0 #,'6'"%4+"#< IBM PC '4' IBM PC/XT.

INS8250-B

)$# 2#411 <1541""%(*-#,#*$+ INS8250, *#.5%""%(3# NMOS-$1:"#4#6''.G"% '<11$ $1 B1 3,#241</,=$# ' #,'6'"%4+"/9 INS8250.

INS8250A

847=H1""%(01,*'(INS8250 * '*3#4+.#0%"'1< $1:"#4#6'' XMOS, 0 -#$#,#9 '*3,%041"/,%.4'="/1 E7"-&'#"%4+"/1 "15#*$%$-'. INS8250A '."%=%4+"# '*3#4+.#0%4%*+ 0 -4#"%: AJ #$ 3,#'.0#5'$1419, 3,'<1"(0H': "='*$/1" 3,#1-$/ BIOS. Q.-.% '*3,%041"'9 0 <'-,#*:1<1>$#$ ='3 "1 <#6 '*3#4+.#0%$+*(* BIOS, *#0<1*$'<#9 * INS8250 '4' INS8250B.

INS82C50A

)$# CMOS-01,*'((* "'.-'< >"1,6#3#$,1241"'1<) INS8250A ' '<11$ *:#B'1 E7"-&'#"%4+"/1 :%,%-$1,'*$'-'.

NS16450

O%- B1, -%- NS8250A, "# * 747=H1"'(<' 54(,%2#$/ * 2#411 2/*$,/<' H'"%<' CPU. IBM '*3#4+.#0%4% >$#$ -#<3#"1"$ 0 IBM AT ' #2"#0'4% IBM BIOS, =$#2/ #"% 2#4+H1 "1 .%0'*14% #$ #H'2#- 0 INS8250.

NS16C450

)$# 01,*'(NS16450 * $1:"#4#6'19 CMOS ("'.-#1>"1,6#3#$,1241"'1).

NS16550

O# B1, =$# ' NS16450, * 16-2%9$#0/< 27E1,#< 31,15%=' ' 3,'1<%, "# -#"*$,7-&'(27E1,% 2/4% "175%="#9 ' "1 <#64% 2/$+ "%5;B"# '*3#4+.#0%"%.

NS16550A

O# B1, =$# ' NS16550, "# * '*3,%041""/<' "15#*$%$-%<' 27E1,%. 16550A ' 16# 3,11<"'-' *$%4' "%'2#411 3#374(,"/<' UART-7*$,#9*$0%<' 0 '"57*$,'' AJ, 0 #*"#0"#< 24%6#5%,(': *3#*#2"#*$' "%5;B"# ,%2#$%$+ "% 0/*#-': *-#,#*$(: 31,15%=' 5%""/: 0 #31,%&'#""/:*'*$1<%:* <1541""/<0,1<1"1<#$-4'-%3,1,/0%"'9.

NS16C552

)$#$ -#<3#"1"$*#*$#'$ '. 507: CMOS UART NS16C550A 0 #5"#< -#,37*1.

PC16550D

O%- B1, -%- NS16550A, * '*3,%041"" / <' "1."%='$14+" / <' "15#*$%$-%<'.)$# ,10'.'(D *1<19*$0% 16550 ' 3#*415"((5#*$73"%(01,*'(#$ National Semiconductor.

1.6.2. NS16550AF 3 PC16550D Ñ 7-& &+%& 3 -& H#

J#<3%"'(National ,1#,6%"'.#0%4%*0#? *'*$1<7 "7<1,%&'' 51$%419 "1*-#4+-# 41$ "%.%5, '='3 NS16550AFN 2#4+H1 "1 *7D1*071 3#5 >$'< "%.0%"'1<. (N*4' 7 0%* 1*$+ NS16550AFN, 3#*<#$,'$1 "% 5%$7 '.6#$#041"'("% -#,37*1 Ñ >$# =1$/,;:."%="#1 ='*4#, #2/="# "%='"%?D11*(* 510($-'. A1,0/1 501 &'E,/ #2#."%=%?$ 6#5, % 3#*415"'1 501 Ñ "1514? 6#5%, -#65% ='3 2/4 73%-#0%". N*4' 7 0%* 1*$+ NS16550AFN, *-#,11 0*16#, #" 7B1 5#0#4+"# *$%, /9.)

@#0/1 "#<1,% 0/64(5($ -%- PC16550DV, * "1."%='$14+"/<' #$4'='(<' 0 *7EE'-*"/: 27-0%: 0 .%0'*'<#*$' #$ <%$1,'%4% -#,37*% ' 16# E#,</. (G3'*%"'1 *'*$1</ "7<1,%&'' <#B"# "%9$' "'B1.)

F%B"# 3#"'<%$+, =$# 0 "1-#$#,/: <%6%.'"%: <#B"# .%34%$'$+ $15 (CV!) .% <'-,#*:1<7 NS16550AFN, 0/37D1""7? 0 1990 6#57,% 0 *#*15"1< (D'-1 <#67$ 41B%$+ "#0/1 PC16550DN * "12#4+H'<' '*3,%041"'(<', -#$#,/1 National 0"1*4%* <#<1"$% 0/37*-% AFN. PC16550DN, 01,#($"#, 3,#'.0151"/ 0 3#*415"'1 3#46#5% ' *$#($ 050#1 51H1041 (#$ $5 (CV!) 3,' #3$#0#9 3#-73-1), =1< NS16550AFN, 3#*-#4+-7#"' 416-# 5#*$73"/.

A#*-#4+-7 3#*$%0-' ='3#0 NS16550AFN 3,#5#4B%?$ *#-,%D%$+*(, &1"%, 01,#($"#, 2751$,%*$' 5# $1: 3#,, 3#-% 2#4+H1 4?519 "1 7."%?$ ' "1 3,'<7$ $#$ E%-$, =$# PC16550DN 519*$0'$14+"#0/3#4"(1$ $7 B1 E7"-&'?,=$# ' *$%,/9 "#<1, 51$%4'.

1.6.3. 83,-#20%(2#'0>33)&2.&%#%-&* National Semiconductor

C$%,/1 "#<1,% 51$%419 NSnnnnnrqp $131,+ '<1?$ E#,<%$ PCnnnnnrgp.

r Ñ >$# 3#41 ,10'.''.O1-7D%(,10'.'(16550 #$ National Semiconductor Ñ D.

p Ñ >$# 3#41 $'3% 3%-1$%. O'3/:

"F"	QFP	(quad flat pack--0%5,%$"/9 34#*-'9 -#,37*)*L- #2,%."/<' 0/0#5%<'
"N"	DIP	(dual inline package Ñ -#,37* * 507*$#,#""'< ,%*3#4#B1"'1< 0/0#5#0) 54(*-0#."#6# <#"$%B%* 3,(</<' 0/0#5%<'
"V"	LPCC	(lead plastic chip carrier Ñ 34%*$'-#0/9 -#,37*)*J- #2,%."/<' 0/0#5%<'

A#41 g #2#."%=%1$ -4%** '.514'(. N*4' 31,15 27-0#9 $'3% 3%-1$% *$#'$ I, >$# 7-%./0%1$ "%

Ç3,#</H41""/9È -4%** 51$%4', -#$#,/9 '<11$ 2#411 0/*#-'1 :%,%-$1,'*$'-', =1<*$%"5%,$"%(51$%4+, "# "1 $%-'1 0/*#-'1, -%- -#<3#"1"$ 0#1""#6# "%."%=1"'((Milspec).)$# "1#2(.%$14+"#1 3#41.

O#, =$# </ ,%"+H1 "%./0%4' NS16550AFN (DIP--#,37*), $131,+ "%./0%1$*(PC16550DN '4' PC16550DIN.

1.7. <'(=3# .'&3A*&+3-#/3 3 0%0/&=3"%?# UART

@% 3,#$(B1"'' <"#6': 41$ ='3/ 8250, 8250A, 16450 ' 16550 4'&1".',#0%4'*+ '4' -#3',#0%4'*+ 5,76'<' 3,#'.0#5'$14(<'. F *47=%1 * 8250, 8250A ' 16450 $#="%(*:1<%("<16%(=19-%") 2/4% 4'&1".',#0%"% <"#6'<' 3,#'.0#5'$14(<', 0-4?=%(Western Digital ' Intel. K,76'1 3,#'.0#5'$14' 3,#0#5'4' #2,%$"7? ,%.,%2#$-7='3% '4' *#.5%0%4' ><74(&'' *%"%4#6'="/< 3#0151"'1<.

F# 0"7$,1""': <#51<%: ,%.,%2#$='- <#51<% =%*$# ><74',71$ 8250A/16450 * 3#<#D+?<'-,#3,#&1**#,% <#51<%, ' ><74',#0%""/9 UART =%*$# '<11$ *-,/$/9 27E1, ,%.<1,#< 0"1*-#4+-# *#$1" 2%9$. L4%6#5%,(,%.<1,7 27E1,%, >$' ><74(&'' <#67$ 2/$+ $%-'<' B1"%5;B"/<', -%- 16550A, 0 *3#*#2"#*$' #2,%2%$/0%$+ 0/*#-#*-#,#*$"/1 5%""/1. G5"%-#2#4+H'"*$0# #31,%&'#""/: *'*$1< 3#-3,1B"1<7 *##2D%?$, =$# UART (04(1$*($#4+-# 8250A '4' 16450, ' <#67$ "1 >EE1-$'0"# '*3#4+.#0%$+ 5#3#4"'$14+"7? 27E1,'.%&'?,3,'*7$*$07?D7? 0><74',#0%""#< UART, 1*4' "1 '*3#4+.7?$*(*31&'%4+"/15,%901,/.

@1-#$#,/1 3,#'.0#5'$14' <#51<#0 3#5 5%041"'1< ,/"#="/: *'4 #$-%./0%?$*(#$-#"*$,7-&'' * 27E1,#< 0 *#$"' 2%9$ ' 0<1*$# >$#6# '*3#4+.7?$ UART 16550A, =$#2/ ':3,#57-&'(0/64(514% 0/'6,/H"# 0 ,/"#="/: *,%0"1"'(:, 5%B1 1*4' >$# <#B1$ *"'.'$+E%-$'=1*-7? 3,#'.0#5'$14+"#*$+.

R%*3,#*$,%";""#1 .%247B51"'1 .%-4?=%1$*(0 $#<, =$# 0*1 <'-,#*:1</ * <%,-',#0-#9"16550A"#5'"%-#0/ 3# 3,#'.0#5'$14+"#*$'.G5"%-# <1B57 "'<' *7D1*$07?$,%.4'='(,%0"1-#$#,/:-4#"%: 16550A 5%B1 0*$,1=%?$*(*1,+;."/1"15#*$%$-'.

J#65% -#<3%"'(National Semiconductor ,%.,%2#$%4% NS16550, #"% 3#47='4% "1*-#4+-#3%$1"$#0 "% >$7 -#"*$,7-&'? ' $%-B1 #6,%"'='4% 4'&1".',#0%"'1, =$# .%$,75"'4# 54(5,76': 3,#'.0#5'$1419 0/37*- ='3#0 * %"%4#6'="/<' :%,%-$1,'*$'-%<'.F ,1.74+$%$13%$1"$#0 #2,%$"# *3,#1-$',#0%""/1 -#"*$,7-&'' ' ><74(&'' 5#4B"/ 2/4' '.216%$+"%,7H1"'(37"-$#0,#:0%$/0%1</: 3%$1"$%<'.F3#*415*$0'' >$' -#3'' 3#=$' "'-#65% "1,%2#$%?$ $#="# $%- B1, -%- NS16550A '4' PC16550D, -#$#,/1 (04(?$*(-#<3#"1"$%<',"%'2#411 0#*$,12#0%""/<' 3,#'.0#5'$14(<' -#<3+?$1,#0 ' <#51<#0, "# '"#65% #"' "16#$#0/34%$'$+&1"7,"1#2:#5'<7? 54(3#47=1"'(#,'6'"%4+"/:51$%419.

@1-#$#,/1 ,%.4'='(0 -4#"%: <'-,#*:1< 16550A "1*7D1*$01""/,0 $# 0,1<(-%- 5,76'1<#67$ 3#4"#*$+? 3,13($*$0#0%$+ '*3#4+.#0%"'? 7*$,#9*$0% * #3,1514;""#9#31,%&'#""#9 *'*$1<#9 '4' 5,%901,#<.)$' ,%.4'='(<#67$ 3,#(0'$+*(3,''*3#4+.#0%"'' 5,76': 5,%901,#0 '4' 3,' 0#."'-"#01"'' #3,1514;""/: -#<2'"%&'9*#2/$'9, -#$#,/1 "1 2/4' :#,#H# 3,#$1*$',#0%"/ '4' 7=$1"/ 0 5,%901,1 Windows¨.)$# 3,#'*:#5'$ 3#$#<7, =$# 2#4+H'"*$0# 3,#'.0#5'$1419 <#51<#0 ' -4#"#0 16550 '*3#4+.7?$ 5,%901,/ Microsoft '. Windows¨ for Workgroups 3.11 ' 7$'4'$7 Microsoft¨ MS-DOS¨ 0-%=1*$01 #*"#0"/: $1*$#0 "% *#0<1*$'<#*$+ * NS16550A.)$#$ =,1.<1,"# 73,#D1""/9

-,'$1,'9 #."%=%1$, =$# 3,' '*3#4+.#0%"'' 5,76#9 #31,%&'#""#9 *'*$1</ <#67$ 0#."'-"7$+ 3,#241</ '.-.% $#"-': ,%.4'='9 <1B57 -4#"%<' ' #,'6'"%4+"/<' -#<3#"1"$%<'.

National Semiconductor 3,15#*$%0'4% 3,#6,%<<7 3#5 "%.0%"'1< COMTEST, -#$#,%(0/3#4"(1$ $1*$/ *#0<1*$'<#*$' "1.%0'*'<# #$ -%-':-4'2# 5,%901,#0 GC. C41571$ 3#<"'$+, =$# &14+ $%-#6# $'3% 3,#6,%<< Ñ 51<#"*$,%&'("15#*$%$-#0 0 3,#57-$%: -#"-7,1"$#0, 3#>$#<7 3,#6,%<<% 2751$ *##2D%$+ -%- # ."%='$14+"/:, $%- ' # -,%9"1 "1."%='$14+"/: ,%.4'='(: 0 3#0151"'' $1*$',71<#6# -#<3#"1"$%.

F *1,'' $1*$#0, 3,#0151""/: %0$#,#< >$#6# 5#-7<1"$% 0 1994 6#57, -#<3#"1"$/ 3,#'.0#5*$0% National Semiconductor, TI, StarTech ' CMD, % $%-B1 <16%(=19-' ' ><74(&'', 0*$,#1""/1 0# 0"7$,1""'1 <#51</, 2/4' 3,#$1*$',#0%"/ * 3#<#D+? COMTEST. @'B1 3,'0151" *=1$='- ,%.4'='9 54("1-#$#,/: '. >$': -#<3#"1"$#0. A#*-#4+-7 >$' $1*$/ 3,#0#5'4'*+ 0 1994 6#57, #"' <#67$ "1 #$,%B%$+ $1-7D7? 3,#'.0#5'$14+"#*$+ 5%""#6# 3,#57-$% #$ 3#*$%0D'-%.

C41571$ #<1'$+, =$# COMTEST #2/="# .%01,H%1$,%2#$7 3,' #2"%,7B1"'' =,1.<1,"#6# -#4'=1*$0% '4' #3,1514;""/: $'3#0 3,#241<. F ,%<-%: >$#6# $1*$',#0%"'(COMTEST 2/4 '.<1";" $%-, =$#2/ #" "1 .%01,H%4 ,%2#$7 "1.%0'*'<# #$ -#4'=1*$0% #2"%,7B1""/: ,%.4'='9.

I&,-0*D3)	@&2#' +#-0/3	CJ3$)3(-0)H# 3A*#,-%?#)0)"'0A/3"3:"*&-"K-09)
National	(PC16550DV)	0
National	(NS16550AFN)	0
National	(NS16C552V)	0
TI	(TL16550AFN)	3
CMD	(16C550PE)	19
StarTech	(ST16C550J)	23
Rockwell	C$%"5%,$"/9 <#51<* 0"7$,1""'< 16550 '4' 16# ><74(&'19 (RC144DPi/C3000-25)	117
Sierra	P#51<*0"7$,1""'< 16550 (SC11951/SC11351)	91

!

@%*16#5"(H"'9 51"+%0$#, 5%""#6# 5#-7<1"$% "1 #2"%,7B'4 "' #5"#6# "1-National -#<3#"1"$%, -#$#,/9 2/ 3#-%./0%4 "7410/1 ,%.4'='(3,' '*3#4+.#0%"'' 3,#6,%<</ COMTEST. 0%-B1 *41571$ #<1'$+, =$# 7 National 2/4# 3($+ 01,*'9 16550 .% >$' 6#5/, ' "#019H'1 -#<3#"1"$/ 0157$ *12("1*-#4+-# '"%=1, =1< -4%**'=1*-'9 NS16550AFN, -#$#,/9 *='$%1$*(>$%4#"#< E7"-&'#"%4+"#*$'. COMTEST, 3#-0'5'<#<7, .%-,/0%1$ 64%.% "% ,%.4'='(0"7$,' 4'"19-' 3,#57-$#0 National ' "1*##2D%1$ #2 #H'2-%: 0 -#<3#"1"$%: National (.% '*-4?=1"'1< #,'6'"%4+"#9 16550), 5%B1 -#65%

> *7D1*$07?$ #E'&'%4+" / 1 errata, #3'*/ 0%? D'1 #H'2-' 0 ,10'.'(: A, B ' C >$': -#<3#"1"$#0, 3#>$#<7 >$7 3,150.($#*$+ COMTEST "1#2:#5'<# 7='$/ 0%$+.

F%B"# 3#"'<%$+, =$# 3,#*$#1 3#5*='$/ 0%"'1 ,%.4'='9 * COMTEST "1 5%;$ 3#4"#6# 3,15*$%041"'(# $#<, -%-'1 ,%.4'='(*7D1*$01""/, % -%-'1 "1$. @%3,'<1,, #-#4# 3#4#0'"/ ,%.4'='9,#2"%,7B1""/: 0 507: 0/ H173#<("7$/: <#51<%: * 0"7$,1""'<' UART, 2/4' 0/.0%"/ $1<, =$# -4#"#0/1 UART "1 3#551,B'0%?$,1B'</ 3($'- ' H1*$'2'$"/: *'<0#4#0. @%*$#(D'1 UART 16550, 16450 ' 8250 3#551,B'0%?$ >$' ,1B'</, ' COMTEST 3,#01,(1$ ': E7"-&'#"%4+"#*$+, 3#>$#<7 E'-*',71$*(2#411 3($'51*($' ,%.4'='9. G5"%-# 3#=$' "' #5'" *#0,1<1""/9 <#51< "1 3#551,B'0%1$ 3($'- '4' H1*$'2'$"/1 *'<0#4/, #*#21""# $1, =$# #24%5%?$ E7"-&'(<' -#,,1-&'' #H'2#- ' *B%$'(.)$# #."%=%1$, =$# ,%.4'='(,*0(.%""/1*,1B'<%<' 3($'- ' H1*$'2'$"/: *'<0#4#0, <#B"# "1 7='$/ 0%$+.

P"#6'1 ,%.4'='(,# -#$#, / : *##2D%1$ COMTEST, *0(.%"/ * 0,1<1""/<' :%,%-$1,'*$'-%<'. F# <"#6': -4#"',#0%""/: -#"*$,7-&'(:, -#65% :#*$ ='$%1$ '. #5"#6# 3#,$%, *$%$7*"/1 2'$/ 0 5,76#< 3#,$1 <#67$ #2"#04($+*(* '"#9 *-#,#*$+? (2/*$,11 '4' <1541""11), =1< 7 *"$)* '!+,&' NS16550AFN, ' COMTEST 0/(04(1$ >$' ,%.4'='(.)$# #."%=%1$, =$# -#4'=1*$0# ,%.4'='9 <#B1$ 00#5'$+ 0 .%247B51"'1: #5"# 7*$,#9*$0# <#B1$ '<1$+ 0*16# #5"# '4' 50% ,%.4'='(, "# #"' -,%9"1 -,'$'="/, $#65% -%- 5,76#1 7*$,#9*$0#, #2"#04(?D11 *$%$7*"/1 ,16'*$,/ 2/*$,11 '4' <1541""11 >$%4#""#9 =%*$' (=$#, 01,#($"#, "'-#65% "1 3#04'(1$ "% ,%2#$7 3,%0'4+"# "%3'*%""#6# 5,%901,%), <#B1$ '<1$+ 51*($-' .%,16'*$,',#0%""/: ,%.4'='9.

COMTEST <#B"# '*3#4+.#0%$+ 0 -%=1*$01 '"*$,7<1"$% 3,#01,-', =$#2/ 3,1573,15'$+ %5<'"'*$,%$#,% # "%4'='' 3#$1"&'%4+"# "1*#0<1*$'</: -#<3#"1"$#0, -#$#,/1 <#67$ 0/.0%$+ 3,#241</ '4' 3#$,127?$ #*#2#6# 3#5:#5%.

N*4' 0/ .%37*-%1$1 COMTEST "% 16550, -#$#,/9 "%:#5'$*(0 <#51<1 '4' - <#51<7 3#5-4?=;" 3#*415#0%$14+"/9 3#,$, "1#2:#5'<# *"%=%4% #$3,%0'$+ <#51<7 -#<%"57 ATE0&W, =$#2/ <#51< "1>:#-3#0$#,(4 "' #5'" '. $1*$#0/: *'<0#4#0. N*4' 0/ .%2751$1 >$# *514%$+, COMTEST *##2D'$ -%- <'"'<7< #2 #5"#< ,%.4'='':

```
Error (6)...Timeout interrupt failed: IIR = c1  LSR = 61
```

1.8. L#=3,-' ? 8250/16450/16550

UART 8250/16450/16550 .%"'<%1$ 0#*1<+ 3#*415#0%$14+"/: %5,1*#0 3#,$#0 00#5%-0/0#5%. F IBM PC #3,15141"/ 50% ,%*3#4#B1"'(54(>$': 0#*+<' 3#,$#0, -#$#,/1 0<1*$1 '.01*$"/ -%- COM1 ' COM2. A,#'.0#5'$14' PC--4#"#0 ' 5#3#4"'$14+"/: -%,$ *#.5%4' 50% 5#3#4"'$14+"/: #24%*$', '.01*$"/: -%- COM3 ' COM4, "#>$' 5#3#4"'$14+"/1 COM-3#,$/ -#"E4'-$7?$ * 5,76'< #2#,75#0%"'1< "% "1-#$#,/: *'*$1<%:. @%'2#411 ,%*3,#*$,%";""/9 -#"E4'-$ 0#."'-%1$ * 0'51#%5%3$1,%<', #21*31='0%?D'<' ><74(&'? IBM 8514.

COM1 "%:#5'$*(0 5'%3%.#"1 #$ 0x3f8 5# 0x3ff ' #2/="# '*3#4+.71$ IRQ 4. COM2 "%:#5'$*(0 5'%3%.#"1 #$ 0x2f8 5# 0x2ff ' #2/="# '*3#4+.71$ IRQ 3. COM3 "%:#5'$*(0 5'%3%.#"1 #$ 0x3e8

5# 0x3ef ' "1 '<11$ *$%"5%,$"#6# IRQ. COM4 "%:#5'$*(0 5'%3%.#"1 #$ 0x2e8 5# 0x2ef ' "1 '<11$ *$%"5%,$"#6# IRQ.

G3'*%"'1 3#,$#0 00#5%-0 / 0#5% UART 8250/16450/16550 3,15*$%041"#"'B1.

I&'-**&+0/*?*&+0	<&,-(.L0A'#J#%	C.3,0%3#
+0x00	.%3'*+(DLAB==0)	R16'*$, 31,15%='5%""/:(THR). Q"E#,<%&'(,.%3'*%""%(0>$#$3#,$,#2,%2%$/0%1$*(-%-*4#0%5%""/:'31,15%;$*(=1,1.UART.
+0x00	=$1"'1(DLAB==0)	R16'*$, 27E1,%3,'1<%(RBR). U?2/1*4#0%5%""/:,3#47=1""/1UART '.3#*415#0%$14+"#6# *#15'"1"'(,5#*$73"/54(=$1"'(:#*$#<=1,1.>$#$3#,$.
+0x00	.%3'*+/=$1"'1(DLAB==1)	P4%5H'92%9$.%D14-'514'$14((DLL Ñ Divisor Latch LSB))$#."%=1"'12751$3#5141"##$#*"#0"#6#0:#5"#6#$%-$#0#6#*'6"%4%(0 IBM PC #*"#0"#9 $%-$#0/9*'6"%4,%01"1,8432 PT&),'3#47=1""/9 $%-$#0/9*'6"%4 2751$#3,1514($+*-#,#*$+31,15%='UART.)$#$,16'*$, *#51,B'$2'$/*03#7514'$14(.
+0x01	.%3'*+/=$1"'1(DLAB==1)	C$%,H'92%9$.%D14-'514'$14((DLH Ñ Divisor Latch MSB))$#."%=1"'12751$,%.5141"##$#*"#0"#6#0:#5"#6#$%-$#0#6#*'6"%4% (0 IBM PC #*"#0"#9 $%-$#0/9*'6"%4,%01"1,8432 PT&),'3#47=1""/9 $%-$#0/9*'6"%4 2751$#3,1514($+*-#,#*$+31,15%='5%""/:UART.)$#$,16'*$,*#51,B'$2'$/*83#15514'$14(.

I&'-**&+0/*?*&+0	<&,-(.L0A'#J#%	C.3,0%3#
+0x01	.%3'*+/=$1"'1(DLAB==0)	R16'*$, ,%.,1H1"'(3,1,/0%"'9 (IER) UART 8250/16450/1655 -4%**'E'&',71$*#2/$'("%=1$/,1-%$16#,''. J%B5%(-%$16#,'(<#B1$2/$+"%*$,#1"%"%61"1,%&'?3,1,/0%"'(3,' 0#."'-"#01"''4?2#6#'.*#2/$'9. UART 8250/16450/16550 61"1,',71$ 15'"/90"1H"'9*'6"%43,1,/0%"'("1.%0'*'<##$$#6#,*-#4+-# *#2/$'90,%.,1H;""/:-%$16#,'(:3,#'.#H4#. M%5%=%64%0"#6# 3,#&1**#,%Ñ#2,%2#$%$+3,1,/0%"'1'.%$1<#3,#*'$+,%.,1H;""/1 -%$16#,''3,1,/0%"'9 (#2/="#3,1,/0%"'(,%.,1H1"/54(0*1: -%$16#,'9), =$#2/#3,1514'$+'*$'""7?3,'='"7(/)3,1,/0%"'(. L'$7WM%,1.1,0',#0%",0*165%0. L'$6WM%,1.1,0',#0%",0*165%0. L'$5WM%,1.1,0',#0%",0*165%0. L'$4WM%,1.1,0',#0%",0*165%0. L'$3WR%.,1H1"'13,1,/0%"'(3#*#*$#("'?<#51<% (EDSSI). 8*$%"#0-%>$#6#2'$%0"1"3#.0#4(1$ UART 61"1,',#0%$+3,1,/0%"'1 3,''.<1"1"''*#*$#("'(#5"#9'4'"1*-#4+-':4'"'9*$%$7*%. L'$2WR%.,1H1"'13,1,/0%"'(3#*#*$#("'?4'"''3,';<"'-% (ELSI). 8*$%"#0-%>$#6#2'$%0"1"3,'0#5'$-61"1,%&''3,1,/0%"'(UART3,' #2"%,7B1"''#H'2-'('4'*'6"%4% BREAK) 0#0:#5(D':5%""/:. L'$1WR%.,1H1"'13,1,/0%"'(3##37*$#H1"'?,16'*$,%31,15%$='-% (ETBEI). 8*$%"#0-%>$#6#2'$%0"1"3,'0#5'$-61"1,%&''3,1,/0%"'(UART, -#65%0 UART 3#(04(1$*(<1*$#54(#5"#6#'4'2#411 5#3#4"'$14+"/:*'<0#4#0, 3,15"%."%=1""/:54(31,15%='. L'$0WR%.,1H1"'13,1,/0%"'(3#"%4'='?3,'"($/:5%""/: (ERBFI). 8*$%"#0-%>$#6#2'$%0"1"3,'0#5'$-61"1,%&''3,1,/0%"'(UART, -#65% UART 3,'"(45#*$%$#="#1-#4'=1*$0#*'<0#4#054(3,10/H1"'(3#,#6% FIFO,'4''*$1-4#0,1<(#B'5%"'(FIFO (7*$%,10H'15%""/1), '4'3,'"($#5'"#="/9*'<0#43,'#$-4?=;""#< FIFO.

I&'- **&+0/* ?*&+0	<&,-(. L0A'#J #%	C.3,0%3#
+0x02	.%3'*+	R16'*$, 73,%041"'(FIFO (FCR Ñ FIFO Control Register) ()$#$ 3#,$ #$*7$*071 0 UART 8250 ' 16450.) L'$ 7 W L'$ $,'661,%3,'1<"'-%#1 L'$ 6 W L'$ $,'661,%3,'1<"'-%#0)$' 50% 2'$%#3,1514(?$,3,' -%-#< -#4'=1*$01 5%"" / : 3,'1<"'- 5#4B1" 61"1,',#0%$+ 3,1,/0%"'1,-#65% FIFO %-$'01". 7 6 J#4'=1*$0# *4#0 31,15 61"1,%&'19 3,1,/0%"'(0 0 1 0 1 4 1 0 8 1 1 14 L'$ 5 W M%,1.1,0',#0%",0*165% 0. L'$ 4 W M%,1.1,0',#0%",0*165% 0. L'$ 3 W F/2#, ,1B'<% DMA. N*4' 2'$ 0 7*$%"#041" 0 "1" (FIFO 0-4?=1"/), 7*$%"#0-%>$#6# 2'$% '.<1"(1$,%2#$7*'6"%4#0 -RXRDY ' -TXRDY * ,1B'<% 0 "% ,1B'< 1. L'$ 2 W C2,#* 31,15%?D16# FIFO. A,' .%3'*' "1" 0 >$#$ 2'$ *#51,B'<#1 FIFO #='D%1$*(.U?2#1 *4#0#, -#$#,#1 31,15%;$*(0 5%"" / 9 <#<1"$, 2751$ #$3,%041"# 3#4"#*$+?.)$% E7"-&'(3#41."% 54(3,1,/0%"'(31,15%='. L'$ 1 W C2,#* 3,'1<"#6# FIFO. A,' .%3'*' "1" 0 >$#$ 2'$ *#51,B'<#1 FIFO #='D%1$*(.U?2#1 *4#0#, -#$#,#1 0 5%"" / 9 <#<1"$ *#2',%1$*(0 *50'6#0#< ,16'*$,1, 2751$ 3,'"($# 3#4"#*$+?. L'$ 0 W F-4?=1"'1 FIFO 16550. A,' 7*$%"#0-1>$#6# 2'$%%-$'0',7?$*(-%- 31,15%?D'9,$%- ' 3,'1<"/9 FIFO. U?2#1 *#51,B'<#1 0 ,16'*$,1 :,%"1"'(,*50'6#0/: ,16'*$,%: '4' FIFO $1,(1$*(3,' 0-4?=1"'' '4' #$-4?=1"'' FIFO.

I&'-**&+0/*?*&+0	<&,-(.L0A'#J#%	C.3,0%3#
+0x02	=$1"'1	R16'*$, '51"$'E'-%&'' 3,1,/0%"'9 L'$7 W FIFO 0-4?=1"/.@% UART 8250/16450 >$#$2'$,%01" "74?. L'$6 W FIFO 0-4?=1"/.@% UART 8250/16450 >$#$2'$,%01" "74?. L'$5 W M%,1.1,0',#0%",0*165% 0. L'$4 W M%,1.1,0',#0%",0*165% 0. L'$3 W L'$ '51"$'E'-%$#,%3,1,/0%"'(X2.@% UART 8250/16450 >$#$2'$,%01" "74?. L'$2 W L'$ '51"$'E'-%$#,%3,1,/0%"'(X1 L'$1 W L'$ '51"$'E'-%$#,%3,1,/0%"'(X0.)$' $,' 2'$% #2S15'"(?$*(54(7-%.%"'(-%$16#,'' *#2/$'(,0/.0%0H16# $1-7D11 3,1,/0%"'1.)$' -%$16#,'' '<1?$3,'#,'1/,3#>$#<7,1*4' "1*-#4+-# -%$16#,'9 *#2/$'9 3,#'*:#5($#5"#0,1<1""#,UART *##2D'$# 2#411 0%B"/:*#2/$'(:31,0/<',' :#*$ 5#4B1" #2,%2%$/0%$+*#2/$'(0 3#,(5-1 ':3#*$7341"'(.F*1*#2/$'(,0/.0%0H'1$1-7D11 3,1,/0%"'1, 5#4B"/ 2/$+#2,%2#$%"/ 5#61"1,%&'' "#0/:3,1,/0%"'9.()$# #6,%"'=1"'1%,:'$1-$7,/ AJ.) 2 1 0 A,'#,'$1$ G3'*%"'1 0 1 1 A1,0/9 A,'"($%(#H'2-%(OE, PE, BI '4' FE) 0 1 0 F$#,#9 K#*$73"/ 3,'"($/15%""/1 1 1 0 F$#,#9 Q51"$'E'-%&'(7,#0"($,'661,%(8*$%,10H'15%""/1 0 27E1,1 3,'1<%) 0 0 1 O,1$'9 A1,15%$='-6#$#0 3,'"($+2#4+H15%""/:(THRE) 0 0 0 Y1$01,$/9 Q.<1"1"'1*#*$#("'(<#51<%(-CTS, -DSR, -RI '4' -DCD) L'$0 W L'$ #B'5%"'(3,1,/0%"'(.N*4'>$#$2'$7*$%"#041" 0"0", $# -%- <'"'<7< #5"#3,1,/0%"'1#B'5%1$ #2,%2#$-'.

I&'-**&+0/*?*&+0	<&,-(.L0A'#J#%	C.3,0%3#
+0x03	.%3'*+/=$1"'1	R16'*$, 73,%041"'(4'"'19 (LCR Ñ Line Control Register) L'$7WL'$5#*$73%-.%D14-1514'$14((DLAB).A,'7*$%"#0-15#*$73-,16'*$,731,15%='/3,'1<%5%""/:(THR/RBR)',16'*$,7,%.,1H1"'(3,1,/0%"'9(IER)#$-4?=%1$*(.U?2#95#*$73->$'<3#,$%<31,1"%3,%04(1$*(-,16'*$,%<.%D14-'514'$14(.8*$%"#0-%>$#6#2'$%,.%6,7.-%,16'*$,#0514'$14('*2,#*DLAB5#4B"/0/3#4"($+*(3,'#$-4?=1""/:3,1,/0%"'(:. L'$6W8*$%"#0-%3,1,/0%"'(.A,'7*$%"#0-10"1"31,15%$='-"%='"%1$31,15%0%$+"13,1,/0"/9'"$1,0%4(Spacing),3#-%>$#$2'$"12751$*2,#H1"0"0".)$#31,1#3,1514(1$4?2/131,15%0%1</12'$/*'<0#4#0. L'$5WI'-*',#0%""/92'$=;$"#*$'.A,'0-4?=1""#93,#01,-1=;$"#*$'7*$%"#0-%>$#6#2'$%3,'0#5'$-$#<7,=$#2'$=;$"#*$'0*165%2751$"1"'4'"0"0.%0'*'<#*$'#$."%=1"'(2'$%4.L'$4WF/2#,=;$"#*$'(EPS).A,'0-4?=1""#93,#01,-1=;$"#*$''1*4'2'$5,%01""0",7*$%"#0-%>$#6#2'$%3,'0#5'$-'*3#4+.#0%"'?'#B'5%"'?=1$"#9=;$"#*$'.F3,#$'0"#<*47=%1'*3#4+.71$*("1=1$"%(=;$"#*$+. L'$3WR%.,1H1"'13,#01,-'=;$"#*$'(PEN).A,'7*$%"#0-10"1"2'$=;$"#*$'0*$%04(1$*(<1B573#*415"'<2'$#<5%""/:'*$#3#0/<2'$#<.UART$%-B1#B'5%1$"%4'='12'$%=;$"#*$'03,'"'<%1</:5%""/:. L'$2WJ#4'=1*$0#*$#3#0/:2'$#0(STB).N*4'7*$%"#041"0"1"''*3#4+.7?$*(5-2'$"/1*4#0%5%""/:,31,15%;$*('#B'5%1$*(1.5*$#3#0/:2'$%0-%B5#<*4#015%""/:.K4(6,7'8-2'$"/:*4#05%""/:31,15%;$*('#B'5%1$*(2*$#3#0/:2'$%.N*4'>$#$2'$*2,#H1"0"0",'*3#4+.71$*(#5'"*$#3#0/92'$0-%B5#<*4#015%""/:. L'$1WL'$0/2#,%54'"/*4#0%#1 (WLSB1) L'$0WL'$0/2#,%54'"/*4#0%#0 (WLSB0) F<1*$1>$'2'$/#3,1514(?$-#4'=1*$0#2'$#00-%B5#<*4#015%""/:. 10K4'"%*4#0% 0052'$5%""/: 0162'$5%""/: 1072'$5%""/: 1182'$5%""/:

I&'-**&+0/*?*&+0	<&,-(.L0A'#J#%	C.3,0%3#
+0x04	.%3'*+/=$1"'1	R16'*$, 73,%041"'(<#51<#< (MCR Ñ Modem Control Register) L'$ 7 W M%,1.1,0',#0%",0*165% 0. L'$ 6 W M%,1.1,0',#0%",0*165% 0. L'$ 5 W M%,1.1,0',#0%",0*165% 0. L'$ 4 W R1B'< 31$4' (Loop-Back). A,' 7*$%"#0-1 0"1" 31,15%$='- '3,';<"'- UART *#15'"(?$*(0"7$,' 54(5'%6"#*$'-'.O%-B1 0/:#5/73,%041"'(<#51<#< UART 3#5-4?=%?$*(- 16# 0:#5%<: CTS - RTS, DTR - DSR, OUT1 - RI, % OUT2 - DCD. L'$ 3 W OUT2. F*3#<#6%$14+"/9 0/:#5,-#$#,/9 3,#&1**#, <#B1$7*$%"#0'$+ 0 0/*#-'9 '4' "'.-'9 7,#01"+. F %5%3$1,1 IBM PC ('2#4+H'"*$01 -4#"#0) OUT2 '*3#4+.71$*(54(#$-4?=1"'(*'6"%4%3,1,/0%"'(#$ UART 8250/16450/16550. L'$ 2 W OUT1. F*3#<#6%$14+"/9 0/:#5,-#$#,/9 3,#&1**#, <#B1$7*$%"#0'$+ 0 0/*#-'9 '4' "'.-'9 7,#01"+. @% %5%3$1,1 IBM PC "1'*3#4+.71$*(. L'$ 1 W M%3,#* "% 31,15%=7 (RTS). A,' 7*$%"#0-1 0"1" 0/:#5 4'"'' -RTS UART 31,1:#5'$ 0 "'.-'9 7,#01"+ (%-$'0"#1 *#*$#("'1). L'$ 0 W T#$#0"#*$+ $1,<'"%4% 5%"" /: (DTR). A,' 7*$%"#0-1 0"1" 0/:#5 4'"'' -DTR UART 31,1:#5'$ 0 "'.-'9 7,#01"+ (%-$'0"#1 *#*$#("'1).

I&'-**&+0/*?*&+0	<&,-(.L0A'#J#%	C.3,0%3#
+0x05	.%3'*+/=$1"'1	R16'*$, *#*$#("'(4'"'' (LSR Ñ Line Status Register) L'$7WGH'2-%0FIFO3,'1<"'-%.@%UART8250/16450>$#$2'$,%01" "74?.)$#$2'$7*$%"%04'0%1$*(0Ç1È,-#65%4?2#9'.2%9$#00FIFO '<11$#5"#'4'"1*-#4+-#'.*4157?D':7*4#0'9#H'2-':PE,FE'4'BI. L'$6WA1,15%$='-37*$(TEMT).J#65%7*$%"#041"0Ç1È,0FIFO 31,15%$='-%'4'*50'6#0#<,16'*$,131,15%$='-%"1#*$%4#*+*4#0. A1,15%$='-3#4"#*$+?21.519*071. L'$5WR16'*$,:,%"1"'(31,15%$='-%37*$(THRE).J#65%7*$%"#041"0 Ç1È,0FIFO('4',16'*$,1:,%"1"'()$131,+1*$+<1*$#54(31,15%='-%-<'"'<7<#5"#6#5#3#4"'$14+"#6#*4#0%.A1,15%$='-<#B1$0*11D; 31,15%0%$+5%""/1,-#65%>$#$2'$7*$%"#041"0Ç1È. L'$4WA,1,/0%"'13#Break(BI).A,'1<"'-#2"%,7B'4*'6"%4Break. L'$3WGH'2-%-%5,',#0%"'((FE).G2"%,7B1"*$%,$#0/92'$,"# *$#3#0/92'$"13#(0'4*(0#B'5%1<#10,1<(.A,'"($#1*4#0#, 01,#($"#,'*-%B1"#. L'$2WGH'2-%=;$"#*$'(PE).L'$=;$"#*$'54(3,'"($#6#*4#0%2/4 "1-#,,1-$1". L'$1WGH'2-%31,13#4"1"'((OE).L/4#3#47=1"#"#0#1*4#0#,"#0 27E1,13,'1<%"12/4#<1*$%.F"#0+3#*$73'0H11*4#0#0*50'6#0#< ,16'*$,1#$2,%*/0%1$*(.@%UART8250/16450*4#0#0,16'*$,1:,%"1"'(#$2,%*/0%1$*(,%0"#0+3#*$73'0H11*4#0#3#<1D%1$*(0,16'*$, :,%"1"'(. L'$0WK%""/16#$#0/(DR).G5"#'4'"1*-#4+-#*4#0"%:#5($*(0FIFO 3,'1<"'-%,-#$#,/1:#*$<#B1$3,#='$%$+.C4#0#5#4B"#2/$+ 3#4"#*$+?3,'"($#'31,1<1D1"#'.*50'6#0#6#,16'*$,%0FIFO('4' ,16'*$,:,%"1"'(54(8250/16450)5#$#6#,-%->$#$2'$2751$7*$%"#041".

I&'-**&+0/*?*&+0	<&,-(.L0A'#J#%	C.3,0%3#
+0x06	.%3'*+/=$1"'1	R16'*$, *#*$#("'(<#51<% (MSR Ñ Modem Status Register) L'$7WG2"%,7B1"'1"1*7D19 5%""/: (DCD). G$,%B%1$ *#*$#("'14'"'' DCD "% UART. L'$6WQ"5'-%$#, 0/.#0% (RI). G$,%B%1$ *#*$#("'14'"'' RI "% UART. L'$5WT#$#0"#*$+ 31,15%$='-%5%""/: (DSR). G$,%B%1$ *#*$#("'14'"'' DSR "% UART. L'$4WT#$#0"#*$+ - 3,';<7 (CTS). G$,%B%1$ *#*$#("'14'"'' CTS "% UART. L'$3WQ.<1"1"'1*#*$#("'(#2"%,7B1"'("1*7D19 5%""/: (DDCD). 8*$%"%04'0%1$*(0"1", 1*4' 4'"'(-DCD '.<1"'4% *#*$#("'11D;,%.*<#<1"$% 3#*415"16# =$1"'(MSR :#*$#<. L'$2WI,#"$*'6"%4% 0/.#0% (TERI). 8*$%"%04'0%1$*(0"1", 1*4' 4'"'(-RI 31,1H4% '.''.-#6# 7,#0"(00/*#-'9 * <#<1"$% 3#*415"16# =$1"'(MSR :#*$#<. L'$1WQ.<1"1"'1*#*$#("'(6#$#0"#*$' 31,15%$='-%5%""/: (DDSR). 8*$%"%04'0%1$*(0"1", 1*4' 4'"'(-DSR '.<1"'4% *#*$#("'11D;,%.*<#<1"$% 3#*415"16# =$1"'(MSR :#*$#<. L'$0WQ.<1"1"'1*#*$#("'(6#$#0"#*$' - 3,';<7 (DCTS). 8*$%"%04'0%1$*(0"1", 1*4' 4'"'(-CTS '.<1"'4% *#*$#("'11D;,%.*<#<1"$% 3#*415"16# =$1"'(MSR :#*$#<.
+0x07	.%3'*+/=$1"'1	R16'*$, Scratch (SCR Ñ Scratch Register).)$#$,16'*$, "10/3#4"(1$"'-%-#9 E7"-&''0 UART. Z#*$ <#B1$.%3'*%$+ 4?2#1."%=1"'10>$#<1*$# ' 3#.5"11*='$%$+ 16#.

1.9. M0 .'#+#/023 UART 16550A

Z#$(National Semiconductor "13,154%6%4% "'-%-': -#<3#"1"$#0, *#0<1*$'</: * 16550 '3,15#*$%04(?D': 5#3#4"'$14+"/1 E7"-&'', 5,76'1 3,#'.0#5'$14' *514%4' >$#. @1-#$#,/1 '.>$': -#<3#"1"$#0 #3'*%"/ "'B1. C41571$ 3#"'<%$+, =$# 54(>EE1-$'0"#6#'*3#4+.#0%"'(>$': 747=H1"'9 <#67$ 3#$,12#0%$+*(5,%901,/ #$ 3,#'.0#5'$14(='3%, 3#*-#4+-7 2#4+H'"*$0# 3#374(,"/: #31,%&'#""/: *'*$1< "13#551,B'0%?$ E7"-&'', 0/:#5(D'1.%,%<-'0#.<#B"#*$19 16550.

ST16650

A# 7<#4=%"'? >$% =%*$+ %"%4#6'="% NS16550A, "# 5#3#4"'$14+"# <#B"# 0-4?='$+,%*H',1""/9 32-2%9$#0/9 27E1, #$3,%0-'' 3,';<%. A,#'.0#5'$14+ Ñ StarTech.

TIL16660

A# 7<#4=%"'? >$% =%*$+ 015;$ *12(%"%4#6'="# NS16550A, "# 5#3#4"'$14+"# <#B1$ 2/$+0-4?=;" ,%*H',1""/9 64-2%9$"/9 27E1, 31,15%=' ' 3,';<%. A,#'.0#5'$*(Texas Instruments.

Hayes ESP

)$% 3,#3,'1$%,"%(0"1H"((-%,$% *#51,B'$ 27E1, 31,15%=' ' 3,'1<% ,%.<1,#< 2048 2%9$ ' 3#551,B'0%1$*-#,#*$+ 31,15%=' 5%"" / : 5# 230,4 J2'$/*. A,#'.0151"# -#<3%"'19 Hayes.

F 5#3#4"1"'1 - >$'<"3,#*$/<"UART <"#6'1 3,#'.0#5'$14' 0/37*-%?$ '"$1441-$7%4+"/1 34%$/ 54(3#*415#0%$14+"#9 *0(.'. O%-#9 $'3 -#"*$,7-&'' #2/="# 0-4?=%1$ <'-,#3,#&1**#,, -#$#,/9 0.%'<#519*$071$ * "1*-#4+-'<' UART, #2,%2%$/0%1$ ' 27E1,'.71$ 5%""/1, % .%$1< 3,' "1#2:#5'<#*$' 7015#<4(1$ #*"#0"#9 3,#&1**#, AJ. A#*-#4+-7 0 $%-#9 *'*$1<1 *0(.' UART "1 5#*$73"/ "%3,(<7? 3,#&1**#,7 AJ, 3,#'.0#5'$14? "1 #2(.%$14+"# '*3#4+.#0%$+ UART, *#0<1*$'</1 * 8250, 16450 '4' 16550.)$# 5%;$,%.,%2#$='-7 *0#2#57 0/2#,% -#<3#"1"$#0 * 47=H'<' :%,%-$1,'*$'-%<' 3,#'.0#5'$14+"#*$'.

2. @0,-'&5)0+'05*#'0 sio

K,%901, sio #21*31='0%1$ 3#551,B-7 '"$1,E19*#0 *0(.' EIA RS-232C (CCITT V.24) "% #*"#01 NS8250, NS16450, NS16550 ' NS16550A. O%-B1 3#551,B'0%?$*("1*-#4+-# <"#6#3#,$#0/:-%,$. A#5,#2"7? $1:"'=1*-7? 5#-7<1"$%&'? *<#$,'$1 "% sio(4).

2.1. Digi International (DigiBoard) PC/8

-%,(')$#.,"'* Andrew Webster <awebster@pubnix.net>. 26 $#&/)*$ 1995.*

F#$ E,%6<1"$ -#"E'67,%&'' * <%H'"/,"% -#$#,#9 7*$%"#041"% 34%$% Digi International PC/8 *='3#< 16550. J "19 3#5-4?=1"# 8 <#51<#0, ,%2#$%?D': "%>$': 8 4'"'(:, ' #"' #$4'="# E7"-&'#"',7?$. @1 .%275+$1 5#2%0'$+ options COM_MULTIPORT, '"%=1 ,%2#$% 2751$ "1*$%2'4+"#9!

```
device          sio4    at isa? port 0x100 flags 0xb05
device          sio5    at isa? port 0x108 flags 0xb05
device          sio6    at isa? port 0x110 flags 0xb05
device          sio7    at isa? port 0x118 flags 0xb05
device          sio8    at isa? port 0x120 flags 0xb05
device          sio9    at isa? port 0x128 flags 0xb05
device          sio10   at isa? port 0x130 flags 0xb05
device          sio11   at isa? port 0x138 flags 0xb05 irq 9
```

Z'$,#*$+ "%*$,#9-' .%-4?=%1$*(0 $#<,=$# *$%,H'9 2'$ E4%6#0 3,15*$%04(1$ 3#*415"'9 3#,$ SIO, 0 5%""#< *47=%1 11, 3#>$#<7 E4%6',%0"/ 0xb05.

2.2. Boca 16

-%,(')$#.,"'* Don Whiteside <whiteside@acm.org>. 26 $#&/)*$ 1995.*

A,#&157,/ 3# "%*$,#9-1 34%$/ Boca * 16 3#,$%<' 0 FreeBSD 5#0#4+"# 3,#*$/,"# 0%<

3#"%5#2'$*("1*-#4+-# 01D19 54(7*31H"#9 ,%2#$/:

1. F%< "1#2:#5'<# 4'2# 7*$%"#0'$+ '*:#5"/1 -#5/ (5,%, =$#2/ 31,1-#<3'4',#0%$+ "7B"/1#3&'', 4'2# "%9$' -#6#-$#, -$# *514%1$ >$# .% 0%*. C$%"5%,$"#1 (5,# 01,*'' 2.0.5", 0-4?=%1$ 3#551, B-7 "1*-#4+-': 3#,$#0, ' 0 4?2#< *47=%1 0%< 3#$,1271$*(5#2%0'$+ .%3'*+ 7*$,#9*$0% 54(-%B5#6# 3#,$%.
2. K0%, 0%< "7B"# ."%$+ 3,1,/0%"'1 ' "%*$,#9-7 00#5%-0/0#5% 54(0%H19 34%$/ Boca, =$#2/ 3,%0'4+"# 7*$%"#0'$+>$' 3%,%<1$,/ 0 (5,1.

F%B"#1 .%<1=%"'1 Ñ ,1%4+"/1 <'-,#*:1</ UART 54(Boca 16 "%:#5($*(0 *#15'"'$14+"#9 -#,#2-1,% "1 "% 0"7$,1""19 34%$1. A#>$#<7, 1*4' #"% #$-4?=1"%, 3#3/$-' 3,#01,'$+ >$' 3#,$/ .%01,H%$*("175%=19. ["'-#65% "1 3,#01,(4 .%6,7.-7 * #$-4?=;""#9 -#,#2-#9 ' 3#*4157?D'<1; 3#5-4?=1"'1<,' "1,1-#<1"57? 0%< >$#6# 514%$+.

N*4' 7 0%* 1D; "1$ "%*$,#1""#6# E%94% -#"E'67,%&'' 3#4+.#0%$14+*-#6# (5,%, #2,%$'$1*+- ,%.5147 J#"E'67,%&'((5,% 0 ,7-#0#5*$01 FreeBSD 54(3#47=1"'(#2D': '"*$,7-&'9. @'B1 3,'0151"/ -#"-,1$"/1 "%*$,#9-' 54(34%$/ Boca 16, 3,153#4%6%1$*(, =$# 0/'*3#4+.71$1 (5,#* '<1"1< MYKERNEL ',15%-$',71$1 16#* 3#<#D+? vi.

1. K#2%0+$1 *$,#-7

   ```
   options COM_MULTIPORT
   ```

   0 -#"E'67,%&'#""/9 E%94.

2. T51 "%:#5($*($1-7D'1 *$,#-' device sion, 0%< "7B"# 5#2%0'$+ 1D; 16 7*$,#9*$0. F *4157?D1< 3,'<1,1 3#-%."% 34%$% Boca Board *3,1,/0%"'1< 3 ' 2%.#0/<%5,1*#< 00#5%-0/0#5% 100h. !5,1* 00#5%-0/0#5% 54(-%B5#6# 3#,$% 7014'='0%1$*("% 8 0 H1*$"%5&%$1,'="#9 *'*$1<1 #$"#*'$14+"# 3,15/57D16# 3#,$%, 3#>$#<7 %5,1*% 2757$ 100h, 108h, 110hÉ

   ```
   device sio1 at isa? port 0x100 flags 0x1005
   device sio2 at isa? port 0x108 flags 0x1005
   device sio3 at isa? port 0x110 flags 0x1005
   device sio4 at isa? port 0x118 flags 0x1005
   ...
   device sio15 at isa? port 0x170 flags 0x1005
   device sio16 at isa? port 0x178 flags 0x1005 irq 3
   ```

   M%3'*+ flags *'0!1$*,.2"'* 5#4B"% 2/$+ '.<1"1"% 3# *,%0"1"'? * >$'< 3,'<1,#<, 1*4' 0/ "1 '*3#4+.71$1 $#="# $%-'1 B1 "%."%=1"'(sio. I4%6' 7*$%"%04'0%?$*(0 *##01*$0'' * 0xMYY, 651 *M* #2#."%=%1$ <4%5H'9 "#<1, 64%0"#6# 3#,$% (3#*415"'9 3#,$ "% Boca 16), % *YY* 7-%./0%1$, 0-4?=1" '4' 0/-4?=1" FIFO (0-4?=1"), '*3#4+.71$*(4' ,%.5141"'1 IRQ (5%) ' 1*$+ 4' ,16'*$, 73,%041"'(IRQ, *#0<1*$'</9 * AST/4 ("1$). F >$#< 3,'<1,1,

```
Êflags
Ê         0x1005
```

7-%./0%1$, =$# #*"#0"#9 3#,$ - sio16. N*4' 5#2%0'$+ 5,767? 34%$7 ' "%."%='$+ 3#,$/ * sio17 3# sio28, E4%6' 54(0*1: 16 3#,$#0 "%*3*'4 34%$1 2757$ 0x1C05, 651 1C #2#."%=%1$ <'"#,"/9 "#<1, #*"#0"#6# 3#,$%.@1 '.<1"(9$1 ."%=1"'1 05.

3. C#:,%"'$1 ' .%01,H'$1 -#"E'67,%&'? (5,%, 31,1-#<3'4',79$1, 7*$%"#0'$1 ' 31,1.%6,7.'$1*+. A,153#4%6%(, =$# 0/ 7*31H"# 7*$%"#0'4' 31,1-#<3'4',#0%""#1 (5,# ' "%*$,#'4' 3,%0'4+"/9 %5,1* ' IRQ, *##2D1"'1 3,' .%6,7.-1 5#4B"# 7-%./0%$+ "% 7*31H"#1 #2"%,7B1"'1 3#,$#0 Boca *4157?D'< #2,%.#<: (#=10'5"#, "#<1,% sio, IO ' IRQ <#67$ #$4'=%$+*()

```
sio1 at 0x100-0x107 flags 0x1005 on isa
sio1: type 16550A (multiport)
sio2 at 0x108-0x10f flags 0x1005 on isa
sio2: type 16550A (multiport)
sio3 at 0x110-0x117 flags 0x1005 on isa
sio3: type 16550A (multiport)
sio4 at 0x118-0x11f flags 0x1005 on isa
sio4: type 16550A (multiport)
sio5 at 0x120-0x127 flags 0x1005 on isa
sio5: type 16550A (multiport)
sio6 at 0x128-0x12f flags 0x1005 on isa
sio6: type 16550A (multiport)
sio7 at 0x130-0x137 flags 0x1005 on isa
sio7: type 16550A (multiport)
sio8 at 0x138-0x13f flags 0x1005 on isa
sio8: type 16550A (multiport)
sio9 at 0x140-0x147 flags 0x1005 on isa
sio9: type 16550A (multiport)
sio10 at 0x148-0x14f flags 0x1005 on isa
sio10: type 16550A (multiport)
sio11 at 0x150-0x157 flags 0x1005 on isa
sio11: type 16550A (multiport)
sio12 at 0x158-0x15f flags 0x1005 on isa
sio12: type 16550A (multiport)
sio13 at 0x160-0x167 flags 0x1005 on isa
sio13: type 16550A (multiport)
sio14 at 0x168-0x16f flags 0x1005 on isa
sio14: type 16550A (multiport)
sio15 at 0x170-0x177 flags 0x1005 on isa
sio15: type 16550A (multiport)
sio16 at 0x178-0x17f irq 3 flags 0x1005 on isa
sio16: type 16550A (multiport master)
```

N*4' *##2D1"'(3,#:#5($*4'H-#<2/*$,#,=$#2/ ':70'51$+,

```
# dmesg | more
```

3#-%B1$ 0%< *##2D1"'(.%6,7.-'.

4. K%411 "1#2:#5'<# *#.5%$+ *##$01$*$07?D'1 .%3'*' 0 /dev 54(7*$,#9*$0 * 3#<#D+? *-,'3$% /dev/MAKEDEV.)$#$ H%6 <#B"# 3,#37*$'$+, 1*4' 0/ '*3#4+.71$1 FreeBSD 5.X*(5,#<,0 -#$#,#< 0-4?=1"% 3#551,B-% devfs(5).

   N*4' 0%< "1#2:#5'<# *#.5%$+ .%3'*' 0 /dev, 0/3#4"'$1 *4157?D7? -#<%"57 #$'<1"' root:

   ```
   # cd /dev
   # ./MAKEDEV tty1
   # ./MAKEDEV cua1

   (everything in between)
   # ./MAKEDEV ttyg
   # ./MAKEDEV cuag
   ```

   N*4' 3# -%-#9-$# 3,'='"1 0%< "1 "7B"/ '4' "1 $,127?$*(7*$,#9*$0% '*:#5(D': *#15'"1"'9,0/ <#B1$1 #2#9$'*+ 21. *#.5%"'(7*$,#9*$0 cua*.

5. N*4' 0%< "7B1" 2/*$,/9 ' "12,1B"/9 *3#*#2 7215'$+*(,=$# 7*$,#9*$0% ,%2#$%?$, 0/ <#B1$1 3,#*$# 3#5-4?='$+ <#51< - -%B5#<7 3#,$7 ' (-%- root)

   ```
   # echo at > ttyd*
   ```

   54(-%B5#6# 7*$,#9*$0%, -#$#,#1 0/ *#.5%4'. F/ *('.5"6* 70'51$+, -%- <'6%?$'"5'-%$#,/ RX 54(-%B5#6# ,%2#=16# 3#,$%.

2.3. I&++#'H)0 +# J K*?9 2%&=&)0%0/1%?9 UART-)0'-

-%,(')$#.,"'7,.2&, 8.2($9':* hmo@sep.hamburg.com, *1"$(2,+ 1999 6#5%

F/ -#65%-"'275+ .%57</0%4'*+ # 3#551,B-1 FreeBSD 0%H19 20-5#44%,#0#9 <"#6#E7"-&'#"%4+"#9 -%,$/ * 507<(('4' 2#411) COM-3#,$%<', ,%.514(?D'<' IRQ? F#$ -%- >$# *514%$+:

G2/="# 15'"*$01"" /9 *3#*#2 3#551,B-' $%-': 34%$ Ñ '*3#4+.#0%"'1 #$514+"#6# IRQ 54(-%B5#6# 3#,$%. @%3,'<1,,1*4' 0%H% <%$1,'"*-%(34%$% '<11$ 0*$,#1"" /9 3#,$ COM1 (#" B1 sio0 Ñ %5,1* 00#5%-0/0#5% 0x3F8 ' IRQ 4), % 7 0%* 1*$+ ,%*H',' $14+"%(34%$% * 507<(UART, $# #2/="# ': "7B"# "%*$,#'$+ -%- COM2 (#" B1 sio1 Ñ %5,1* 00#5%-0/0#5% 0x2F8 ' IRQ 3), % $,1$'9 3#,$ (#" B1 sio2) Ñ * %5,1*#< 0x3E8 ' IRQ 5. G=10'5"#, >$# ,%*$#='$14+"#1 '*3#4+.#0%"'1 ,1*7,*#0 IRQ, $%- -%- 0 3,'"&'31 0#.<#B"# .%37*$'$+ #2% 3#,$%

,%*H',' $14+"#9 34%$/ * #5"'< IRQ, '*3#4+.7(-#"E'67,%&'? COM_MULTIPORT, #3'*%""7? 0 3,15/57D': ,%.514%:.

O%-'1 "15#,#6'1 34%$/ 00#5%-0/0#5% #2/="# '<1?$ 31,1</=1="7? <%$,'&7 4x3 54(COM-3#,$#0, 3#5#2"7? *4157?D19:

```
Ê          o  o  o  *
Port A        |
Ê          o  *  o  *
Port B     |
Ê          o  *  o  o
IRQ        2  3  4  5
```

A#-%.%"#, =$# 3#,$ A 3#5-4?=1" 54(IRQ 5, % 3#,$ B Ñ 54(IRQ 3. C$#42&/ IRQ "% 0%H19 -#"-,1$"#9 34%$1 <#67$ #$4'=%$+*(Ñ 5,76'1 34%$/ <#67$ 3,15#*$%04($+ 31,1</=-' 54(IRQ 3, 4, 5 ' 7.

P#B"# 2/4# 2/ *514%$+ 0/0#5, =$# 3#5-4?=1"'1 #2#': 3#,$#0 - IRQ 3 * 3#<#D+? *%<#514+"#9 31,1</=-', .%</-%?D19 0*1 $,' $#=-' *#15'"1"'(0 -#4#"-1 IRQ 3, ,1H'$ 3,#241<7, "# >$# "1 $%-. @10#.<#B"# 5724',#0%$+ IRQ 3, 3#$#<7 =$# 0/:#5"/1 5,%901,/-%B5#6# UART *#15'"1"/ 3# *:1<1 "<#"$%B"#1 Q", ' 1*4' #5'" '. UART 73,%04(1$ IRQ 3, 0/:#5"#9 *'6"%4 2751$ "1 $%-'< -%- #B'5%1$*(. F .%0'*'<#*$' #$,1%4'.%&'' 34%$/ ,%*H',1"'('4' <%$1,'"*-#9 34%$/,4'"'(IRQ 3 2751$ 3#*$#(""# "%:#5'$+*(0 0/*#-#< 7,#0"1 '4' 0*165% #*$%0%$+*("'.-#9.

F%< "1#2:#5'<# ,%.514'$+ 5,%901,/ 3,1,/0%"'9 54(507: UART, =$#2/ 4'"'(3,1,/0%"'(34%$/ 3#5"'<%4%*+ $#4+-# $#65% (' $#4+-# $#65%), -#65% #5'" '. UART 0/./0%1$ 3,1,/0%"'1,' #*$%0%4%*+ "'.-#9 0 3,#$'0"#< *47=%1. R1H1"'1 2/4# 3,154#B1"# \#,6#< F7"H1< j@ida.interface-business.de: 3,'3%($+ <#"$%B"7? *:1<7 "<#"$%B"#1 QUQ", *#*$#(D7? '. 507: 5'#5#0 (3,153#=$'$14+"# 61,<%"'10/: '4' $'3% V#$$-') ' ,1.'*$#,% "%1 -G<. F#$*:1<%, "%='"%(*-#"$%-$"#6# 3#4(4x3 0/H1:

```
Ê                      Diode
Ê             +---------->|-------+
Ê            /                    |
Ê          o  *  o  o             |     1 kOhm
Port A                            +-----|######|-------+
Ê          o  *  o  o             |                    |
Port B       `--------------------+                ==+==
Ê          o  *  o  o             |                Ground
Ê             \                   |
Ê              +--------->|-------+
IRQ        2  3  4  5    Diode
```

J%$#5/ 5'#5#0 *#15'"1"/ 0 #2D19 $#=-1 0<1*$1 * 3#5$(6'0%?D'< ,1.'*$#,#< 1 -G<. F%B"# 3#5-4?='$+ ,1.'*$#, - .1<41, =$#2/ '.21B%$+ 34%0%"'(4'"'' IRQ "% H'"1.

O131,+</6#$#0/ "%*$,#'$+ (5,#.A,#5#4B%(>$#$ 3,'<1,,</ "%*$,#'<:

```
# standard on-board COM1 port
device          sio0    at isa? port "IO_COM1" flags 0x10
# patched-up multi-I/O extension board
options         COM_MULTIPORT
device          sio1    at isa? port "IO_COM2" flags 0x205
device          sio2    at isa? port "IO_COM3" flags 0x205 irq 3
```

G2,%$'$1 0"'<%"'1, =$# "%*$,#9-% flags 54(sio1 ' sio2 519*$0'$14+"# 0%B"%; 3#5,#2"#*$'*<#$,'$1 0 sio(4). (G2/="# 2 0 %$,'27$1 "flags" #$"#*'$*(- sio2, -#$#, /9 *#51,B'$ IRQ, ' 0%<"%01,"(-% 3#$,1271$*("'B"'9 "'224 5.) A,' 0-4?=;""#< ,1B'<1 3#5,#2"#6# 0/0#5% (5,%>$# 5#4B"# 5%$+ =$#-$# 3#:#B11 "%*4157?D11:

```
sio0: irq maps: 0x1 0x11 0x1 0x1
sio0 at 0x3f8-0x3ff irq 4 flags 0x10 on isa
sio0: type 16550A
sio1: irq maps: 0x1 0x9 0x1 0x1
sio1 at 0x2f8-0x2ff flags 0x205 on isa
sio1: type 16550A (multiport)
sio2: irq maps: 0x1 0x9 0x1 0x1
sio2 at 0x3e8-0x3ef irq 3 flags 0x205 on isa
sio2: type 16550A (multiport master)
```

Z#$(/sys/i386/isa/sio.c 0/64(5'$ "1*-#4+-# .%6%5#="# '.-.% '*3#4+.#0%"'(<%**'0% "irq maps" 0/H1, #*"#0"%('51(.%-4?=%1$*(0 $#<, =$# 0/ "%24?5%1$1 0x1 "% 31,0#9, $,1$+19 '=1$01,$#9 3#.'&'(:.)$# #."%=%1$, =$# *##$01$*$07?D'9 IRQ 2/4 7*$%"#041" 3,' 0/0#51 '*2,#H1" 3#*41, =$# 3#4"#*$+? *##01*071 #B'5%"'(<.N*4' 0%H1 (5,# "1 51<#"*$,',71$$%-#1 3#0151"'1,*-#,11 0*16#, 3,#241<% 0 0%H19 ,%.0#5-1.

3. @0,-'&5)0+'05*#'0 cy

-%,(')$#.,"' ;.,<)': =3>,:.6 ?@"! 1996.*

P"#6#3#,$#0/1 -%,$/ Cyclades #*"#0%"/ "% 5,%901,1 cy, % "1 "% #2/="#< 5,%901,1 sio, '*3#4+.71<#< 5,76'<' <"#6#3#,$#0/<' -%,$%<'. @%*$,#9-% *0#5'$*(- 3,#*$/<519*$0'(<:

1. K#2%0+$1 7*$,#9*$0# cy 0 -#"E'67,%&'? (5,% (#2,%$'$1 0"'<%"'1, =$# 3%,%<1$,/ irq 'iomem <#67$#$4'=%$+*().

   ```
   device cy0 at isa? irq 10 iomem 0xd4000 iosiz 0x2000
   ```

2. A1,1*$,#9$1 ' 7*$%"#0'$1 "#0/9 #2,%. (5,%.
3. C#.5%9$1 E%94/ 7*$,#9*$0, 0015((*4157?D'9 3,'<1, 3,153#4%6%1$ 8-3#,$#07?34%$7):

```
# cd /dev
# for i in 0 1 2 3 4 5 6 7;do ./MAKEDEV cuac$i ttyc$i;done
```

4. N*4' "1#2:#5'<#, 5#2%0+$1 .%3'*' 54(-#<<7$',71<#6# 5#*$73% 0 /etc/ttys, 5724',7(.%3'*' 54(3#*415#0%$14+"/: 7*$,#9*$0 (ttyd) ' '*3#4+.7(ttyc 0<1*$# ttyd. @%3,'<1,:

```
ttyc0   "/usr/libexec/getty std.38400"  unknown on insecure
ttyc1   "/usr/libexec/getty std.38400"  unknown on insecure
ttyc2   "/usr/libexec/getty std.38400"  unknown on insecure
...
ttyc7   "/usr/libexec/getty std.38400"  unknown on insecure
```

5. A1,1.%6,7.'$1*+**"#0/<(5,#<.

4. @0,-'&5)0+'05*#'0 si

-%,(')$#.,"'* Nick Sayer <nsayer@FreeBSD.org>. *25 : $%*$ 1998.*

C31&'%4+"/1 <74+$'3#,$"/1 -%,$/ Specialix SI/XIO ' SX '*3#4+.7?$ 5,%901, si. @% #5"#9 <%H'"1 <#B1$ 2/$+ 7*$%"#041"# 5# 4 :#*$--%,$. A#551,B'0%?$*(*4157?D'1 :#*$--%,$/:

- ISA SI/XIO host card (2 versions)
- EISA SI/XIO host card
- PCI SI/XIO host card
- ISA SX host card
- PCI SX host card

Z#$(:#*$--%,$/ SX ' SI/XIO 0/64(5($.%<1$"# 3#-,%."#<7, ': E7"-&'#"%4+"#*$+ 3,%-$'=1*-' #5'"%-#0%. Z#*$--%,$/ "1 '*3#4+.7?$ 3#,$/ 00#5%-0/0#5%, % 0<1*$# >$#6# $,127?$ 32J *16<1"$% 3%<($'. M%0#5*-%(-#"E'67,%&'(54(-%,$ ISA ,%.<1D%1$ >$#$ *16<1"$ 3# %5,1*7 0xd0000-0xd7fff. O%-B1 '< $,1271$*(IRQ. J%,$/ PCI, ,%.7<11$*(, "%*$,%'0%?$*(%0$#<%$'=1*-'.

F/ <#B1$1 3#5-4?='$+ 5# 4 0"1H"': <#57419 - -%B5#9 -%,$1 :#*$%. F"1H"'1 <#574' *#51,B%$ 4'2# 4,4'2# 8 3#*415#0%$14+"/: 3#,$#0. G"'2/0%?$*4157?D': 0'5#0:

- P#574' SI "%4'4' 8 3#,$#0. A#551,B'0%1$*(*-#,#*$+ 5# 57600 2'$/* "% -%B5#< 3#,$7.
- XIO 8-3#,$#0/1 <#574'. A#551,B'0%1$*(*-#,#*$+ 5# 115200 2'$/* "% -%B5#< 3#,$7. G5'"'. $'3#0 <#57419 XIO '<11$ 7 3#*415#0%$14+"/: ' 1 3%,%4414+"/9 3#,$.
- P#574' SXDC * 8 3#,$%<'. A#551,B'0%1$*(*-#,#*$+ 5# 921600 2'$/* "% -%B5#< 3#,$7. J%- ' 0*47=%1*XIO, 5#*$731" <#574+**#5"'< 3%,%4414+"/< 3#,$#<.

K4("%*$,#9-' -%,$/ :#*$% ISA 5#2%0+$1 *4157?D7? *$,#-7 0 E%94 -#"E'67,%&'' (5,%,

'.<1"'0='*4% 3# <1,1"1#2:#5'<#*$':

```
device si0 at isa? iomem 0xd0000 irq 11
```

K#37*$'</1"#<1,% IRQ: 9, 10, 11, 12 ' 15 54(SX ISA host cards ' 11, 12 ' 15 54(SI/XIO ISA host cards.

K4("%*$,#9-' -%,$/ EISA '4' PCI '*3#4+.79$1*4157?D7?*$,#-7:

```
device si0
```

A#*41 5#2%041"'(.%3'*' -#"E'67,%&'' 31,1*#21,'$1 ' 7*$%"#0'$1*0#1"#0#1(5,#.

> **!** C4157?D'9 H%6"1#2(.%$141",1*4' 0/ '*3#4+.71$1 devfs(5) 0 FreeBSD 5.*X*.

A#*41 31,1.%6,7.-' * "#0/<(5,#<"1#2:#5'<# *#.5%$+ E%94/ 7*$,#9*$0 0 /dev. C-,'3$ MAKEDEV 0/3#4"'$>$7 .%5%=7 .%0%*. A#5*='$%9$1#2D11 -#4'=1*$0# 3#,$#0 ' 0015'$1:

```
# cd /dev
# ./MAKEDEV ttyAnn cuaAnn
```

(651 *nn* Ñ -#4'=1*$0# 3#,$#0)

N*4' 0/ :#$'$1, =$#2/ 3,'64%H1"'(- 0:#57 #$#2,%B%4'*+ "% >$': 3#,$%:, 0%< "7B"# 5#2%0'$+ $%-'1*$,#-' 0 /etc/ttys:

```
ttyA01  "/usr/libexec/getty std.9600"   vt100   on insecure
```

Q.<1"'1'3 $1,<'"%4% 3# "1#2:#5'<#*$'.K4(<#51<#0 3#5#957$ dialup '4' unknown.