# **AN1578** Application Note

# MECL 10H™ SPICE Kit for Berkeley SPICE (PSPICE)

Prepared by
Andrea Diermeier
Cleon Petty
Motorola Logic Applications Engineering

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## MECL 10H SPICE Kit for Berkeley SPICE (PSPICE)

The purpose of this application note is to present spice parameters and schematics for a particular set of MC10H MECL logic devices. The devices to be presented are the:

MC10H101, H102, H103, H104, H105, H116, H131, H188, H189, H210, and H211.

This file is intended for Berkeley SPICE Type simulators (e.g. PSPICE). A similar file is available for H–SPICE. Those are the most used simulators.

MC10H is a Motorola ECL family that features a 100% speed improvement over the standard 10K family, and still maintains the same gate power. The family has been designed with voltage compensation to keep both DC and AC parameters constant over a ±5% power supply variation, with a 75% improvement in noise margin as a result. The 10H family is a pin for pin duplicate of many of the MECL 10K devices, is compatible with 10K, MECL III, and Motorola's new MC10E and MC10EL ECLinPS and E-Lite families. The devices, like all single supply ECL devices, are usable in a PECL (Positive Emitter Coupled Logic) mode and will suffer no AC or DC performance degradation if treated as prescribed in a Motorola Application Note "Designing with PECL (ECL at +5.0V)" (AN1406/D). AN1406 can be found in the new "High Performance ECL Data Book" (DL140/D) or it can be obtained through the Motorola Literature Distribution

Family Specifications are located in the MECL DATA book DL122/D. Section 2 presents the temperature and power

supply variations that can be expected from the family. The typical delay is 1.0ns, Tr/Tf is 1Ns, measured at the 20–80% points of the edges, Typical VOH is VCC–890MV, Typical VOL is VCC–1750MV, Typical VBB is VCC–1295MV, and 50 ohms to VTT (VCC–2.0v) is the max load recommended.

The following are netlists of the MC10H devices and will include the necessary typical resistor parasitics. The schematics of the netlist are included in the paper to allow the user the ease of seeing the function and follow the netlist more easily. There are no ESD models for the devices since the MC10H family has none.

The Global nodes will be:

(CLKB)

116	e Global flodes will be.						
	(VCC)	Top rail power supply					
	(VCCO)	Top Rail Power supply for Emitter					
		Follower Output Transistors					
	(VEE)	Bottom Rail Power Supply					
	(VBB)	Switching Bias Voltage (VCC-1295MV)					
	(VBBP)	Reference-Voltage (VCC-2095MV)					
	(VBBPP)	Reference-Voltage (VCC-2895MV)					
	(VCS)	Current Source Base Voltage (VEE +					
		1.3V)					
	(VTT)	Termination sink supply (VCC – 2.0V)					
	(IN)	Input					
	(INB)	Inverted input					
	(OR)	Or Output					
	(NOR)	Nor output					
	(CLK)	Clock Input					

Clock Bar Input

```
******************
               THE FOLLOWING IS A PIN MODEL FOR THE
                Package Models ( )
********************
  Package Models: (8-lead SOIC)
                (16-lead DIP) CENTER PIN
                (16-lead DIP) END PIN
                (20-Lead PLCC)
                (20-Lead SOIC Center Pin)
                (20-Lead SOIC End Pin)
                (28-lead PLCC)
* EXT = THE END CONNECTED TO EXTERNAL NODE
* INT = THE END CONNECTED TO THE CIRCUIT INSIDE PACKAGE
********************
***** (8-LEAD SOIC PACKAGE)
.SUBCKT PKG8 EXT INT
   X EXT INT PKG params: C=0.8P R1=750 R2=0.1 L=1.5N
.ENDS PKG8
***** (16-LEAD DIP PACKAGE CENTER PIN)
.SUBCKT PKG16CP EXT INT
   X EXT INT PKG params: C=0.7P R1=750 R2=0.1 L=2.5N
.ENDS PKG16CP
***** (16-LEAD DIP PACKAGE END PIN)
.SUBCKT DIP16EP EXT INT
   X EXT INT PKG params: C=1.3P R1=750 R2=0.1 L=5.5N
.ENDS DIP16EP
***** (20-LEAD PLCC PACKAGE)
.SUBCKT PKG20 EXT INT
   X EXT INT PKG params: C=0.65P R1=750 R2=0.2 L=0.9N
.ENDS PKG20
***** (20-LEAD SOIC PACKAGE CENTER PIN)
.SUBCKT SC20CP EXT INT
   X EXT INT PKG params: C=0.6P R1=750 R2=0.2 L=1.9N
.ENDS SC20CP
***** (20-LEAD SOIC PACKAGE END PIN)
.SUBCKT SC20EP EXT INT
  X EXT INT PKG params: C=0.8P R1=750 R2=0.2 L=3.0N
.ENDS
      SC20EP
***** (28-LEAD PLCC PACKAGE)
.SUBCKT PKG28 EXT INT
  X EXT INT PKG params: C=0.8P R1=750 R2=0.2 L=1.1N
.ENDS PKG28
*NOTE NODES SIN=STROBE IN. SOUT=STROBE PIN TO OTHER UNITS IN PACKAGE*
********************
.SUBCKT H101 VCC VCCO VBB VCS VEE IN SIN OR NOR
   01
       3 1 5 VEE
       3 2 5 VEE
   Q2
       4 VBB 5 VEE
   Q3
                     T08I3
   04
      5 VCS 6 VEE
                     T12B1
       VCCO 4 OR VEE T5406
   Q5
       VCCO 3 NOR VEE T5406
   06
   XR1
       VCC 3 VCC
                     RES params: R=276
   XR2
       VCC 4 VCC
                     RES params: R=276
        6 VEE VCC
                    RES params: R=127
   XR3
   XRB1 IN 1 VCC
                     RES params: R=50
   XRB2 SIN 2 VCC
                    RES params: R=50
   XRP1 IN VEE VCC
                    RPD params: R=50K
   XRP2 SIN VEE VCC
                    RPD params: R=50K
.ENDS H101
```

```
*******************
* THERE ARE TWO SUBCIRCUITS IN THE MC10H102 ONE FOR THE THREE NOR  *
* ONLY GATES (H102N) AND ONE FOR THE OR/NOR GATE (H102NO).
********************
.SUBCKT H102N VCC VCCO VBB VCS VEE IN1 IN2 NOR1
   01
       3 1 4 VEE
                    T08I3
   Q2
       3 2 4 VEE
                     T08I3
       VCC VBB 4 VEE T0813
   Q3
   04
       4 VCS 5 VEE
                    T12B1
       VCCO 3 NOR1 VEE T5406
  Q5
  XR1
      VCC 3 VCC RES params: R=276
  XR2 5 VEE VCC
                   RES params: R=127
  XRB1 IN1 1 VCC
                   RES params: R=50
  XRB2 IN2 2 VCC
                   RES params: R=50
  XRP1 IN1 VEE VCC RPD params: R=50K XRP2 IN2 VEE VCC RPD params: R=50K
.ENDS H102N
********************
.SUBCKT H102NO VCC VCCO VBB VCS VEE IN3 IN4 OR NOR2
      8 6 10 VEE T08I3
  06
   Q7
       8 7 10 VEE
                     T08I3
       9 VBB 10 VEE T08I3
   Q8
       10 VCS 11 VEE T12B1
   09
      VCCO 9 OR VEE T5406
  010
  011
      VCCO 8 NOR2 VEE T5406
  XR4
      VCC 8 VCC RES params: R=276
  XR5 VCC 9 VCC
                   RES params: R=276
  XR6 11 VEE VCC
                   RES params: R=127
  XRB3 IN3 6 VCC
                   RES params: R=50
  XRB4 IN4 7 VCC
                   RES params: R=50
  XRP3 IN3 VEE VCC RPD params: R=50K
  XRP4 IN4 VEE VCC RPD params: R=50K
.ENDS H102NO
*****************
* THERE ARE TWO SUBCIRCUITS IN THE MC10H103 ONE FOR THE THREE OR *
* ONLY GATES (H1030) AND ONE FOR THE OR/NOR GATE (H103NO)
********************
.SUBCKT H1030 VCC VCCO VBB VCS VEE IN1 IN2 NOR1
      VCC 1 4 VEE
                    T08I3
   Q1
       VCC 2 4 VEE
   Q2
                    T08I3
   Q3
       3 VBB 4 VEE
                    T08I3
   04
       4 VCS 5 VEE
                    T12B1
       VCCO 3 NOR1 VEE T5406
  Q5
      VCC 3 VCC RES params: R=276
  XR1
  XR2 5 VEE VCC
                   RES params: R=127
  XRB1 IN1 1 VCC
                   RES params: R=50
  XRB2 IN2 2 VCC
                   RES params: R=50
  XRP1 IN1 VEE VCC RPD params: R=50K XRP2 IN2 VEE VCC RPD params: R=50K
.ENDS H1030
.SUBCKT H103NO VCC VCCO VBB VCS VEE IN3 IN4 OR NOR2
   Q6
       8 6 10 VEE
                    T08I3
   07
       8 7 10 VEE
                     T08I3
       9 VBB 10 VEE
   08
                    T08I3
       10 VCS 11 VEE T12B1
   Q9
       VCCO 9 OR VEE T5406
  010
       VCCO 8 NOR2 VEE T5406
  Q11
      VCC 8 VCC RES params: R=276
  XR4
  XR5 VCC 9 VCC
                   RES params: R=276
  XR6 11 VEE VCC
                   RES params: R=127
```

```
XRB3 IN3 6 VCC
                  RES params: R=50
  XRB4 IN4 7 VCC
                  RES params: R=50
  XRP3 IN3 VEE VCC RPD params: R=50K
  XRP4 IN4 VEE VCC
                 RPD params: R=50K
.ENDS H103NO
* The MC10H104 is a Quad 2-Input AND/NAND gate.
******************
.SUBCKT H104 VCC VCCO VBB VBBPP VCS VEE IN1 IN2 OUT OUTB
     VCC 1 2 VEE T08I3
  Q1
  Q2
        2 2 3 VEE
                    T08T3
       VCC VBBPP 3 VEE T08I3
  Q3
  04
       3 VCS 4 VEE T12B1
  Q5
       6 5 7 VEE
  Q6
       8 VBB 7 VEE
  07
       8 VBB 9 VEE
                    T08I3
  08
       7 3 10 VEE
                    T08T3
       9 VBBPP 10 VEE T08I3
  09
  Q10
      10 VCS 11 VEE T12B1
       VCCO 6 OUTB VEE T5406
  Q11
       VCCO 8 OUT VEE T5406
  Q12
  XR1
       VCC 6 VCC
                    RES params: R=281
       VCC 8 VCC
  XR2
                    RES params: R=281
                   RES params: R=377
  XR3
       4 VEE VCC
      11 VEE VCC
                   RES params: R=128
  XR4
  XRb1 IN2 1 VCC
                   RES params: R=50
  XRb2 IN1 5 VCC
                   RES params: R=50
  XRP1 IN1 VEE VCC RPD params: R=50K
  XRP2 IN2 VEE VCC RPD params: R=50K
  XRXCX1 VCC 1 VEE
                   RXCX1
.ENDS H104
* THERE ARE TWO SUBCIRCUITS IN THE MC10H105 ONE FOR THE TWO TWO
* INPUT OR/NOR GATES (H1052) AND ONE FOR THE THREE INPUT OR/NOR
* GATE (H1053)
********************
.SUBCKT H1052 VCC VCCO VBB VCS VEE IN1 IN2 OR1 NOR1
      3 1 5 VEE
                  T08I3
  Q1
       3 2 5 VEE
  Q2
                   T08I3
  Q3
       4 VBB 5 VEE
                   T08I3
  04
      5 VCS 6 VEE
                   T12B1
      VCCO 4 OR1 VEE T5406
  Q5
  Q6
      VCCO 3 NOR1 VEE T5406
  XR1
      VCC 3 VCC RES params: R=276
  XR2 VCC 4 VCC
                  RES params: R=276
  XR3 6 VEE VCC
                  RES params: R=127
  XRB1 IN1 1 VCC
                  RES params: R=50
  XRP2 IN2 VEE VCC RPD params: R=50K
.ENDS H1052
******************
.SUBCKT H1053 VCC VCCO VBB VCS VEE IN3 IN4 IN5 OR2 NOR2
      10 7 12 VEE
   07
                  T08I3
   Q8
        10 8 12 VEE
                     T08I3
   09
       10 9 12 VEE
                     T08I3
                   T08I3
   Q10 11 VBB 12 VEE
   Q11 12 VCS 13 VEE T12B1
   Q12 VCCO 11 OR2 VEE T5406
   Q13 VCCO 10 NOR2 VEE T5406
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```
XR4
        VCC 10 VCC
                      RES params: R=276
        VCC 11 VCC
   XR5
                      RES params: R=276
         13 VEE VCC
                      RES params: R=127
   XR6
   XRB3 IN3 7 VCC
                       RES params: R=50
   XRB4 IN4 8 VCC
                       RES params: R=50
   XRB5 IN5 9 VCC
                       RES params: R=50
        IN3 VEE VCC
    XRP3
                       RPD params: R=50K
   XRP4 IN4 VEE VCC
                       RPD params: R=50K
   XRP5 IN5 VEE VCC
                      RPD params: R=50K
ENDS H1053
*********************
* THE MC10H116 LINE RECEIVER (H116) HAS THREE GATES IN A PACKAGE
* AND NO PULLDOWNS TO VEE
******************
.SUBCKT H116 VCC VCCO VCS VEE IN INB OUT OUTB
   01
       2 1 4 VEE
                     T08T3
   02
       3 6 4 VEE
                      T08I3
                    T12B1
   03
       4 VCS 5 VEE
       VCCO 2 OUTB VEE T5406
   04
       VCCO 3 OUT VEE T5406
   Q5
      VCC 2 VCC
   XR1
                     RES params: R=289
       VCC 3 VCC
   XR2
                     RES params: R=289
   XR3
       5 VEE VCC
                     RES params: R=127
                    RES params: R=50
   XRB1 IN 1 VCC
   XRB2 INB 6 VCC
                    RES params: R=50
.ENDS H116
********************
* THE MC10H131 IS A DUAL D FLIP FLOP WITH SET AND RESET.
* CC=COMMON CLOCK, CE=INDIV CLOCK IN, DIN=DATA IN, SE=SET IN,
* RES=RESET, Q=TRUE OUT, QB=INV OUT, VBBP=VBB -.82V
*************************
.SUBCKT H131 VCC VCCO VBB VBBP VCS VEE DIN CC CE SE RE O OB
        VCC 29 33 VEE T0812
   01
         VCC 30 33 VEE T0812
   02
        VCC 31 33 VEE T0812
   Q3
         VCC 32 33 VEE T0812
   Q4
         34 VCS 35 VEE T12B4
   Q5
   Q6
         2 1 5 VEE
                      T05I3
   07
         4 VBB 5 VEE
         5 VBBP 6 VEE T05I3
   Q8
   Q9
         6 VCS 7 VEE
                     T12B4
   010
        8 VCS 9 VEE
                     T06B1
   Q11
        11 33 6 VEE
                     T05I3
       2 10 11 VEE T05I3
   Q12
        2 8 11 VEE
   Q13
                     T05I3
   Q14
       VCC 4 8 VEE
                    T05I2
   Q15
       VCC 2 13 VEE T05I2
        4 13 11 VEE
   Q16
   Q17
        4 12 11 VEE
                     T05I3
   018
       13 VCS 14 VEE T06B1
        16 13 19 VEE
   Q19
                      T08T3
        16 15 19 VEE
                    T08I3
   Q20
        19 33 20 VEE
   Q21
                      T08I3
        20 VCS 21 VEE T12B4
   Q22
         23 VCS 22 VEE T12B1
   Q23
   Q24
        17 18 19 VEE
                      T08I3
   025
        17 8 19 VEE
                      T08I3
        VCC 17 24 VEE T08I2
   Q26
   Q27
        16 23 25 VEE T08I3
       25 VBBP 20 VEE T08I3
   Q28
   Q29
         27 VCS 28 VEE T12B1
```

```
17 27 25 VEE T08I3
   030
         VCC 16 26 VEE T0812
   Q31
         VCCO 17 QB VEE T5406
   Q32
   Q33
         VCCO 16 Q VEE T5406
   QD1
         33 33 34 VEE
                        T08I3
         24 24 23 VEE
   QD2
                        T08I3
   OD3
         26 26 27 VEE
                        T08I3
   XRXCX1 VCC 29 VEE
                        RXCX1
   XRXCX2 VCC 30 VEE
                        RXCX1
   XRXCX3 VCC 31 VEE
                       RXCX1
   XRXCX4 VCC 32 VEE
                       RXCX1
   XR1
        35 VEE VCC
                       RES params: R=130
   XR2
        3 2 VCC
                        RES params: R=203
   XR3
         3 4 VCC
                        RES params: R=203
   XR4
         7 VEE VCC
                        RES params: R=236
         9 VEE VCC
   XR5
                        RES params: R=480
   XR6
         14 VEE VCC
                        RES params: R=480
   XR7
         VCC 16 VCC
                       RES params: R=235
         VCC 17 VCC
                        RES params: R=235
   XB8
         21 VEE VCC
   XR9
                        RES params: R=110
        22 VEE VCC
   XR10
                        RES params: R=232
        28 VEE VCC
   XR11
                        RES params: R=232
        VCC 3 VCC
   XR12
                        RES params: R=203
         CE 29 VCC
   XRB1
                        RES params: R=50
   XRB2
        CC 30 VCC
                       RES params: R=50
   XRB3 SE 31 VCC
                       RES params: R=50
   XRB4 RE 32 VCC
                       RES params: R=50
   XRB5 DIN 1 VCC
                       RES params: R=50
   XRB6 SE 10 VCC
                       RES params: R=50
   XRB7 RE 12 VCC
                       RES params: R=50
   XRB8 RE 15 VCC
                       RES params: R=50
   XRB9 SE 18 VCC
                       RES params: R=50
   XRP1 CE VEE VCC
                       RPD params: R=50K
   XRP2 CC VEE VCC
                       RPD params: R=50K
   XRP3 SE VEE VCC
                        RPD params: R=50K
        RE VEE VCC
                        RPD params: R=50K
   XRP4
   XRP5
        DIN VEE VCC
                       RPD params: R=50K
.ENDS H131
********************
* THE MC10H188 IS A HEX BUFFER WITH COMMON ENABLE INPUT. THE ENABLE *
* INPUT IS ATTACHED TO TWO EMITTER FOLLOWERS WHICH DRIVE THREE
* BUFFERS EACH.
* EIN=ENABLE INPUT, DIN=DATA IN, OUT=OUTPUT
******************
.SUBCKT H188 VCC VCCO VBB VBBP VCS VEE EIN DIN OUT
   Q1
         VCC 1 2 VEE
                       T05I2
   02
         VCC VBBP 2 VEE T04I1
         2 VCS 3 VEE
   Q3
         5 2 7 VEE
   04
                        T08I3
   05
         7 VCS 8 VEE
                        T12B1
         6 VBBP 7 VEE
   Q6
                       T08T3
   Q7
         VCC 4 6 VEE
                        T08I2
         5 VBB 6 VEE
   Q8
                        T08I2
   Q9
         VCCO 5 OUT VEE T5406
   XR1
         3 VEE VCC
                       RES params: R=121
   XR2
         8 VEE VCC
                        RES params: R=130
   XR3
         VCC 5 VCC
                       RES params: R=286
   XR4
         6 VBBP VCC
                       RESK params: R=16k
   XRXCX1 VCC 1 VEE
                        RXCX1
   XRB1 EIN 1 VCC
                        RES params: R=75
   XRB2 DIN 4 VCC
                        RES params: R=75
```

```
XRP1 EIN VEE VCC RPD params: R=50K
  XRP2 DIN VEE VCC RPD params: R=50K
ENDS H188
******************
* THE MC10H189 IS A HEX INVERTER WITH COMMON ENABLE INPUT. THE
* ENABLE INPUT IS ATTACHED TO TWO EMITTER FOLLOWERS WHICH DRIVE
* THREE BUFFERS EACH.
* EIN=ENABLE INPUT, DIN=DATA IN, OUT=OUTPUT
*******************
.SUBCKT H189 VCC VCCO VBB VBBP VCS VEE EIN DIN OUT
       VCC 1 2 VEE
                   T05I2
   01
        VCC VBBP 2 VEE T04I1
   Q2
        2 VCS 3 VEE
   Q3
                   T12B1
   04
        5 2 7 VEE
   Q5
       7 VCS 8 VEE T12B1
       6 VBBP 7 VEE T08I3
   Q6
  07
        5 4 6 VEE
                    T08I2
        VCC VBB 6 VEE T0812
  08
       VCCO 5 OUT VEE T5406
  09
       3 VEE VCC
  XR1
                 RES params: R=121
                   RES params: R=130
  XR2
        8 VEE VCC
                  RES params: R=286
RESK params: R=16k
       VCC 5 VCC
  XR3
  XR4 6 VBBP VCC
                   RXCX1
  XRXCX1 VCC 1 VEE
  XRB1 EIN 1 VCC
                   RES params: R=75
  XRB2 DIN 4 VCC
                   RES params: R=75
  XRP1 EIN VEE VCC RPD params: R=50K
  XRP2 DIN VEE VCC RPD params: R=50K
******************
* THE MC10H210 IS A DUAL 3 INPUT 3 OUTPUT OR GATE. IN1,2,3=DATA IN, *
* OR1,2,3=OR OUTPUTS
********************
.SUBCKT H210 VCC VCCO VBB VCS VEE IN1 IN2 IN3 OR1 OR2 OR3
     1 5 3 VEE
                  Т32Т5
  01
   Q2
       1 6 3 VEE
                    T32I5
   Q3
       1 7 3 VEE
                    T32I5
   Q4
       2 VBB 3 VEE
                    T32I5
   Q5
       3 VCS 4 VEE
                     T30B9
       VCCO 2 OR3 VEE T5406
   Q6
   07
       VCCO 2 OR2 VEE T5406
   08
       VCCO 2 OR1 VEE T5406
  XR1
      VCC 1 VCC
                RES params: R=80
  XR2 VCC 2 VCC
                   RES params: R=80
  XR3 4 VEE VCC
                   RES params: R=32
  XRB1 IN1 5 VCC
                   RES params: R=50
  XRB2 IN2 6 VCC
                   RES params: R=50
  XRB3 IN3 7 VCC
                   RES params: R=50
  XRP1 IN1 VEE VCC
                   RPD params: R=50K
  XRP2 IN2 VEE VCC
                   RPD params: R=50K
  XRP3 IN3 VEE VCC
                   RPD params: R=50K
******************
* THE MC10H211 IS A DUAL 3 INPUT 3 OUTPUT NOR GATE. IN1,2,3=DATA IN,*
* OR1,2,3=NOR OUTPUTS
********************
.SUBCKT H211 VCC VCCO VBB VCS VEE IN1 IN2 IN3 NOR1 NOR2 NOR3
  Q1
      1 5 3 VEE
                     T32T5
       1 6 3 VEE
  Q2
                     T32I5
  Q3
       1 7 3 VEE
                     T32I5
   Q4
       2 VBB 3 VEE
                     T32I5
```

```
05
        3 VCS 4 VEE
                         T30B9
        VCCO 1 NOR3 VEE T5406
   Q6
         VCCO 1 NOR2 VEE T5406
   Q7
         VCCO 1 NOR1 VEE T5406
   Q8
   XR1
         VCC 1 VCC
                         RES params: R=80
   XR2
        VCC 2 VCC
                         RES params: R=80
   XR3
         4 VEE VCC
                         RES params: R=32
   XRB1 IN1 5 VCC
                         RES params: R=50
   XRB2 IN2 6 VCC
                         RES params: R=50
   XRB3 IN3 7 VCC
                         RES params: R=50
   XRP1 IN1 VEE VCC
                         RPD params: R=50K
   XRP2 IN2 VEE VCC
                         RPD params: R=50K
   XRP3 IN3 VEE VCC
                         RPD params: R=50K
.ENDS H211
******************
* The following is a general model for the Resistor. The termperature*
* Coeifficent is 900PPM with Tc1=900 and TC2=0. Inside the DRES model*
* is a formula for calculation of the resistor parasitic capacitance,*
^st if the simulator is capable of using it. Otherwise it will have to ^st
* be hand calculated and inserted at the proper point in the DRES
* diode model.One Calculation is for Resistors <2500\Omega assuming a
* 100\Omega/\square sheet RHO, the other for R> 2500\Omega assuming 500\Omega/\square sheet RHO*
********************
.SUBCKT RES A B VCC params: R=50
       Assumes Sheet Rho=100\Omega/\Box, Resistor Width=10U, and Cap in Farads.
       Use for Resistors up to 2500\Omega
             \{R/2\} TC=900,0
   Ra A 1
   Rb 1 B
             \{R/2\} TC=900,0
   D1 1 VCC DRES
   .MODEL DRES D
     + (IS=3.7E-16)
     + CJO=\{4.72E-16*R+58E-16\})
.ENDS RES
.SUBCKT RESK A B VCC params: R=50
* R IS THE RESISTOR VALUE TO BE MODELED.
* Reistor Model for R> 2.5k Ohm.
*It assumes Sheet Rho=500\Omega/\Box, Resistor Width=5U, and Cap in Farads.
   Ra A 1
           \{R/2\} TC=900,0
   Rb 1 B
              \{R/2\} TC=900,0
   D1 1 VCC DRES
   .MODEL DRES D
     + (IS=3.7E-16)
     + CJO = \{0.265E - 16*R + 29E - 16\})
.ENDS RESK
.SUBCKT RPD A B VCC params: R=50K
             \{R/2\} TC=900,0
   Ra A 1
   Rb 1 B
             \{R/2\} TC=900,0
   D1 1 VCC DRPD
   .MODEL DRPD D
     + (IS=3.7E-16
     + CJO=0.1149P)
.ENDS RPD
.SUBCKT RXCX1 IN OUT VEE
   Q1 OUT 1 OUT VEE RXCX
   R1 1 IN
                     1000
   .MODEL RXCX NPN
       + (IS=4.601E-16 BF=85 CJS=.79E-12 RE=0.5
       + CJE=.65E-12 BR=5 CJC=3.85E-12 RC=24
                                                  RB = 7084)
.ENDS RXCX1
```

9

```
.SUBCKT PKG EXT INT params: C=1.5P R1=750 R2=0.2 L=3N
                {C}
        82 0
   CPKG
   RPKG1 EXT 82 {R1}
   RPKG2 82 83
                 {R1}
   RPKG3 83 INT
                {R2}
   LPKG1 EXT 82
                {L}
   LPKG2 82 83
                {L}
ENDS PKG
*******************
******** **** MODEL PARAMETERS FOR THE TRANSISTORS **********
*******************
.MODEL T0411 NPN
 + (IS=17.4E-18)
               BF=112
                          BR=5
                                  RE=1.8
                                              IKF=.017
 + ISE=200E-18 RB=63
                          RBM=0
                                  IRB=0
                                              IKR=54E-5
 + ISC=76.5E-18 EG=1.11
                          RC=31
                                  NC=1.141
                                             NR = .995
 + CJE=54.2E-15 VJE=1.037 MJE=.57 NF=1.0
                                              XTT=4.7
 + CJC=79.6E-15 VJC=.45
                          MJC=.27
                                  NE=2.0
                                              XTB=1.15
 + CJS=122E-15 VJS=.505
                         MJS=.35 TR=9.9E-9 PTF=16
                          VTF=1.67 ITF=.0081
 + TF=35E-12
                XTF = 2.25
                                             XCJC=.069
 + FC=0.8
                VAF=42
                          VAR=3.7)
.MODEL T0512 NPN
 + (IS=21.2E-18
                BF=112
                          BR=5
                                   RE=1.5
                                              IKF=.021
 + ISE=250E-18
                RB=106
                          RBM=0
                                   IRB=0
                                              IKR=54E-5
    ISC=95.6E-18 EG=1.11
                          RC=27
                                   NC=1.141
                                              NR = .995
   CJE=67.7E-15 VJE=1.037 MJE=.57 NF=1.0
                                              XTI=4.7
 + CJC=99.6E-15 VJC=.45
                          MJC=.27 NE=2.0
                                              XTB=1.15
                          MJS=.35 TR=9.9E-9 PTF=20
 + CJS=152E-15 VJS=.505
 + TF=35E-12
                XTF=2.25 VTF=1.67 ITF=.0081 XCJC=.069
 + FC = 0.8
                VAF=42
                          VAR=3.7)
.MODEL T0513 NPN
 + (IS=21.2E-18 BF=112
                          BR=5
                                   RE=1.5
                                             IKF=.021
 + ISE=250E-18 RB=212
                          RBM=111 IRB=1.7E-3 IKR=54E-5
 + ISC=95.6E-18 EG=1.11
                          RC=27
                                  NC=1.141
                                            NR=.995
 + CJE=67.7E-15 VJE=1.037 MJE=.57 NF=1.0
                                              XTI=4.7
 + CJC=99.6E-15 VJC=.45
                          MJC=.27 NE=2.0
                                              XTB=1.15
                VJS=.505
                          MJS=.35 TR=9.9E-9 PTF=20
 + CJS=152E-15
                          VTF=1.67 ITF=.0081 XCJC=.069
 + TF=35E-12
                XTF=2.25
   FC=0.8
                VAF=42
                          VAR=3.7)
.MODEL T06B1 NPN
 + (IS=40.2E-18)
               BF=112
                          BR=5
                                   RE=1.33
                                              IKF=.028
   ISE=492E-18
                RB=267
                          RBM=133
                                   IRB=1.3E-3 IKR=54E-5
 + ISC=95.6E-18 EG=1.11
                          RC=27
                                   NC=1.141
                                             NR = .995
 + CJE=94.3E-15 VJE=1.037 MJE=.57 NF=1.0
                                              XTT=4.7
 + CJC=12.2E-15 VJC=.45
                          MJC=.27 NE=2.0
                                              XTB=1.15
 + CJS=173E-15 VJS=.505
                          MJS=.35 TR=9.9E-9 PTF=60
 + TF=35E-12
                XTF=2.25 VTF=1.67 ITF=.0081
                                             XCJC=.069
 + FC=0.8
                VAF = 42
                          VAR=3.7)
.MODEL T0812 NPN
 + (IS=33.3E-18
               BF=112
                          BR=5
                                  RE=1.33
                                             TKF= .034
                                   IRB=0.3E-3 IKR=115
 + ISE=1.0E-15 RB=57
                          RBM=30
                          RC=23
 + ISC=184.7E-18 EG=1.11
                                   NC=1.085
                                              NR=.995
 + CJE=99.3E-15 VJE=1.037 MJE=.57 NF=1.0
                                              XTI=4.7
   CJC=124.4E-15 VJC=.45
                          MJC=.27
                                   NE=2.0
                                              XTB=1.15
   CJS=170E-15 VJS=.505
                          MJS=.35
                                   TR=9.9E-9
                                              PTF=60
    TF=35E-12
                XTF=2.25
                          VTF=1.67 ITF=.0081
                                              XCJC=.089
   FC=0.8
                VAF=42
                          VAR=3.7)
.MODEL T0813 NPN
               BF=112
 + (IS=33.3E-18
                          BR = 5
                                   RE=1.33
                                              TKF= .034
 + ISE=1.0E-15 RB=222
                          RBM=111
                                   IRB=1.7E-3 IKR=115
                          RC=23
 + ISC=184.7E-18 EG=1.11
                                   NC=1.085
                                              NR = .995
 + CJE=99.3E-15 VJE=1.037 MJE=.57 NF=1.0
                                              XTI=4.7
```

+ + + +	CJC=124.4E-15 CJS=170E-15 TF=35E-12 FC=0.8	VJC=.45 VJS=.505 XTF=2.25 VAF=42	MJC=.27 MJS=.35 VTF=1.67 VAR=3.7)	NE=2.0 TR=9.9E-9 ITF=.0081	XTB=1.15 PTF=60 XCJC=.089			
.MODEL T12B1 NPN								
	(IS=75.2E-18	BF=112	BR=5	RE=4	IKF=.056			
+	ISE=931E-18	RB=77	RBM=77	IRB=2.6E-3	IKR=53E-5			
+	ISC=95.6E-18	EG=1.11	RC=26	NC=1.141	NR=.997			
+	CJE=168.5E-15		MJE=.57	NF=1.0	XTI=4.7			
+	CJC=174.5E-15	VJC=.45 VJS=.505	MJC=.27 MJS=.35	NE=2.0	XTB=1.15			
+	CJS=211E-15 TF=35E-12	XTF=2.25	VTF=1.67	TR=9.9E-9 ITF=.0081	PTF=100 XCJC=.059			
+	FC=0.8	VAF=42	VAR=3.7)	1170001	ACUC=.039			
	EL T12B4 NPN	VAF-4Z	VAR-3.7)					
+	(IS=75.2E-18	BF=112	BR=5	RE=4	IKF=.056			
+	ISE=931E-18	RB=17	RBM=17	IRB=2.6E-3	IKR=53E-5			
+	ISC=95.6E-18	EG=1.11	RC=26	NC=1.141	NR=.997			
+	CJE=168.5E-15		MJE=.57	NF=1.0	XTI=4.7			
+	CJC=174.5E-15		MJC=.27	NE=2.0	XTB=1.15			
+	CJS=211E-15	VJS=.505	MJS=.35	TR=9.9E-9	PTF=100			
+	TF=35E-12	XTF=2.25	VTF=1.67	ITF=.0081	XCJC=.059			
+	FC=0.8	VAF=42	VAR=3.7)					
	EL T32I5 NPN		,					
	(IS=1.33E-16	BF=112	BR=5	RE=16	IKF=.134			
+	ISE=4.0E-15	RB=56	RBM=28	IRB=10.4E-3				
+	ISC=7.4E-16	EG=1.11	RC=6	NC=1.141	NR=.997			
+	CJE=6.74E-13	VJE=1.037	MJE=.57	NF=1.0	XTI=4.7			
+	CJC=4.98E-13	VJC=.45	MJC=.27	NE=2.0	XTB=1.15			
+	CJS=6.8E-13	VJS=.505	MJS=.35	TR=9.9E-9	PTF=100			
+	TF=35E-12	XTF=2.25	VTF=1.67	ITF=.0081	XCJC=.059			
+	FC=0.8	VAF=42	VAR=3.7)					
.MODEL T30B9 NPN								
+	(IS=1.63E-16	BF=112	BR=5	RE=10	IKF=.141			
+	ISE=2.33E-15	RB=31	RBM=28	IRB=6.4E-3	IKR=53E-5			
+	ISC=2.4E-16	EG=1.11	RC=10.5	NC=1.141	NR = .997			
+	CJE=4.2E-13	VJE=1.037	MJE=.57	NF=1.0	XTI=4.7			
+	CJC=4.4E-13	VJC=.45	MJC=.27	NE=2.0	XTB=1.15			
+	CJS=5.28E-13	VJS=.505	MJS=.35	TR=9.9E-9	PTF=100			
+	TF=35E-12	XTF=2.25	VTF=1.67	ITF=.0081	XCJC=.126			
+	FC=0.8	VAF=42	VAR=3.7)					
.MODEL T5406 NPN								
	(IS=3.29E-16	BF=112	BR=5	RE=.67	IKF=.372			
+	ISE=4.11E-15	RB=17	RBM=8	IRB=1.0E-2	IKR=53E-5			
+	ISC=95.6E-18	EG=1.11	RC=26	NC=1.141	NR=.997			
+	CJE=7.3E-13	VJE=1.037	MJE=.57	NF=1.0	XTI=4.7			
+	CJC=8.1E-13	VJC=.45	MJC=.27	NE=2.0	XTB=1.15			
+	CJS=6.9E-13	VJS=.505	MJS=.35	TR=9.9E-9	PTF=100			
+	TF=35E-12	XTF=2.25	VTF=1.67 VAR=3.7)	ITF=.0081	XCJC=.126			
+ .END	FC=0.8	VAF=42	(1.C-7Av					
• END								

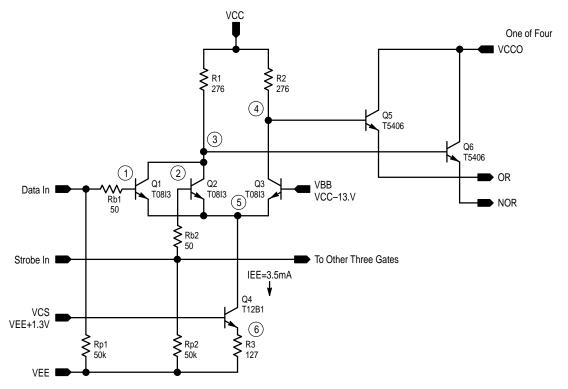


Figure 1. MC10H101 Quad OR/NOR Gate

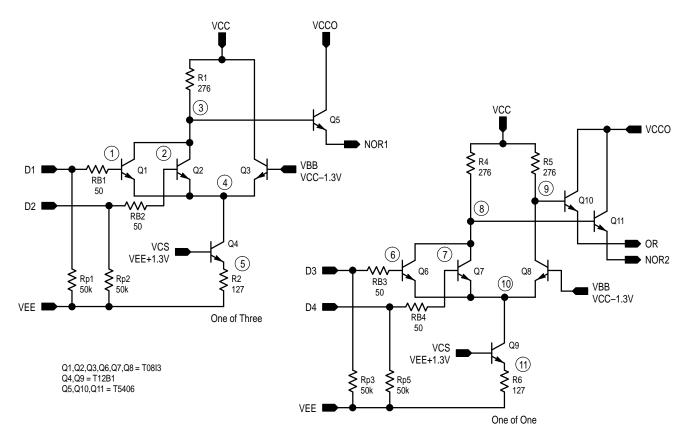


Figure 2. MC10H102 Quad 2-Input NOR Gate

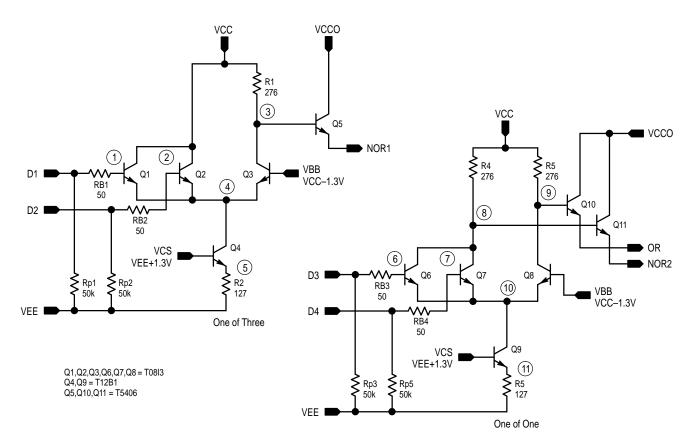


Figure 3. MC10H103 Quad 2-Input OR Gate

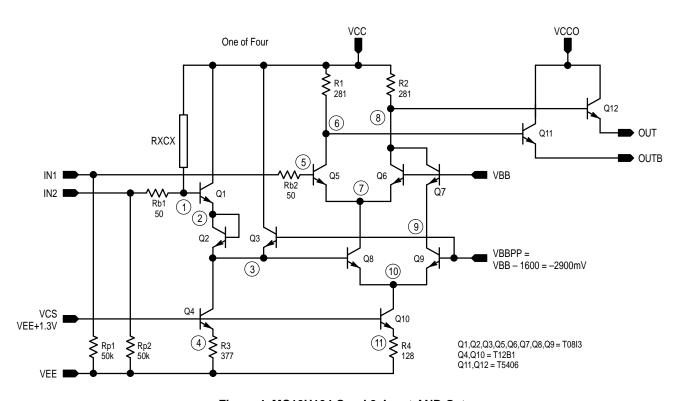


Figure 4. MC10H104 Quad 2-Input AND Gate

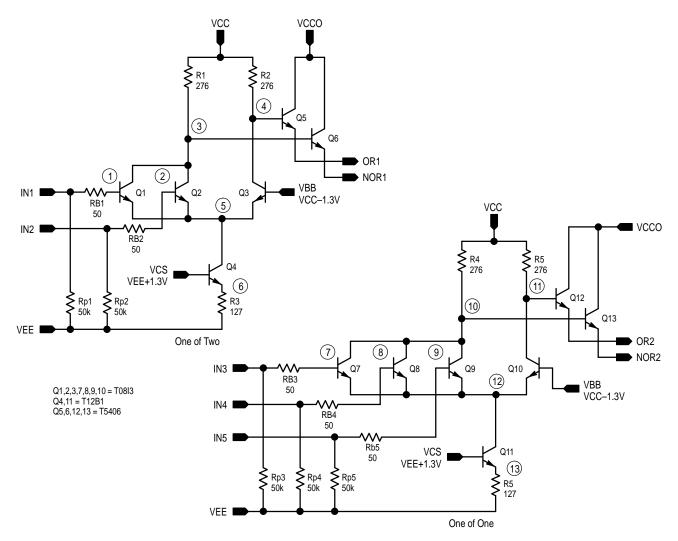


Figure 5. MC10H105 Triple 2-3-2-Input OR/NOR

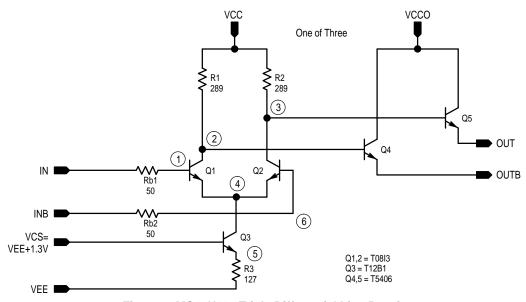


Figure 6. MC10H116 Triple Differential Line Receiver

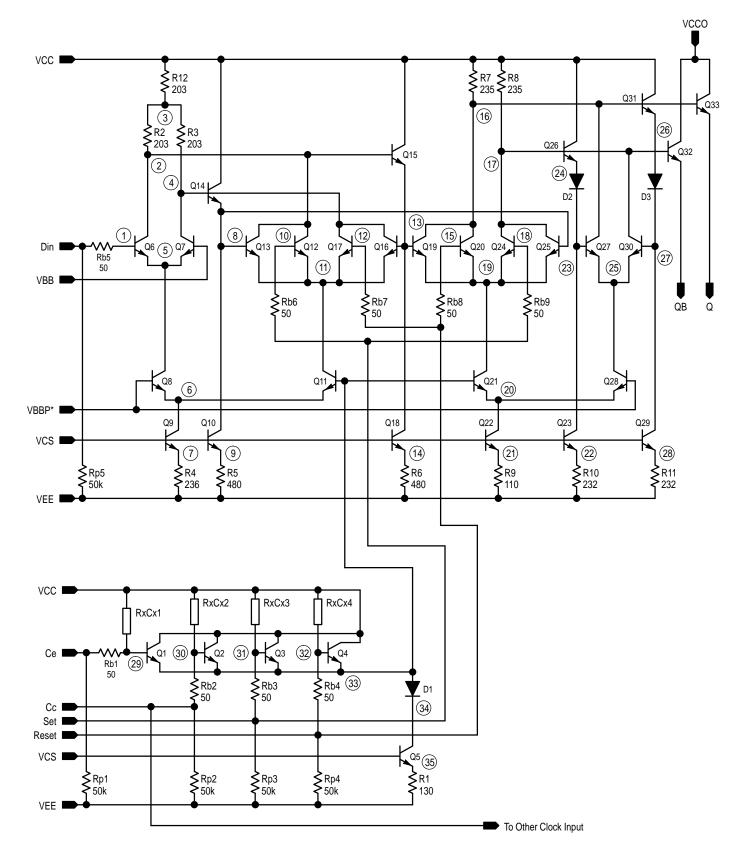


Figure 7. MC10H131 Dual D Flip-Flop

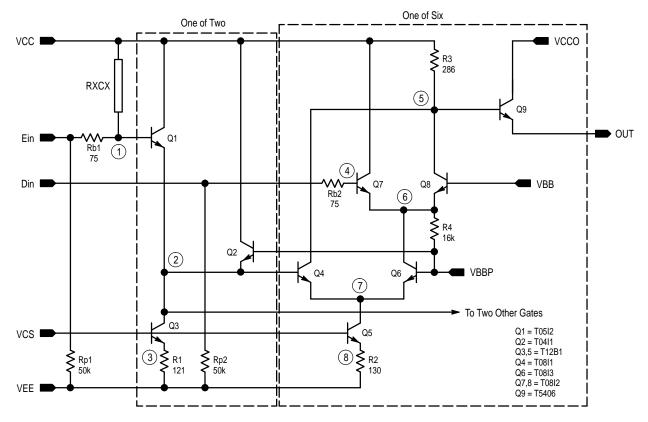


Figure 8. MC10H188

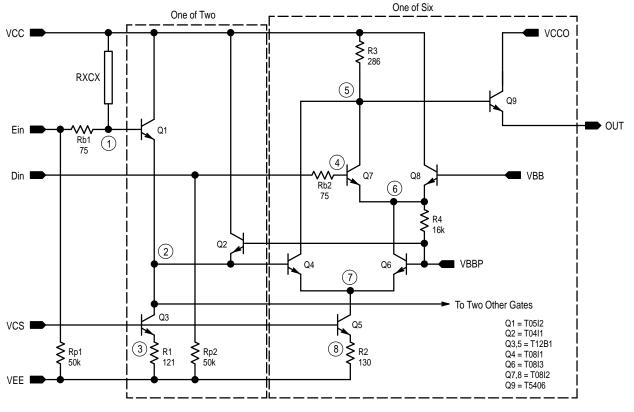


Figure 9. MC10H189

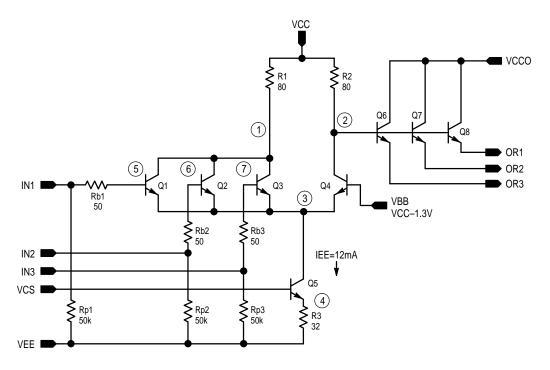


Figure 10. MC10H210 Dual 3-Input/3-Output OR Gate

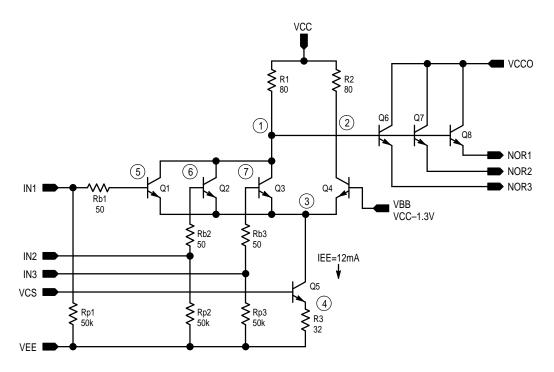
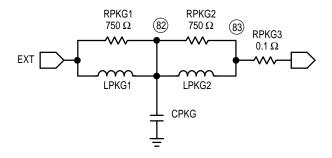


Figure 11. MC10H211 Dual 3-Input/3-Output NOR Gate



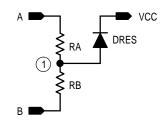


Figure 12. Package Pin Model

Figure 13. Resistor Model

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#### How to reach us:

**USA/EUROPE/Locations Not Listed**: Motorola Literature Distribution; P.O. Box 20912; Phoenix, Arizona 85036. 1–800–441–2447 or 602–303–5454

**MFAX**: RMFAX0@email.sps.mot.com – TOUCHTONE 602–244–6609 **INTERNET**: http://Design=NET.com

JAPAN: Nippon Motorola Ltd.; Tatsumi–SPD–JLDC, 6F Seibu–Butsuryu–Center, 3–14–2 Tatsumi Koto–Ku, Tokyo 135, Japan. 03–81–3521–8315

ASIA/PACIFIC: Motorola Semiconductors H.K. Ltd.; 8B Tai Ping Industrial Park, 51 Ting Kok Road, Tai Po, N.T., Hong Kong. 852–26629298



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