

INFORMATION NOTE

Fourth Generation 16M - DRAMs

Characterisation Data (3.3 V products)

This information note is intended to provide technical information on the SIEMENS fourth generation 16M-DRAMs DYNAMIC ACCESS MEMORIES operating at 3.3 V Vcc power supply.

CHARACTERISTICS OF DC & AC - PARAMETERS

The SIEMENS 16M - DRAM devices are guaranteed to meet certain DC parametric limits over the temperature range 0° to 70°C. This information note shows the actual performance levels that can typically be expected from devices. All DRAM organisations -- x4, x8 & x 16 --- and fast page mode or hyper page mode (EDO) versions came from the same die and are selected by bonding options only. Therefore the AC timing characteristics are nearly independent from the DRAM and refresh organisation. The DC behaviour -- mainly the operating currents depends on addressing and refresh organisation (1k, 2k or 4k refresh).

The SIEMENS 16M - DRAMs are available in the following refresh organisations for both fast page mode and EDO devices:

Organisation	Refresh	Refresh Period	Row Addresses	Column Addresses
4M x 4	4k	64 ms	12	10
	2k	32 ms	11	11
2M x 8	2k	32 ms	11	10
	4k	64 ms	12	8
1M x 16	1k	16 ms	10	10

Samples out of different production lots have been randomly selected and characterised. Typical values of operation currents as a function of cycle time and refresh organisations are shown in fig.1 through fig. 4. Fig.5 shows the DQ behaviour. CAS access (tcac) and hold time (tcoh) in EDO-mode is shown at VCC = 3.6V for two different capacitive output loadings.

Since all devices come from the same die, the AC characteristic values are nearly independent from the refresh and memory organisation. Table 1 through 4 summarise all AC timing parameters and DC-currents at their worst case conditions for a selection of products:

table 1	4M x 4 DRAM, EDO, 4k-refresh
table 2	2M x 8 DRAM, EDO, 2k-refresh
table 3	1M x 16 DRAM, EDO, 4k-refresh
table 4	1M x 16 DRAM, FPM, 4k-refresh
table 5	1M x 16 DRAM, EDO, 1k-refresh
table 6	1M x 16 DRAM, FPM, 1k-refresh

All measurements shown in this information note have been performed on an ADVANTEST 5361 dedicated memory test system.

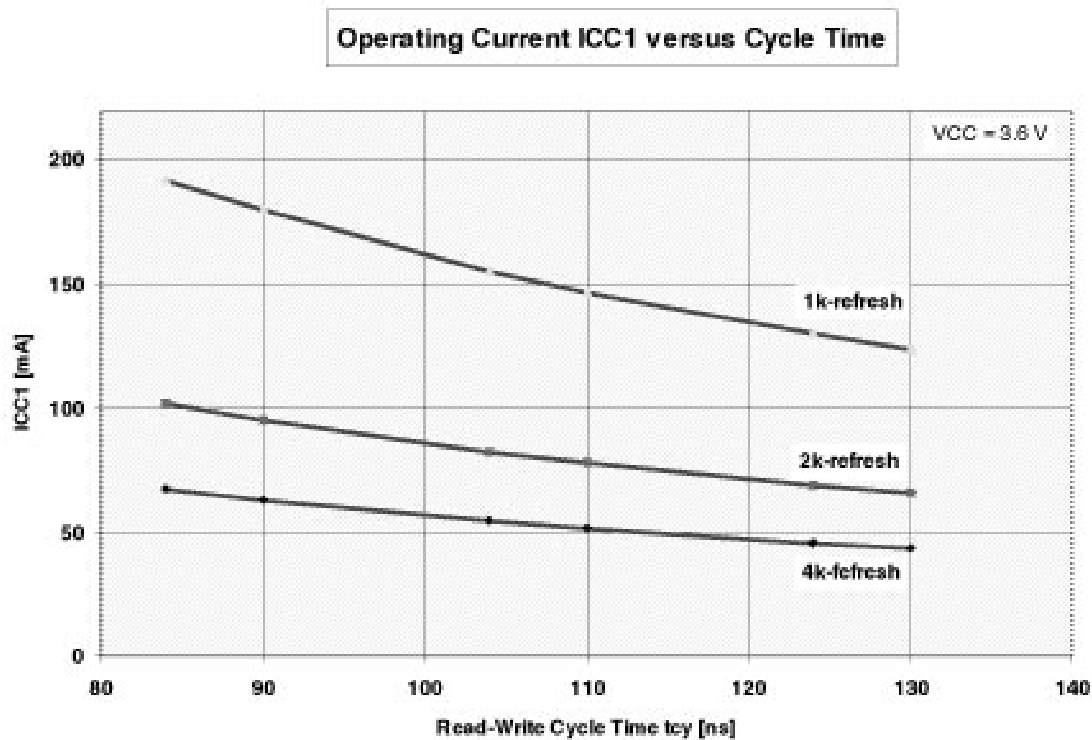


fig.1

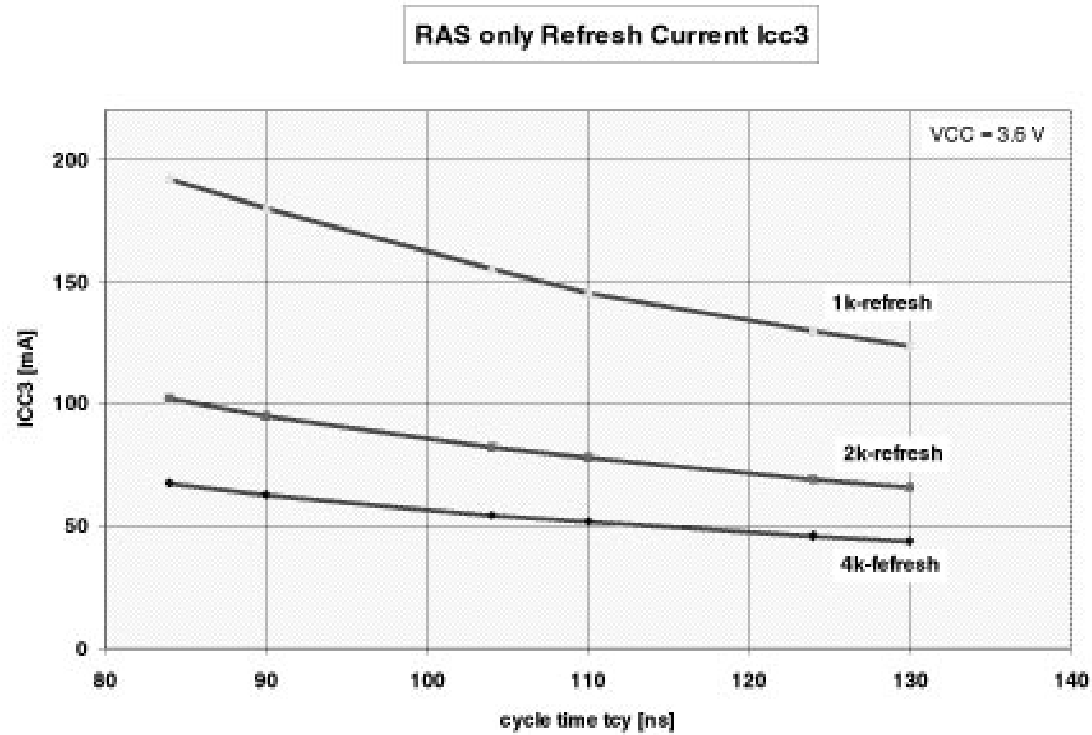


fig.2

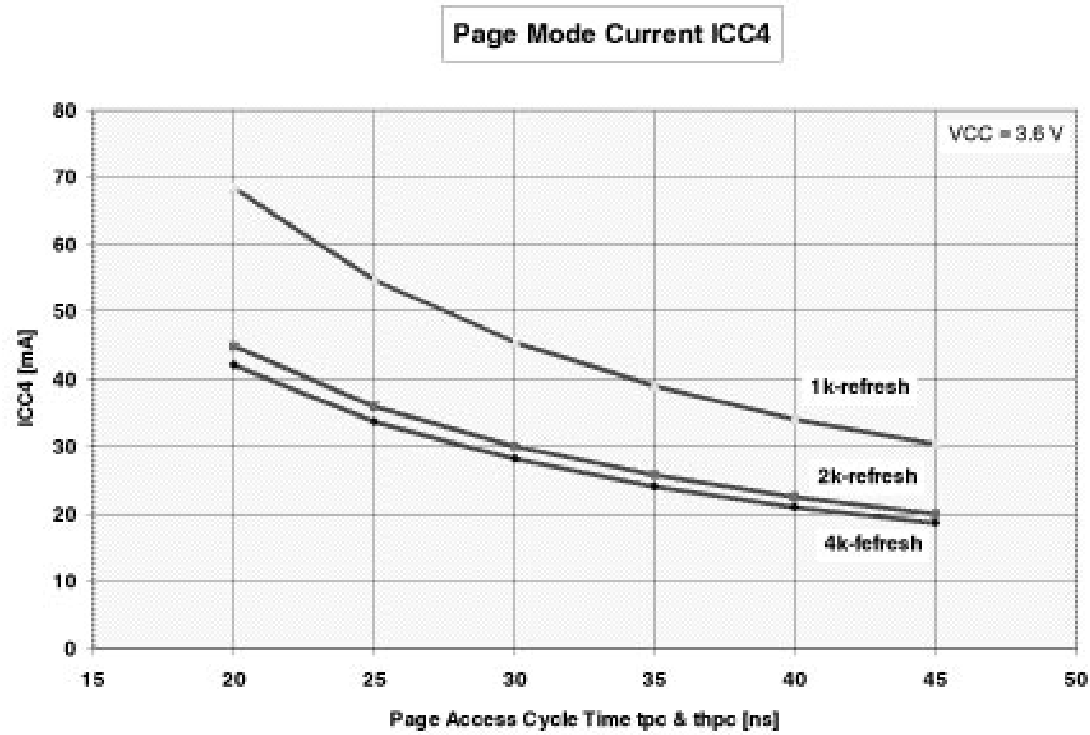


fig.3

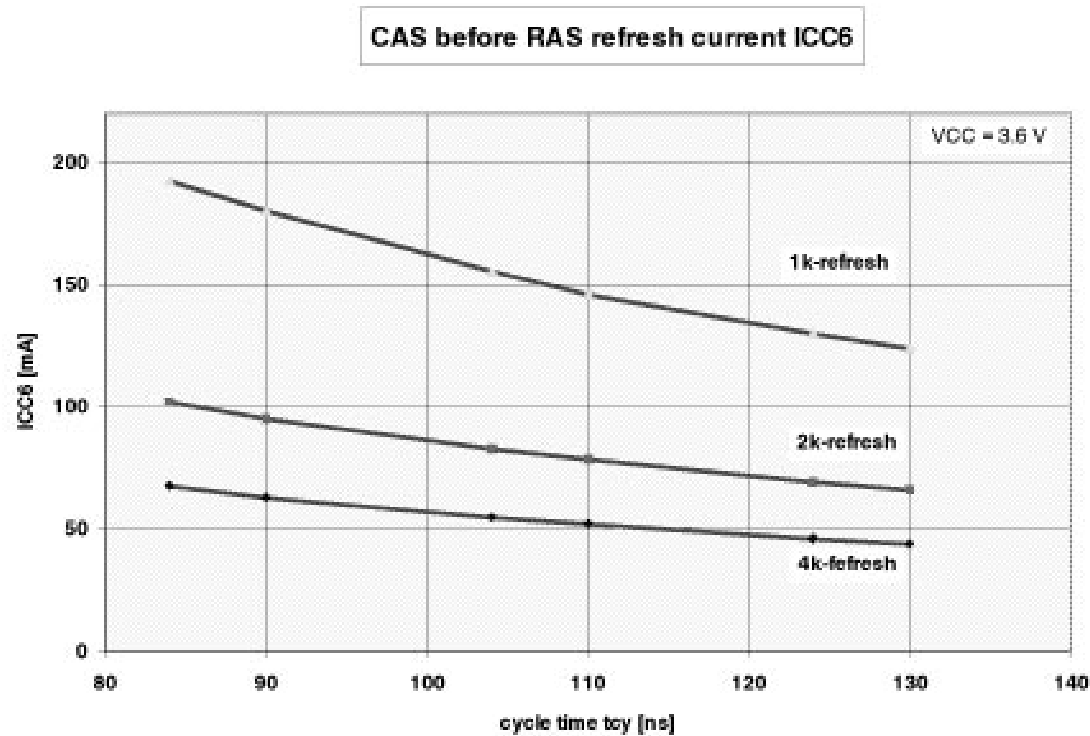


fig.4

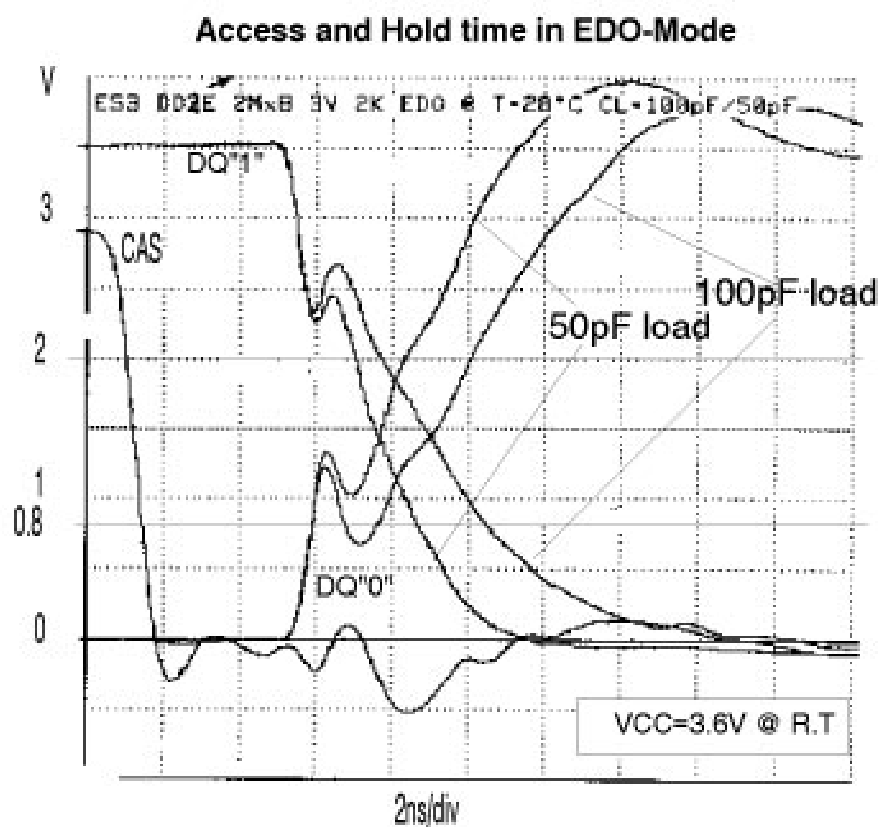


fig.5

Table 1:

AC CHARACTERISTICS

HYB3116405BT 4M x 4 DRAM 4k-Refresh, EDO

Parameter	Mean	Unit
TRC	75,3	ns
TRWC	96,9	ns
THPC	19,3	ns
TPRWC	48,9	ns
TRCDBEND	35,7	ns
TRAC-MIN	42,3	ns
TRAC-50	42,3	ns
TRAC-60	46,6	ns
TRAC-70	56,4	ns
TRAD	8,0	ns
TCAC	9,3	ns
TAA	18,4	ns
TCPA	19,4	ns
TCLZ	4,1	ns
TOFF	10,3	ns
TRP	25,3	ns
TRAS	14,3	ns
TRSH	2,4	ns
TCSH	40,1	ns

Parameter	Mean	Unit
TCAS	4,4	ns
TRAH	6,0	ns
TCAH	7,0	ns
TRAL	8,0	ns
TWCH	2,0	ns
TWP	1,0	ns
TRWL	1,4	ns
TCWL	5,0	ns
TCWD	15,0	ns
TRWD	51,0	ns
TAWD	27,0	ns
TWTH	4,0	ns
TWRH	3,3	ns
TOEA	5,3	ns
TCRP	0,0	ns
TCP	1,0	ns
TDH EW	3,0	ns
TDH RMW	2,0	ns

Parameter	Mean	Unit
TRPC	1,1	ns
TRPCROR	2,0	ns
REFDIS	705	ms
REFPAU	370	ms
TCHR	0,0	ns
TASR	-5,0	ns
TASC	-5,0	ns
TRCS	-2,5	ns
TRCH	-4,0	ns
TRRH	-2,3	ns
TDS EW	-3,5	ns
TDS RMW	-3,0	ns
TWCS	-2,0	ns
TCSR	-3,0	ns
TCPT	-2,0	ns
TWTS	-4,0	ns
TWRP	-4,0	ns
TCOH	5,5	ns

Parameter	Timing	Mean	Unit
ICC1	50ns	64,3	mA
ICC1	60ns	55,7	mA
ICC1	70ns	46,3	mA
ICC2		0,16	mA
ICC5		0,02	mA
ICC7		0,81	mA
ICC3	50ns	64,4	mA
ICC3	60ns	55,4	mA
ICC3	70ns	47,1	mA
ICC4	50ns	35,5	mA
ICC4	60ns	24,7	mA
ICC4	70ns	20,8	mA
ICC6	50ns	65,3	mA
ICC6	60ns	56,4	mA
ICC6	70ns	47,2	mA

Parameter	Mean	Unit
VLADALL	1,19	V
VLRAS	1,20	V
VLICAS	1,19	V
VLWRT	1,20	V
VLOE	1,20	V
VLIOALL	1,40	V
VHADALL	1,67	V
VHRAS	1,66	V
VHCAS	1,66	V
VHWRT	1,55	V
VHOE	1,67	V
VHIOALL	1,64	V
VOHALLS	2,89	V
VOLALLS	0,02	V

Parameter	Mean	Unit
VCCMIN	2,25	V
VCCMAX	5,00	V

BUMP UP / BUMP DOWN

Parameter	Mean	Unit
BUMP UP	12,0	%
BUMP DOWN	23,0	%

*) tester limit

**) measured rail to rail

Table 2:

AC CHARACTERISTICS

HYB3117805BSJ 2M x 8 DRAM 2k-Refresh, EDO

Parameter	Mean	Unit
TRC	76,5	ns
TRWC	97,3	ns
THPC	21,0	ns *
TPRWC	42,4	ns
TRCDBEND	35,3	ns
TRAC-MIN	42,9	ns
TRAC-50	43,1	ns
TRAC-60	47,8	ns
TRAC-70	57,5	ns
TRAD	7,3	ns
TCAC**	9,5	ns
TAA	19,1	ns
TCPA	20,6	ns
TCLZ	3,9	ns
TOFF	9,6	ns
TRP	25,5	ns
TRAS	13,9	ns
TRSH	2,5	ns
TCSH	40,8	ns

Parameter	Mean	Unit
TCAS	5,3	ns
TRAH	6,0	ns
TCAH	7,0	ns
TRAL	8,0	ns
TWCH	3,0	ns
TWP	2,0	ns
TRWL	1,0	ns
TCWL	5,0	ns
TCWD	17,1	ns
TRWD	52,9	ns
TAWD	29,0	ns
TWTH	-0,5	ns
TWRH	-0,8	ns
TOEA	6,0	ns
TCRP	1,0	ns
TCP	1,0	ns
TDH EW	2,0	ns
TDH RMW	1,0	ns

Parameter	Mean	Unit
TRPC	-2,0	ns
TRPCROR	-1,0	ns
REFDIS	1323	ms
REFPAU	725	ms
TCHR	0,0	ns
TASR	-5,0	ns
TASC	-5,0	ns
TRCS	-3,0	ns
TRCH	-4,0	ns
TRRH	-2,0	ns
TDS EW	-2,0	ns
TDS RMW	-2,0	ns
TWCS	-2,0	ns
TCSR	-3,0	ns
TCPT	-1,0	ns
TWTS	-7,5	ns
TWRP	-7,5	ns
TCOH	6,3	ns

Parameter	Timing	Mean	Unit
ICC1	50ns	102,1	mA
ICC1	60ns	88,6	mA
ICC1	70ns	73,9	mA
ICC2		0,16	mA
ICC5		0,02	mA
ICC7		0,18	mA
ICC3	50ns	101,8	mA
ICC3	60ns	88,1	mA
ICC3	70ns	74,4	mA
ICC4	50ns	41,7	mA
ICC4	60ns	28,1	mA
ICC4	70ns	23,7	mA
ICC6	50ns	101,1	mA
ICC6	60ns	87,5	mA
ICC6	70ns	73,8	mA

Parameter	Mean	Unit
VLADALL	1,19	V
VLRAS	1,19	V
VLCAS	1,20	V
VLWRT	1,19	V
VLOE	1,20	V
VLIOALL	1,16	V
VHADALL	1,70	V
VHRAS	1,66	V
VHCAS	1,66	V
VHWRT	1,55	V
VHOE	1,67	V
VHIOALL	1,64	V
VOHALLS	2,89	V
VOLALLS	0,10	V

Parameter	Mean	Unit
VCCMIN	2,10	V
VCCMAX	5,00	V

BUMP UP / BUMP DOWN

Parameter	Mean	Unit
BUMP UP	13,1	%
BUMP DOWN	22,3	%

*) tester limit

**) measured rail to rail

Table 3:

AC CHARACTERISTICS

HYB 3116165BSJ 1M x 16 DRAM 4k-Refresh, EDO

Parameter	Mean	Unit
TRC	80,0	ns
TRWC	100,1	ns
THPC	21,0	ns
TPRWC	48,0	ns
TRCDBEND	35,6	ns
TRAC-MIN	46,6	ns
TRAC-50	46,6	ns
TRAC-60	50,9	ns
TRAC-70	60,9	ns
TRAD	7,4	ns
TCAC**	12,8	ns
TAA	22,6	ns
TCPA	24,0	ns
TCLZ	7,0	ns
TOFF	12,6	ns
TRP	25,1	ns
TRAS	14,5	ns
TRSH	2,1	ns
TCSH	44,4	ns

Parameter	Mean	Unit
TCAS	4,4	ns
TRAH	8,8	ns
TCAH	6,0	ns
TRAL	8,0	ns
TWCH	2,0	ns
TWP	2,0	ns
TRWL	2,0	ns
TCWL	6,0	ns
TCWD	18,0	ns
TRWD	53,3	ns
TAWD	30,0	ns
TWTH	-0,5	ns
TWRH	-0,7	ns
TOEA	9,8	ns
TCRP	1,0	ns
TCP	1,0	ns
TDH EW	4,0	ns
TDH RMW	3,0	ns
TDH RMW	1,0	ns

Parameter	Mean	Unit
TRPC	-2,0	ns
TRPCROR	2,0	ns
REFDIS	1312	ms
REFPAU	665	ms
TCHR	0,0	ns
TASR	-5,0	ns
TASC	-5,0	ns
TRCS	-2,0	ns
TRCH	-4,0	ns
TRRH	-2,0	ns
TDS EW	-4,0	ns
TDS RMW	-4,0	ns
TWCS	-2,0	ns
TCSR	-3,0	ns
TCPT	-2,0	ns
TWTS	-7,5	ns
TWRP	-7,5	ns
TCOH	6,3	ns

Parameter	Timing	Mean	Unit
ICC1	50ns	67,5	mA
ICC1	60ns	56,9	mA
ICC1	70ns	48,4	mA
ICC2		0,20	mA
ICC5		0,02	mA
ICC7		0,17	mA
ICC3	50ns	63,9	mA
ICC3	60ns	55,5	mA
ICC3	70ns	46,4	mA
ICC4	50ns	44,9	mA
ICC4	60ns	26,2	mA
ICC4	70ns	22,4	mA
ICC6	50ns	66,0	mA
ICC6	60ns	56,8	mA
ICC6	70ns	48,1	mA

Parameter	Mean	Unit
VLADALL	1,20	V
VLRAS	1,20	V
VLCAS	1,20	V
VLWRT	1,20	V
VLOE	1,20	V
VLIOALL	1,18	V
VHADALL	1,70	V
VHRAS	1,68	V
VHCAS	1,68	V
VHWRT	1,55	V
VHOE	1,68	V
VHIOALL	1,65	V
VOHALLS	2,73	V
VOLALLS	0,24	V

Parameter	Mean	Unit
VCCMIN	2,21	V
VCCMAX*	5,00	V

BUMP UP / BUMP DOWN

Parameter	Mean	Unit
BUMP UP	11,88	%
BUMP DOWN	26,00	%

*) tester limit

Table 4:

AC CHARACTERISTICS

HYB 3116165BSJ 1M x 16 DRAM 4k-Refresh, FPM

Parameter	Mean	Unit
TRC	76,1	ns
TRWC	103,8	ns
TPC	29,3	ns
TPRWC	46,5	ns
TRCDBEND	35,1	ns
TRAC-MIN	42,8	ns
TRAC-50	42,9	ns
TRAC-60	47,6	ns
TRAC-70	57,4	ns
TRAD	7,8	ns
TCAC	7,1	ns
TAA	19,1	ns
TCPA	20,4	ns
TCLZ	5,0	ns
TOFF	5,4	ns
TRP	21,1	ns
TRAS	11,4	ns
TRSH	2,0	ns
TCSH	37,8	ns
TCAS	2,1	ns

Parameter	Mean	Unit
TRAH	2,1	ns
TCAH	3,0	ns
TRAL	4,0	ns
TWCH	7,0	ns
TWP	-1,0	ns
TRWL	-1,0	ns
TCWL	1,0	ns
TCWD	5,4	ns
TRWD	10,0	ns
TAWD	45,6	ns
TWTH	-0,5	ns
TWRH	-0,8	ns
TOEA	6,1	ns
TCRP	-2,4	ns
TCP	-2,0	ns
TDH EW	2,3	ns
TDH RMW	1,8	ns
TRPC	-2,0	ns
TRPCROR	-1,0	ns
REFDIS	1371	ms

Parameter	Mean	Unit
REFPAU	775	ms
TCHR	-4,0	ns
TASR	-8,0	ns
TASC	-8,0	ns
TRCS	-6,0	ns
TRCH	-9,0	ns
TRRH	-7,0	ns
TDS EW	-9,0	ns
TDS RMW	-9,0	ns
TWCS	-4,3	ns
TCSR	-6,0	ns
TCPT	-5,0	ns
TWTS	-7,5	ns
TWRP	-7,5	ns

Parameter	Timing	Mean	Unit
ICC1	50ns	63,0	mA
ICC1	60ns	53,9	mA
ICC1	70ns	46,7	mA
ICC2		0,19	mA
ICC5		0,01	mA
ICC7		0,16	mA
ICC3	50ns	59,9	mA
ICC3	60ns	52,3	mA
ICC3	70ns	44,8	mA
ICC4	50ns	26,5	mA
ICC4	60ns	21,3	mA
ICC4	70ns	19,0	mA
ICC6	50ns	60,9	mA
ICC6	60ns	52,7	mA
ICC6	70ns	44,7	mA

Parameter	Mean	Unit
VLADALL	1,20	V
VLRAS	1,21	V
VLCAS	1,20	V
VLWRT	1,20	V
VLOE	1,21	V
VLIOALL	1,35	V
VHADALL	1,65	V
VHRAS	1,65	V
VHCAS	1,65	V
VHWRT	1,55	V
VHOE	1,65	V
VHIOALL	1,75	V
VOHALLS	2,86	V
VOLALLS	0,02	V

Parameter	Mean	Unit
VCCMIN	2,25	V
VCCMAX	5,00	V

BUMP UP / BUMP DOWN

Parameter	Mean	Unit
BUMP UP	24,4	%
BUMP DOWN	13,6	%

Table 5:

AC CHARACTERISTICS

HYB 3118165BSJ 1M x 16 DRAM 1k-Refresh, EDO

Parameter	Mean	Unit
TRC	80,5	ns
TRWC	101,5	ns
THPC	21,0	ns
TPRWC	49,9	ns
TRCDBEND	36,8	ns
TRAC-MIN	48,0	ns
TRAC-50	48,1	ns
TRAC-60	51,3	ns
TRAC-70	61,0	ns
TRAD	7,9	ns
TCAC**	12,3	ns
TAA	23,1	ns
TCPA	24,1	ns
TCLZ	7,0	ns
TOFF	12,6	ns
TRP	25,0	ns
TRAS	14,9	ns
TRSH	2,8	ns
TCSH	45,4	ns

Parameter	Mean	Unit
TCAS	4,4	ns
TRAH	8,9	ns
TCAH	6,0	ns
TRAL	8,8	ns
TWCH	3,0	ns
TWP	2,0	ns
TRWL	2,0	ns
TCWL	6,0	ns
TCWD	17,9	ns
TRWD	54,8	ns
TAWD	30,3	ns
TWTH	-0,5	ns
TWRH	-0,7	ns
TOEA	9,9	ns
TCRP	1,0	ns
TCP	1,0	ns
TDH EW	4,3	ns
TDH RMW	3,4	ns
TRPC		ns

Parameter	Mean	Unit
TRPCROR	2,1	ns
REFDIS	799	ms
REFPAU	1553	ms
TCHR	0,0	ns
TASR	-5,0	ns
TASC	-5,0	ns
TRCS	-2,3	ns
TRCH	-4,0	ns
TRRH	-2,0	ns
TDS EW	-4,9	ns
TDS RMW	-3,9	ns
TWCS	-2,0	ns
TCSR	-3,0	ns
TCPT	-2,0	ns
TWTS	-7,5	ns
TWRP	-7,5	ns
TCOH	6,3	ns

Parameter	Timing	Mean
ICC1	50ns	195,1
ICC1	60ns	169,4
ICC1	70ns	145,1
ICC2		0,20
ICC5		0,02
ICC7		0,17
ICC3	50ns	194,2
ICC3	60ns	170,1
ICC3	70ns	143,9
ICC4	50ns	68,3
ICC4	60ns	43,1
ICC4	70ns	36,4
ICC6	50ns	196,9
ICC6	60ns	169,6

Parameter	Mean	Unit
VLADALL	1,15	V
VLRAS	1,15	V
VLCAS	1,19	V
VLWRT	1,16	V
VLOE	1,20	V
VLIOALL	1,15	V
VHADALL	1,70	V
VHRAS	1,66	V
VHCAS	1,65	V
VHWRT	1,55	V
VHOE	1,68	V
VHIOALL	1,65	V
VOHALLS	2,73	V
VOLALLS	0,22	V

Parameter	Mean	Unit
VCCMIN	2,23	V
VCCMAX	5,00	V

BUMP UP / BUMP DOWN

Parameter	Mean	Unit
BUMP UP	12,00	%
BUMP DOWN	23,75	%

*) tester limit

Table 6:

AC CHARACTERISTICS

HYB 3118160BSJ 1M x 16 DRAM 1k-Refresh, FPM

Parameter	Mean	Unit
TRC	79	ns
TRWC	106	ns
TPC	29	ns
TPRWC	52	ns
TRCDBEND	37	ns
TRAC-MIN	45	ns
TRAC-50	45	ns
TRAC-60	48	ns
TRAC-70	58	ns
TRAD	8	ns
TCAC	8	ns
TAA	20	ns
TCPA	21	ns
TCLZ	5	ns
TOFF	6	ns
TRP	22	ns
TRAS	11	ns
TRSH	2	ns
TCSH	39	ns
TCAS	3	ns

Parameter	Mean	Unit
TRAH	3	ns
TCAH	3	ns
TRAL	5	ns
TWCH	7	ns
TWP	0	ns
TRWL	-1	ns
TCWL	1	ns
TCWD	5	ns
TRWD	10	ns
TAWD	47	ns
TWTH	-0,5	ns
TWRH	-1,0	ns
TOEA	6	ns
TCRP	-2	ns
TCP	-2	ns
TDH EW	3	ns
TDH RMW	2	ns
TRPC	-2	ns
TRPCROR	-1	ns
REFDIS	714	ms

Parameter	Mean	Unit
REFPAU	1125	ms
TCHR	-4,0	ns
TASR	-8	ns
TASC	-8	ns
TRCS	-6	ns
TRCH	-9	ns
TRRH	-7	ns
TDS EW	-10	ns
TDS RMW	-9	ns
TWCS	-5	ns
TCSR	-6	ns
TCPT	-5	ns
TWTS	-6,0	ns
TWRP	-5,0	ns

Parameter	Timing	Mean	Unit
ICC1	50ns	184,9	mA
ICC1	60ns	161,3	mA
ICC1	70ns	137,9	mA
ICC2		0,19	mA
ICC5		0,02	mA
ICC7		0,16	mA
ICC3	50ns	183,3	mA
ICC3	60ns	160,0	mA
ICC3	70ns	136,4	mA
ICC4	50ns	48,6	mA
ICC4	60ns	40,2	mA
ICC4	70ns	35,8	mA
ICC6	50ns	182,3	mA
ICC6	60ns	158,9	mA
ICC6	70ns	135,1	mA

Parameter	Mean	Unit
VLADALL	1,16	V
VLRAS	1,22	V
VLCAS	1,19	V
VLWRT	1,20	V
VLOE	1,20	V
VLIOALL	1,33	V
VHADALL	1,66	V
VHRAS	1,65	V
VHCAS	1,65	V
VHWRT	1,55	V
VHOE	1,65	V
VHIOALL	1,75	V
VOHALLS	2,86	V
VOLALLS	0,02	V

Parameter	Mean	Unit
VCCMIN	2,25	V
VCCMAX	5,00	V

BUMP UP / BUMP DOWN

Parameter	Mean	Unit
BUMP UP	23,1	%
BUMP DOWN	13,9	%