SIEMENS

INFORMATION NOTE

Fourth Generation 16M - DRAMs

Characterisation Data (5V products)

11.95
Info16M10.DOC

This information note is intended to provide technical information on the SIEMENS fourth generation 16M-DRAMs DYNAMIC ACCESS MEMORIES operating at 5 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^{o} to 70^{o}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 independend from the DRAM and refresh organisation. The DC behaviour -- mainly the operating currents depends on addressing and refresh organsation (1k, 2k or 4k refresh).

The SIEMENS 16M - DRAMs are available in the following refresh organisations:

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
1M x 16	4k	64 ms	12	8
	1k	16 ms	10	10

Samples out of different production lots have been randomly selected and characterised. Typical values of operation and standby currents as a function of cycle time and refresh organisations are shown in fig.1 through fig. 4.

Due to the use of an internal regulated power supply all AC parameters are mainly independent from the power supply voltage. Table 1 through 4 summarise all AC timing parameters and DC-currents at their worst case conditions for the following products:

table 1	4M x 4 fast page mode DRAM 2k-refresh
table 2	2M x 8 fast page mode DRAM 2k-refresh
table 3	1M x 16 fast page mode DRAM 2k-refresh
table 4	4M x 4 EDO-DRAM 2k-refresh
table 5	4M x 4 EDO-DRAM 4k-refresh
table 6	1M x 16 EDO-DRAM 1k-refresh

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

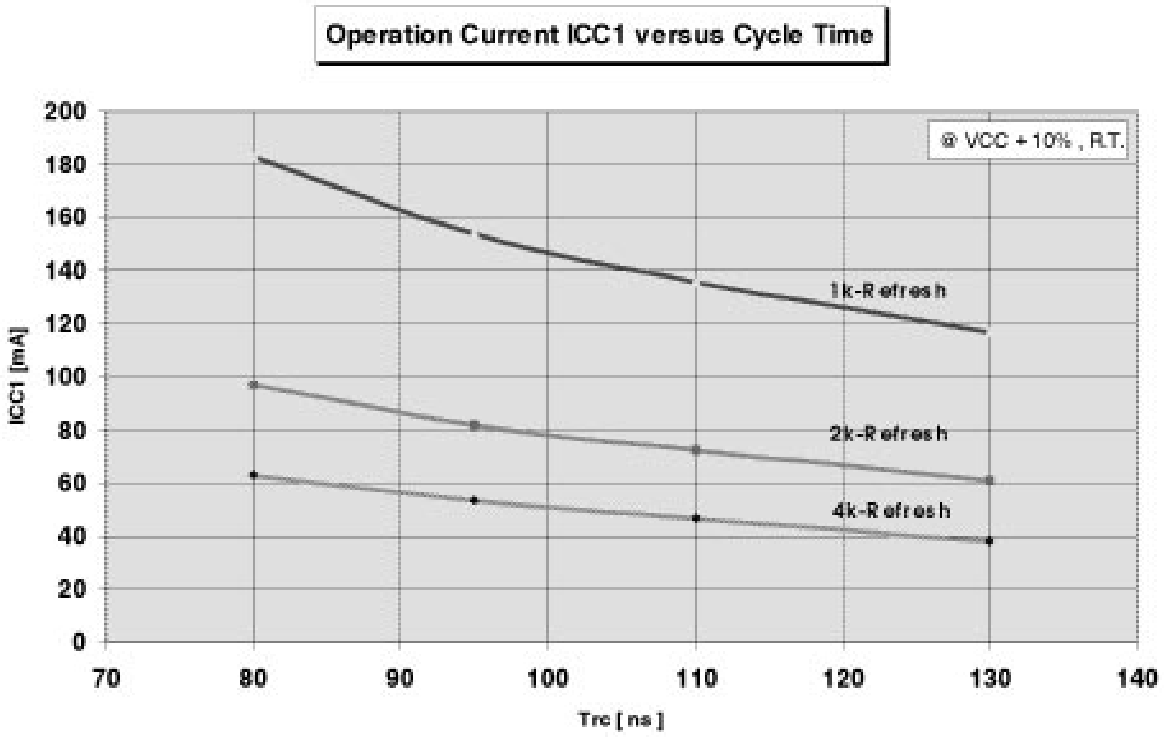
Operation Current ICC1 versus Cycle Time
@ VCC + 10% , R.T.
1k-Refresh
2k-Refresh
4k-Refresh
ICC1 [mA]
Trc [ns]
200
180
160
140
120
100
80
60
40
20
0
70
80
90
100
110
120
130
140

fig.1

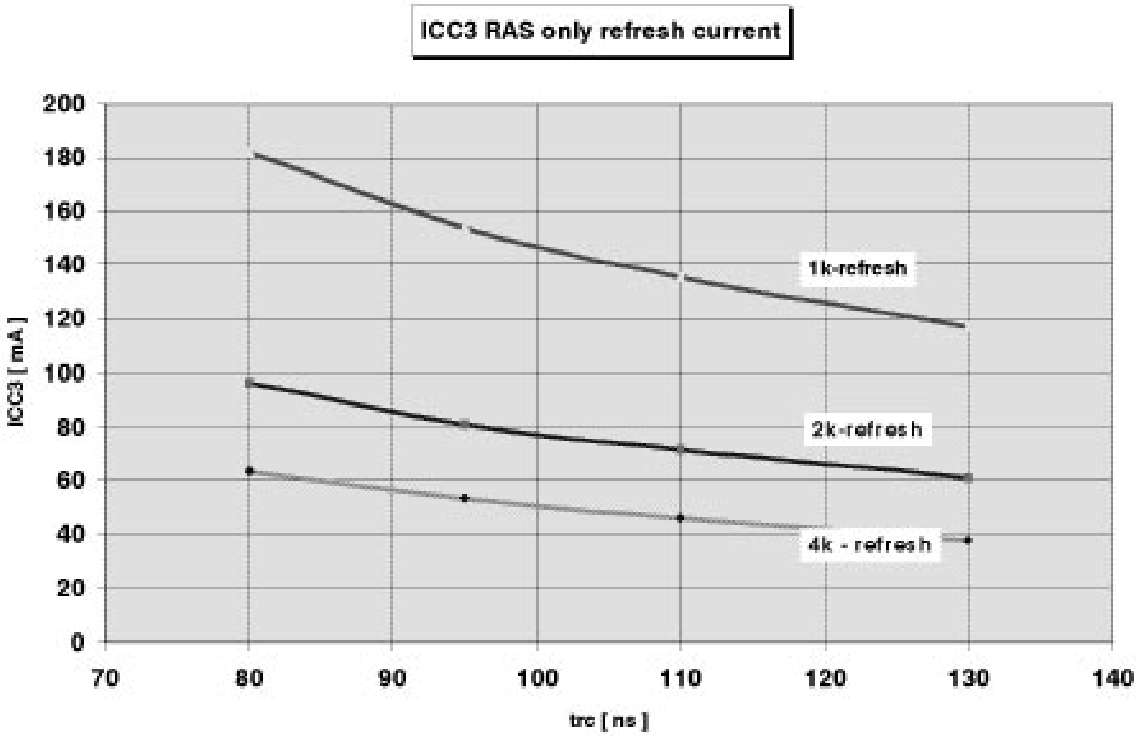
ICC3 RAS only refresh current
1k-refresh
2k-refresh
4k - refresh
ICC3 [mA]
trc [ns]
200
180
160
140
120
100
80
60
40
20
0
70
80
90
100
110
120
130
140

fig.2

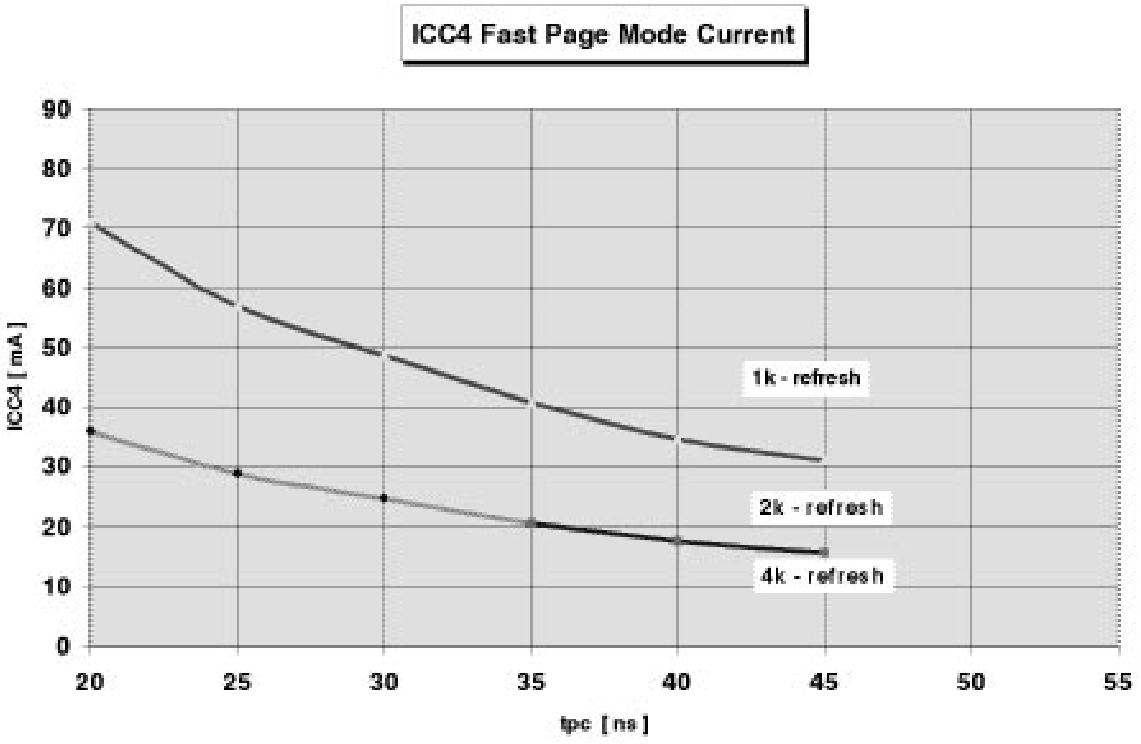
ICC4 Fast Page Mode Current
ICC4 [mA]
90
80
70
60
50
40
30
20
10
0
20
25
30
35
40
45
50
55
tpc [ns]
1k - refresh
2k - refresh
4k - refresh

fig.3

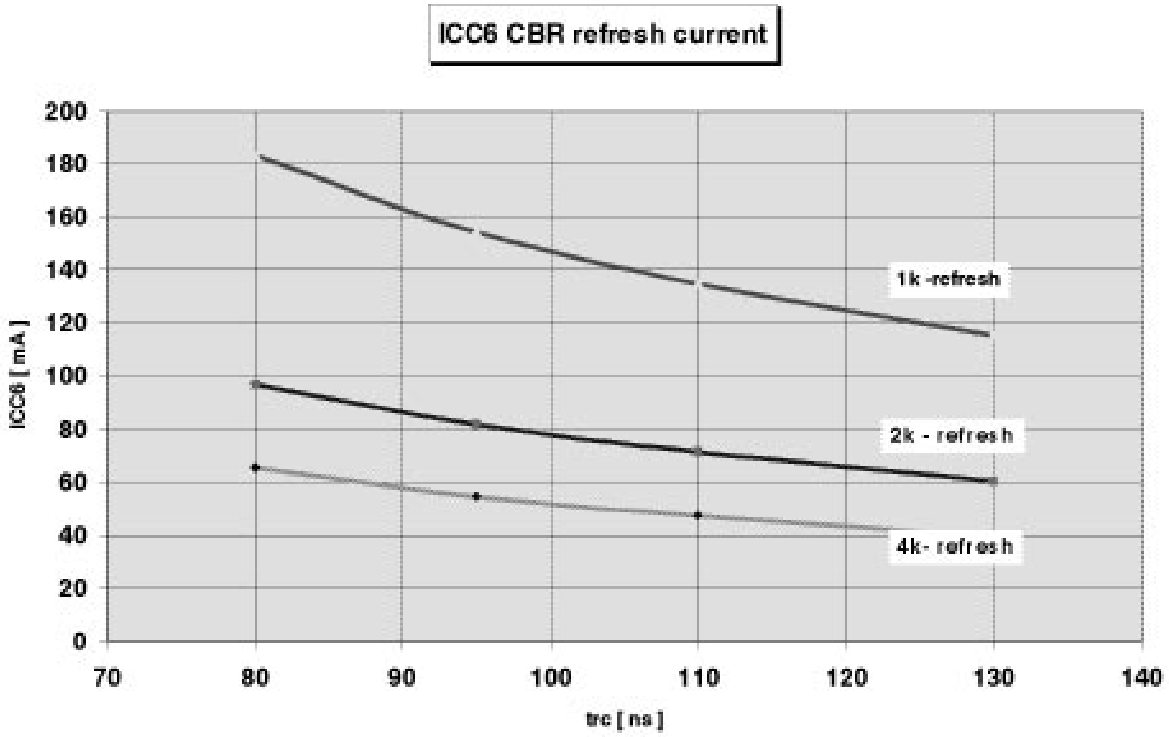
ICC6 CBR refresh current
ICC6 [mA]
200
180
160
140
120
100
80
60
40
20
0
70
80
90
100
110
120
130
140
trc [ns]
1k -refresh
2k - refresh
4k- refresh

fig.4

Table 1:

AC CHARACTERISTICS
HYB 5117400BJ/BT 4M x 4 DRAM 2k-Refresh Fast Page Mode

Parameter	Mean	Unit
TRC	75,1	ns
TRWC	98,8	ns
TPC	28,4	ns
TPRWC	43,6	ns
TRCDBEND *)	31,9	ns
TRAC-MIN	41,0	ns
TRAC-50	44,0	ns
TRAC-60	49,0	ns
TRAC-70	58,8	ns
TRAD	6,5	ns
TCAC	8,6	ns
TAA	18,8	ns
TCPA	20,4	ns
TCLZ	4,5	ns
TOFF	7,5	ns
TRP	22,9	ns
TRAS	<10	ns
TRSH	0,6	ns

Parameter	Mean	Unit
TCSH	36,3	ns
TCAS	3,6	ns
TRAH	1,5	ns
TCAH	3,1	ns
TRAL	6,0	ns
TWCH	-1,0	ns
TWP	-2,1	ns
TRWL	-0,5	ns
TCWL	3,1	ns
TCWD	14,8	ns
TRWD	48,0	ns
TAWD	25,3	ns
TWTH	-0,5	ns
TWRH	-0,8	ns
TOEA	7,4	ns
TCRP	-2,3	ns
TCP	-4,0	ns
TDH EW	3,5	ns

Parameter	Mean	Unit
TDH RMW	1,5	ns
TRPC	-2,0	ns
TRPCROR	-1,0	ns
REFDIS	1182,5	ms
REFPAU	775,0	ms
TCHR	-4,0	ns
TASR	-8,1	ns
TASC	-9,0	ns
TRCS	-6,6	ns
TRCH	-9,9	ns
TRRH	-7,0	ns
TDS EW	-8,8	ns
TDS RMW	-8,0	ns
TWCS	-6,0	ns
TCSR	-5,3	ns
TCPT	-4,0	ns
TWTS	-7,5	ns
TWRP	-7,5	ns

Parameter	Timing	Mean	Unit
ICC1	50ns	81,7	mA
ICC1	60ns	72,2	mA
ICC1	70ns	61,0	mA
ICC2		0,06	mA
ICC5		0,04	mA
ICC7		0,14	mA
ICC3	50ns	80,8	mA
ICC3	60ns	71,2	mA
ICC3	70ns	60,8	mA
ICC4	50ns	20,6	mA
ICC4	60ns	17,5	mA
ICC4	70ns	15,6	mA
ICC6	50ns	81,6	mA
ICC6	60ns	71,0	mA
ICC6	70ns	60,4	mA

Parameter	Mean	Unit
VLADALL	1,20	V
VLRAS	1,45	V
VLCAS	1,19	V
VLWRT	1,30	V
VLOE	1,29	V
VLIOALL	1,63	V
VHADALL	1,50	V
VHRAS	1,72	V
VHCAS	1,48	V
VHWRT	1,40	V
VHOE	1,48	V
VHIOALL	1,87	V
VOHALLS	3,70	V
VOLALLS	0,02	V

Parameter	Mean	Unit
VCCMIN	2,63	V
VCCMAX	7,55*	V

BUMP UP / BUMP DOWN

Parameter	Mean	Unit
BUMP UP	30*	%
BUMP DOWN	30*	%

Notes: *) not specified in the data sheets, for characterisation only.
All AC-measurements for fast page mode parts are performed with 2 TTL loads and 100 pF capacitive loading with tf = 5ns. Reference points for valid output data are 2.4 V and 0.4 V.

Table 2:

AC CHARACTERISTICS
HYB 5117800BJ/BT 2M x 8 DRAM 2k-Refresh Fast Page Mode

Parameter	Mean	Unit
TRC	76,4	ns
TRWC	99,9	ns
TPC	30,8	ns
TPRWC	42,9	ns
TRCDBEND	32,8	ns
TRAC-MIN	42,3	ns
TRAC-50	44,5	ns
TRAC-60	49,5	ns
TRAC-70	59,4	ns
TRAD	6,5	ns
TCAC	9,4	ns
TAA	19,4	ns
TCPA	20,3	ns
TCLZ	4,3	ns
TOFF	7,3	ns
TRP	24,1	ns
TRAS	26,0	ns

Parameter	Mean	Unit
TRSH	1,0	ns
TCSH	37,5	ns
TCAS	4,4	ns
TRAH	1,5	ns
TCAH	3,1	ns
TRAL	6,0	ns
TWCH	-0,8	ns
TWP	-2,0	ns
TRWL	-0,8	ns
TCWL	2,9	ns
TCWD	13,9	ns
TRWD	47,5	ns
TAWD	24,3	ns
TOEA	7,5	ns
TCRP	-2,0	ns
TCP	-4,0	ns
TDH EW	4,9	ns

Parameter	Mean	Unit
TDH RMW	2,9	ns
TRPCROR	-0,6	ns
REFDIS	1199,8	ms
REFPAU	777,0	ms
TCHR	-4,0	ns
TASR	-8,1	ns
TASC	-9,3	ns
TRCS	-6,9	ns
TRCH	-9,8	ns
TRRH	-7,0	ns
TDS EW	-9,9	ns
TDS RMW	-8,4	ns
TWCS	-6,0	ns
TCSR	-5,0	ns
TCPT	-4,0	ns

Parameter	Timing	Mean	Unit
ICC1	50ns	81,3	mA
ICC1	60ns	72,3	mA
ICC1	70ns	61,3	mA
ICC2		0,07	mA
ICC5		0,04	mA
ICC7		0,13	mA
ICC3	50ns	80,4	mA
ICC3	60ns	71,0	mA
ICC3	70ns	60,6	mA
ICC4	50ns	22,8	mA
ICC4	60ns	19,2	mA
ICC4	70ns	17,1	mA
ICC6	50ns	81,7	mA
ICC6	60ns	71,1	mA
ICC6	70ns	60,4	mA

Parameter	Mean	Unit
VLADALL	1,18	V
VLRAS	1,46	V
VLCAS	1,15	V
VLWRT	1,32	V
VLOE	1,31	V
VLIOALL	1,31	V
VHADALL	1,53	V
VHRAS	1,74	V
VHCAS	1,51	V
VHWRT	1,44	V
VHOE	1,53	V
VHIOALL	1,51	V
VOHALLS	3,84	V
VOLALLS	0,20	V

Parameter	Mean	Unit
VCCMIN	2,30	V
VCCMAX	7,55*	V

BUMP UP/DOWN

Parameter	Mean	Unit
BUMP UP	30*	%
BUMP DOWN	30*	%

Notes: *) not specified in the data sheets, for characterisation only.
All AC-measurements for fast page mode parts are performed with 2 TTL loads and 100 pF capacitive loading with tf = 5ns. Reference points for valid output data are 2.4 V and 0.4 V.

Table 3:

AC CHARACTERISTICS
HYB 5118160BSJ/BST 1M x 16 DRAM 1k-Refresh Fast Page Mode

Parameter	Mean	Unit
TRC	76,8	ns
TRWC	101,8	ns
TPC	27,9	ns
TPRWC	47,8	ns
TRCDBEND *)	32,0	ns
TRAC-MIN	42,1	ns
TRAC-50	45,1	ns
TRAC-60	50,0	ns
TRAC-70	59,8	ns
TRAD	6,5	ns
TCAC	9,6	ns
TAA	20,1	ns
TCPA	20,8	ns
TCLZ	2,6	ns
TOFF	6,0	ns
TRP	23,3	ns
TRAS	<10	ns

Parameter	Mean	Unit
TRSH	0,5	ns
TCSH	37,1	ns
TCAS	4,6	ns
TRAH	1,6	ns
TCAH	2,9	ns
TRAL	6,0	ns
TWCH	-1,0	ns
TWP	-2,0	ns
TRWL	-0,5	ns
TCWL	3,9	ns
TCWD	13,4	ns
TRWD	46,1	ns
TAWD	23,6	ns
TOEA	8,6	ns
TCRP	-2,3	ns
TCP	-4,0	ns
TDH EW	4,6	ns

Parameter	Mean	Unit
TDH RMW	2,9	ns
TRPCROR	-1,0	ns
REFDIS	743,0	ms
REFPAU	1125,0	ms
TCHR	-3,6	ns
TASR	-8,0	ns
TASC	-8,9	ns
TRCS	-6,0	ns
TRCH	-10,0	ns
TRRH	-7,0	ns
TDS EW	-10,4	ns
TDS RMW	-10,0	ns
TWCS	-5,9	ns
TCSR	-6,0	ns
TCPT	-4,0	ns

Parameter	Timing	Mean	Unit
ICC1	50ns	154,0	mA
ICC1	60ns	136,6	mA
ICC1	70ns	117,1	mA
ICC2		0,07	mA
ICC5		0,04	mA
ICC7		0,12	mA
ICC3	50ns	153,6	mA
ICC3	60ns	135,5	mA
ICC3	70ns	116,4	mA
ICC4	50ns	40,6	mA
ICC4	60ns	34,7	mA
ICC4	70ns	30,9	mA
ICC6	50ns	154,3	mA
ICC6	60ns	135,0	mA
ICC6	70ns	115,3	mA

Parameter	Mean	Unit
VHIOALL	1,80	V
VLADALL	1,15	V
VLRAS	1,45	V
VLUCAS	1,30	V
VLLCAS	1,29	V
VLWRT	1,31	V
VLOE	1,30	V
VLIOALL	1,56	V
VHADALL	1,51	V
VHRAS	1,69	V
VHUCAS	1,45	V
VHLCAS	1,46	V
VHWRT	1,42	V
VHOE	1,46	V
VHIOALL	1,75	V
VOHALLS	3,62	V
VOLALLS	0,02	V

Parameter	Mean	Unit
VCCMIN	2,72	V
VCCMAX	7,55*	V

BUMP UP/DOWN

Parameter	Mean	Unit
BUMP UP	30*	%
BUMP DOWN	30*	%

Notes: *) not specified in the data sheets, for characterisation only.
All AC-measurements for fast page mode parts are performed with 2 TTL loads and 100 pF capacitive loading with tf = 5ns. Reference points for valid output data are 2.4 V and 0.4 V.

Table 4:

AC CHARACTERISTICS
HYB 5117405BJ/BT 4M x 4 DRAM 2k-Refresh EDO

Parameter	Mean	Unit
TRC	71,1	ns
TRWC	95,6	ns
TPC	25,8	ns
THPC	19,0	ns
TPRWC	42,1	ns
TRCDBEND *)	31,5	ns
TRAC-MIN	38,0	ns
TRAC-50	41,5	ns
TRAC-60	46,5	ns
TRAC-70	56,3	ns
TRAD	6,3	ns
TCACRTR	9,5	ns
TAA	16,4	ns
TCPA	17,8	ns
TCLZ	4,3	ns
TOFF	10,9	ns
TCOH	9,4	ns
TRP	25,8	ns

Parameter	Mean	Unit
TRAS	13,4	ns
TRSH	1,3	ns
TCSH	36,0	ns
TCAS	4,3	ns
TRAH	4,3	ns
TCAH	5,9	ns
TRAL	6,3	ns
TWCH	2,0	ns
TWP	1,0	ns
TRWL	0,1	ns
TCWL	3,8	ns
TCWD	17,1	ns
TRWD	50,1	ns
TAWD	27,6	ns
TWRH	2,1	ns
TOEA	5,1	ns
TCRP	0,4	ns
TCP	-1,0	ns

Parameter	Mean	Unit
TDH EW	2,3	ns
TDH RMW	1,0	ns
TRPCROR	2,0	ns
REFDIS	1017,5	ns
REFPAU	632,0	ms
TCHR	-1,0	ms
TASR	-5,1	ns
TASC	-6,0	ns
TRCS	-3,3	ns
TRCH	-5,0	ns
TRRH	-2,1	ns
TDS EW	-2,8	ns
TDS RMW	-1,0	ns
TWCS	-3,0	ns
TCSR	-2,5	ns
TCPT	-1,0	ns
TWRP	-4,4	ns

Parameter	Timing	Mean	Unit
ICC1	50ns	88,2	mA
ICC1	60ns	77,3	mA
ICC1	70ns	65,3	mA
ICC2		0,08	mA
ICC5		0,04	mA
ICC7		0,15	mA
ICC3	50ns	88,6	mA
ICC3	60ns	77,1	mA
ICC3	70ns	65,3	mA
ICC4	50ns	33,8	mA
ICC4	60ns	23,3	mA
ICC4	70ns	19,6	mA
ICC6	50ns	89,0	mA
ICC6	60ns	76,8	mA
ICC6	70ns	64,8	mA

Parameter	Mean	Unit
VLADALL	1,21	V
VLRAS	1,47	V
VLCAS	1,21	V
VLWRT	1,32	V
VLOE	1,31	V
VLIOALL	1,61	V
VHADALL	1,51	V
VHRAS	1,74	V
VHCAS	1,50	V
VHWRT	1,42	V
VHOE	1,51	V
VHIOALL	1,95	V
VOHALLS	3,71	V
VOLALLS	0,02	V

Parameter	Mean	Unit
VCCMIN	2,62	V
VCCMAX	7,51	V

BUMP UP/DOWN

Parameter	Mean	Unit
BUMP UP	30*	%
BUMP DOWN	30*	%

Notes: *) not specified in the data sheets, for characterisation only.
All AC-measurements for hyper page mode (EDO) parts are performed with 2 TTL loads and 50 pF capacitive loading with tf = 2ns. Reference points for valid output data are 2.0 V and 0.8 V.

Table 5:

AC CHARACTERISTICS
HYB 5116405BJ/BT 4M x 4 DRAM 4k-Refresh EDO

Parameter	Mean	Unit
TRC	70,0	ns
TRWC	93,4	ns
TPC	25,3	ns
THPC	26,3	ns
TPRWC	42,0	ns
TRCDBEND *)	30,5	ns
TRAC-MIN	36,9	ns
TRAC-50	41,4	ns
TRAC-60	46,4	ns
TRAC-70	56,1	ns
TRAD	6,0	ns
TCACRTR	9,1	ns
TAA	15,6	ns
TCPA	17,9	ns
TCLZ	4,0	ns
TOFF	10,3	ns
TCOH	2,8	ns
TRP	25,5	ns

Parameter	Mean	Unit
TRAS	14,0	ns
TRSH	1,3	ns
TCSH	34,9	ns
TCAS	4,0	ns
TRAH	4,3	ns
TCAH	5,4	ns
TRAL	6,0	ns
TWCH	1,8	ns
TWP	0,6	ns
TRWL	0,1	ns
TCWL	3,6	ns
TCWD	16,9	ns
TRWD	48,9	ns
TAWD	27,5	ns
TWRH	2,0	ns
TOEA	4,6	ns
TCRP	0,8	ns
TCP	-1,0	ns

Parameter	Mean	Unit
TDH EW	2,5	ns
TDH RMW	1,0	ns
TRPCROR	2,0	ns
REFDIS	1210,0	ms
REFPAU	756,0	ms
TCHR	-1,0	ns
TASR	-5,0	ns
TASC	-6,0	ns
TRCS	-3,0	ns
TRCH	-4,9	ns
TRRH	-2,0	ns
TDS EW	-2,9	ns
TDS RMW	-1,0	ns
TWCS	-3,0	ns
TCSR	-2,1	ns
TCPT	-1,0	ns
TWRP	-4,4	ns

Parameter	Timing	Mean	Unit
ICC1	50ns	55,0	mA
ICC1	60ns	48,8	mA
ICC1	70ns	40,5	mA
ICC2		0,07	mA
ICC5		0,04	mA
ICC7		0,13	mA
ICC3	50ns	55,3	mA
ICC3	60ns	48,4	mA
ICC3	70ns	40,9	mA
ICC4	50ns	32,3	mA
ICC4	60ns	21,8	mA
ICC4	70ns	18,3	mA
ICC6	50ns	56,7	mA
ICC6	60ns	49,1	mA
ICC6	70ns	41,2	mA

Parameter	Mean	Unit
VLADALL	1,31	V
VLRAS	1,50	V
VLCAS	1,31	V
VLWRT	1,32	V
VLOE	1,31	V
VLIOALL	1,63	V
VHADALL	1,53	V
VHRAS	1,75	V
VHCAS	1,51	V
VHWRT	1,43	V
VHOE	1,51	V
VHIOALL	1,96	V
VOHALLS	3,74	V
VOLALLS	0,02	V

Parameter	Mean	Unit
VCCMIN	2,61	V
VCCMAX	7,51	V

BUMP UP/DOWN

Parameter	Mean	Unit
BUMP UP	30*	%
BUMP DOWN	30*	%

Notes: *) not specified in the data sheets, for characterisation only.
All AC-measurements for hyper page mode (EDO) parts are performed with 2 TTL loads and 50 pF capacitive loading with tf = 2ns. Reference points for valid output data are 2.0 V and 0.8 V.

Table 6:

AC CHARACTERISTICS
HYB 5118165BJ/BT 1M x 16 DRAM 1k-Refresh EDO

Parameter	Mean	Unit
TRC	77,1	ns
TRWC	94,6	ns
TPC	23,8	ns
THPC	19,9	ns
TPRWC	44,5	ns
TRCDBEND	30,9	ns
TRAC-MIN	38,4	ns
TRAC-50	42,4	ns
TRAC-60	47,3	ns
TRAC-70	57,1	ns
TRAD	6,3	ns
TCACRTR	8,9	ns
TAA	17,1	ns
TCPA	18,1	ns
TCLZ	5,0	ns
TOFF	11,9	ns
TCOH	22,3	ns

Parameter	Mean	Unit
TRP	25,8	ns
TRAS	11,1	ns
TRSH	1,0	ns
TCSH	36,5	ns
TCAS	5,1	ns
TRAH	4,3	ns
TCAH	5,9	ns
TRAL	6,3	ns
TWCH	2,0	ns
TWP	1,0	ns
TRWL	0,4	ns
TCWL	4,1	ns
TCWD	14,9	ns
TRWD	46,3	ns
TAWD	25,0	ns
TOEA	5,9	ns
TCRP	1,0	ns

Parameter	Mean	Unit
TCP	-1,0	ns
TDH EW	3,9	ns
TDH RMW	2,9	ns
TRPCROR	2,0	ns
REFDIS	840,0	ms
REFPAU	1352,5	ms
TCHR	-1,0	ns
TASR	-5,0	ns
TASC	-6,0	ns
TRCS	-3,0	ns
TRCH	-5,0	ns
TRRH	-2,4	ns
TDS EW	-5,0	ns
TDS RMW	-4,0	ns
TWCS	-2,0	ns
TCSR	-3,0	ns
TCPT	-1,0	ns

Parameter	Timing	Mean	Unit
ICC1	50ns	167,0	mA
ICC1	60ns	144,6	mA
ICC1	70ns	122,9	mA
ICC2		0,09	mA
ICC5		0,04	mA
ICC7		0,14	mA
ICC3	50ns	166,6	mA
ICC3	60ns	145,8	mA
ICC3	70ns	123,8	mA
ICC4	50ns	60,7	mA
ICC4	60ns	36,4	mA
ICC4	70ns	31,1	mA
ICC6	50ns	166,9	mA
ICC6	60ns	144,8	mA
ICC6	70ns	123,0	mA

Parameter	Mean	Unit
VLADALL	1,29	V
VLRAS	1,47	V
VLUCAS	1,33	V
VLLCAS	1,34	V
VLWRT	1,36	V
VLOE	1,31	V
VLIOALL	1,36	V
VHADALL	1,56	V
VHRAS	1,72	V
VHUCAS	1,49	V
VHLCAS	1,49	V
VHWRT	1,51	V
VHOE	1,52	V
VHIOALL	1,53	V
VOHALLS	3,94	V
VOLALLS	0,18	V

Parameter	Mean	Unit
VCCMIN	2,45	V
VCCMAX	7,55*	V

BUMP UP/DOWN

Parameter	Mean	Unit
BUMP UP	30*	%
BUMP DOWN	30*	%

Notes: *) not specified in the data sheets, for characterisation only.
All AC-measurements for hyper page mode (EDO) parts are performed with 2 TTL loads and 50 pF capacitive loading with tf = 2ns. Reference points for valid output data are 2.0 V and 0.8 V.