

TENTATIVE TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

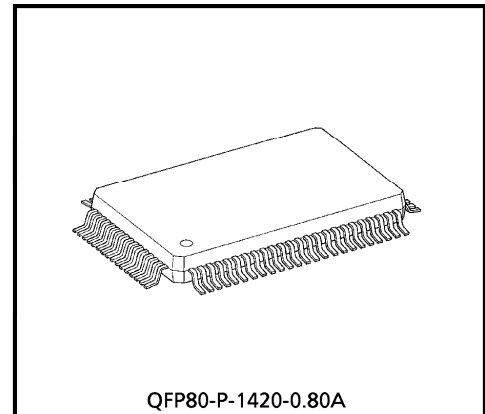
TC9284BF

CD SINGLE CHIP PROCESSOR WITH BUILT-IN 1BIT DA CONVERTER

The TC9284BF is a single chip processor for sync separation protection/synchronization, EFM demodulation, error correction/interpolation, microcomputer interface, CLV servo a focus tracking servo in CD player system. And, built-in 1bit DA converter. In combination with the TA8190F/TA8191F/TA2031F/TA2035F/TA2065F/TA2077F, which are focus tracking servo LSI, a CD player system can be composed very simply.

FEATURES

- Positive sync pattern detection, sync signal protection and synchronization.
- Built-in EFM demodulation and subcode demodulation circuit.
- Has the correction capacity of single and double corrections for C1 and C2 correcting units, respectively, using CIRC correction theoretical format.
- Jitter absorbing capacity of ± 5 frames.
- Built-in 16K RAM.
- Built-in digital out circuit.
- Smooth muting through zero cross detection.
- Read timing free subcode Q data.
- Built-in data slicer and analog PLL (free-adjustment VCO adopted) circuit.
- Focus/tracking loop gain auto adjusting function incorporated.
- Built-in AFC and APC circuits for disc motor CLV servo.
- Built-in focus tracking servo control circuit.
- Tracking search control capable of coping with all modes.
- Built-in 1bit DA converter.
Function of DA converter.
 - (1) Built-in 8-time oversampling digital filter.
 - (2) Built-in soft mute function.
- Built-in microcomputer interface circuit.
- Double speed play is possible.
- In CMOS structure, high speed and low power dissipation.
- 80 pin flat package.



QFP80-P-1420-0.80A

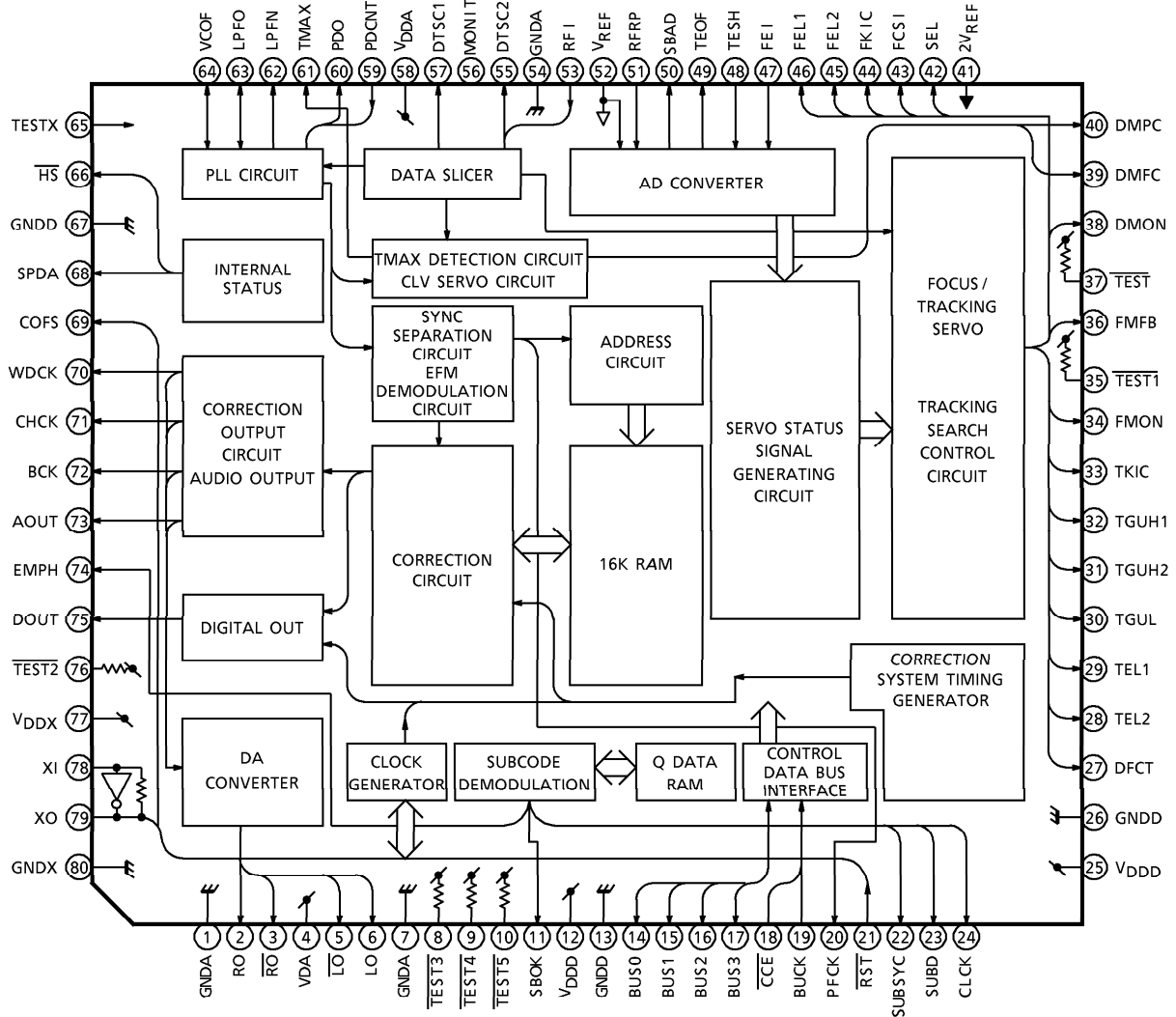
Weight : 1.57g (Typ.)

980508EBA2

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PIN CONNECTION / BLOCK DIAGRAM

(Top view)



PIN FUNCTION

| PIN No. | SYMBOL | I/O | FUNCTIONAL DESCRIPTION | REMARKS |
|---------------|--------------------|-----|--|---|
| 1 | GNDA | — | Analog grand terminal for DA converter (R channel) | — |
| 2 | RO | O | R channel data forward output terminal. | — |
| 3 | \overline{RO} | O | R channel data reverse output terminal. | — |
| 4 | V _{DA} | — | Analog power supply terminal for DA converter. | — |
| 5 | \overline{LO} | O | L channel data reverse output terminal. | — |
| 6 | LO | O | L channel data forward output terminal. | — |
| 7 | GNDA | — | Analog grand terminal for DA converter (L channel) | — |
| 8 | $\overline{TEST3}$ | I | Test terminal. Normally, keep at "H" level or open. | With pull-up resistor |
| 9 | $\overline{TEST4}$ | I | Test terminal. Normally, keep at "H" level or open. | |
| 10 | $\overline{TEST5}$ | I | Test terminal. Normally, keep at "H" level or open. | |
| 11 | SBOK | O | Subcode Q data CRC check adjusting result output terminal. The adjusting result is OK at "H" level. | — |
| 12 | V _{DDD} | — | Digital supply voltage terminal. (+5V) | — |
| 13 | GNDD | — | Digital ground terminal. | — |
| 14 5 17 | BUS0 5 BUS3 | I/O | Command and data sending/receiving input/output terminals. | Schmitt input Open drain output With pull-up resistor |
| 18 | \overline{CCE} | I | Command and data sending/receiving chip enable signal input terminal. The bus line becomes active at "L" level. | Schmitt input |
| 19 | BUCK | I | Command and data sending/receiving clock input terminal. | |
| 20 | PFCK | O | Regeneration system frame periodic signal output terminal. 7.35kHz | — |
| 21 | \overline{RST} | I | Reset input terminal. The internal system is reset at "L" level. | With pull-up resistor |
| 22 | SUBSYC | O | Subcode sync signal output terminal. | — |
| 23 | SUBD | O | Subcode P~W output terminals. | — |
| 24 | CLCK | I | Subcode P~W data readout clock input terminal. | — |
| 25 | V _{DDD} | — | Digital supply voltage terminal. | — |
| 26 | GNDD | — | Digital ground terminal. | — |
| 27 | DFCT | O | Defect detection signal output terminal. V _{REF} when defect is detected. Normally, HiZ. | — |
| 28 | TEL2 | O | Tracking gain adjusting analog switch output terminals V _{REF} or HiZ. | — |
| 29 | TEL1 | | | |
| 30 | TGUL | O | Tracking servo loop low frequency phase compensator change-over analog switch output terminal. HiZ (gain up) when detecting shock. Normally, V _{REF} . | — |

PIN FUNCTION

| PIN No. | SYMBOL | I/O | FUNCTIONAL DESCRIPTION | REMARKS | | | | | | | | | | | | | | | | |
|---------|-------------------|--------------------|---|-----------------------|-------------|--------------------|--------------|-----------|---|--------------------|------|--------|--------------|------|-----|--------------------|-------|------------------|---------------|--|
| 31 | TGUH2 | O | Tracking servo loop middle/high frequency phase compensator change-over analog switch output terminals. | — | | | | | | | | | | | | | | | | |
| 32 | TGUH1 | | HiZ (gain up) when detecting shock. Normally, V _{REF} . TGUH1 is used at normal regeneration and TGUH2 is used at double speed regeneration. | | | | | | | | | | | | | | | | | |
| 33 | TKIC | O | Tracking actuator kick signal output terminal. Kicks in the outer circumferential direction at "H" level and in the inner circumferential direction at "L" level. | 3-state output | | | | | | | | | | | | | | | | |
| 34 | FMON | O | Feed servo ON/OFF analog switch output terminals. Servo on at "HiZ". Servo off at "V _{REF} ". | — | | | | | | | | | | | | | | | | |
| 35 | TEST1 | I | Test terminal. Normally, keep at "H" level or open. | With pull-up resistor | | | | | | | | | | | | | | | | |
| 36 | FMFB | O | Feed motor FWD/BWD feeding control signal output terminal. Feed in the outer circumferential direction at "H" level and in the inner circumferential direction at "L" level. | 3-state output | | | | | | | | | | | | | | | | |
| 37 | TEST | I | Test terminal. Normally, keep at "H" level or open. | With pull-up resistor | | | | | | | | | | | | | | | | |
| 38 | DMON | O | Disc motor driving circuit gain change-over analog switch output terminal. | — | | | | | | | | | | | | | | | | |
| 39 | DMFC | O | Disc motor CLV servo AFC signal output terminal. | 3-state output | | | | | | | | | | | | | | | | |
| | | | <table border="1"> <thead> <tr> <th>COMMAND</th> <th>DMFC OUTPUT</th> <th>OPERATION</th> </tr> </thead> <tbody> <tr> <td>DMFK</td> <td>H</td> <td>Motor acceleration</td> </tr> <tr> <td>DMSV</td> <td>PWM</td> <td>CLV servo ON</td> </tr> <tr> <td>DMBK</td> <td>L</td> <td>Motor deceleration</td> </tr> <tr> <td>DMOFF</td> <td>V_{REF}</td> <td>CLV servo OFF</td> </tr> </tbody> </table> | | COMMAND | DMFC OUTPUT | OPERATION | DMFK | H | Motor acceleration | DMSV | PWM | CLV servo ON | DMBK | L | Motor deceleration | DMOFF | V _{REF} | CLV servo OFF | |
| | | | COMMAND | | DMFC OUTPUT | OPERATION | | | | | | | | | | | | | | |
| | | | DMFK | | H | Motor acceleration | | | | | | | | | | | | | | |
| | | | DMSV | | PWM | CLV servo ON | | | | | | | | | | | | | | |
| DMBK | L | Motor deceleration | | | | | | | | | | | | | | | | | | |
| DMOFF | V _{REF} | CLV servo OFF | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| 40 | DMPC | O | Disc motor CLV servo APC signal output terminal. | 3-state output | | | | | | | | | | | | | | | | |
| 41 | 2V _{REF} | I | Double times reference voltage input terminal. (V _{REF} × 2) | — | | | | | | | | | | | | | | | | |
| 42 | SEL | O | Servo mode indicating signal output terminal. | 3-state output | | | | | | | | | | | | | | | | |
| | | | <table border="1"> <thead> <tr> <th>SEL</th> <th>LD ON/OFF</th> <th>FOCUS SERVO</th> <th>OPERATION</th> </tr> </thead> <tbody> <tr> <td>L</td> <td>OFF</td> <td>OFF</td> <td>LD OFF</td> </tr> <tr> <td>HiZ</td> <td>ON</td> <td>OFF</td> <td>Focus Search</td> </tr> <tr> <td>H</td> <td>ON</td> <td>ON</td> <td>Normal play, etc. Focus Servo ON : FOK)</td> </tr> </tbody> </table> | | SEL | LD ON/OFF | FOCUS SERVO | OPERATION | L | OFF | OFF | LD OFF | HiZ | ON | OFF | Focus Search | H | ON | ON | Normal play, etc. Focus Servo ON : FOK) |
| | | | SEL | | LD ON/OFF | FOCUS SERVO | OPERATION | | | | | | | | | | | | | |
| | | | L | | OFF | OFF | LD OFF | | | | | | | | | | | | | |
| | | | HiZ | | ON | OFF | Focus Search | | | | | | | | | | | | | |
| H | ON | ON | Normal play, etc. Focus Servo ON : FOK) | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |

| PIN No. | SYMBOL | I/O | FUNCTION DESCRIPTION | REMARKS | | | | | | | | | | | | |
|---------|--------|-----------------------------|---|----------------|-------------|------------------------------|-----------|-------|---|------------------------------|-------|---|---------------------|--------|-----|-----------------------------|
| 43 | FCSI | O | Focus actuator driving signal output terminal in the focus search mode. | 3-state output | | | | | | | | | | | | |
| | | | <table border="1"> <thead> <tr> <th>COMMAND</th> <th>FCSI OUTPUT</th> <th>OPERATION</th> </tr> </thead> <tbody> <tr> <td>FORST</td> <td>H</td> <td>Lens gets for away from disc</td> </tr> <tr> <td>FOSET</td> <td>L</td> <td>Lens gets near disc</td> </tr> <tr> <td>Others</td> <td>HiZ</td> <td>Other than focus search</td> </tr> </tbody> </table> | | COMMAND | FCSI OUTPUT | OPERATION | FORST | H | Lens gets for away from disc | FOSET | L | Lens gets near disc | Others | HiZ | Other than focus search |
| | | | COMMAND | | FCSI OUTPUT | OPERATION | | | | | | | | | | |
| | | | FORST | | H | Lens gets for away from disc | | | | | | | | | | |
| FOSET | L | Lens gets near disc | | | | | | | | | | | | | | |
| Others | HiZ | Other than focus search | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| 44 | FKIC | O | Focus actuator driving signal output terminal in the focus gain adjusting mode. | 3-state output | | | | | | | | | | | | |
| | | | <table border="1"> <thead> <tr> <th>COMMAND</th> <th>FKIC OUTPUT</th> <th>OPERATION</th> </tr> </thead> <tbody> <tr> <td>FGASR</td> <td>H</td> <td>Lens gets for away from disc</td> </tr> <tr> <td>FGASS</td> <td>L</td> <td>Lens gets near disc</td> </tr> <tr> <td>Others</td> <td>HiZ</td> <td>Other than focus adjustment</td> </tr> </tbody> </table> | | COMMAND | FKIC OUTPUT | OPERATION | FGASR | H | Lens gets for away from disc | FGASS | L | Lens gets near disc | Others | HiZ | Other than focus adjustment |
| | | | COMMAND | | FKIC OUTPUT | OPERATION | | | | | | | | | | |
| | | | FGASR | | H | Lens gets for away from disc | | | | | | | | | | |
| FGASS | L | Lens gets near disc | | | | | | | | | | | | | | |
| Others | HiZ | Other than focus adjustment | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| 45 | FEL2 | O | Focus again adjusting analog switch output terminals. | — | | | | | | | | | | | | |
| 46 | FEL1 | | | | | | | | | | | | | | | |
| 47 | FEI | I | Focus error signal input terminal. | Analog output | | | | | | | | | | | | |
| 48 | TESH | I | Tracking error signal input sample holding analog switch input terminal. | — | | | | | | | | | | | | |
| 49 | TEOF | O | Tracking servo operation ON/OFF analog switch output terminal. V _{REF} when the tracking servo is OFF. | — | | | | | | | | | | | | |
| 50 | SBAD | I | Sub beam adding signal input terminal. | Analog input | | | | | | | | | | | | |
| 51 | RFRP | I | RF ripple signal input terminal. | | | | | | | | | | | | | |
| 52 | VREF | I | Reference voltage input terminal. (+2.1V) | — | | | | | | | | | | | | |
| 53 | RFI | I | RF signal input terminal. | Analog input | | | | | | | | | | | | |
| 54 | GNDA | — | Analog ground terminal. | — | | | | | | | | | | | | |
| 55 | DTSC2 | O | Data slice control EFM signal passive output terminal. | — | | | | | | | | | | | | |
| 56 | MONIT | O | Internal signal (EFMO, PLCK, LOCK and MBOV) output terminal. Selected by command. | — | | | | | | | | | | | | |
| 57 | DTSC1 | O | Data slice control EFM signal negative output terminal. | — | | | | | | | | | | | | |
| 58 | VDDA | — | Analog supply voltage terminal. (+5V) | — | | | | | | | | | | | | |
| 59 | PDCNT | I | PDO output control terminal. At "L" level, PDO output is made to HiZ by force. | — | | | | | | | | | | | | |
| 60 | PDO | O | Phase error signal output terminal between EFM signal and PLCK. | 3-state output | | | | | | | | | | | | |

| PIN No. | SYMBOL | I/O | FUNCTIONAL DESCRIPTION | REMARKS | | | | | | | | |
|-------------------------------|------------------------|-----|--|-----------------------|-------------|-------------|------------------------------|---|-------------------------------|------------------------|------------------|-----|
| 61 | TMAX | O | TMAX signal output terminal. Hiz at time of system clock. | 3-state output | | | | | | | | |
| | | | <table border="1"> <thead> <tr> <th>TMAX PERIOD</th> <th>TMAX OUTPUT</th> </tr> </thead> <tbody> <tr> <td>Longer than specified period</td> <td>L</td> </tr> <tr> <td>Shorter than specified period</td> <td>H (2V_{REF})</td> </tr> <tr> <td>Specified period</td> <td>HiZ</td> </tr> </tbody> </table> | | TMAX PERIOD | TMAX OUTPUT | Longer than specified period | L | Shorter than specified period | H (2V _{REF}) | Specified period | HiZ |
| | | | TMAX PERIOD | | TMAX OUTPUT | | | | | | | |
| | | | Longer than specified period | | L | | | | | | | |
| Shorter than specified period | H (2V _{REF}) | | | | | | | | | | | |
| Specified period | HiZ | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 62 | LPFN | I | LPF amplifier inverting input terminal for PLL. | — | | | | | | | | |
| 63 | LPFO | O | LPF amplifier output terminal for PLL. | — | | | | | | | | |
| 64 | VCOF | I | VCO filter terminal. | — | | | | | | | | |
| 65 | TESTX | I | Test terminal. | — | | | | | | | | |
| 66 | \overline{HS} | O | Double speed monitor output terminal. Double speed operation at "L" level. | — | | | | | | | | |
| 67 | GNDD | — | Digital ground terminal. | — | | | | | | | | |
| 68 | SPDA | O | Processor status signal output terminal. Correction process judging result, memory buffer capacity, etc. | — | | | | | | | | |
| 69 | COFS | O | Correction system frame periodic signal output terminal. 7.35kHz. | — | | | | | | | | |
| 70 | WDCK | O | Word clock output terminal. Normally, 88.2kHz. | — | | | | | | | | |
| 71 | CHCK | O | Channel clock output terminal. Normally, 44.1kHz. | — | | | | | | | | |
| 72 | BCK | O | Bit clock output terminal. Normally, 1.4112MHz. | — | | | | | | | | |
| 73 | AOUT | O | Audio data output terminal. | — | | | | | | | | |
| 74 | EMPH | O | Emphasis ON/OFF indication signal output terminal. Emphasis ON at "H" level. | — | | | | | | | | |
| 75 | DOUT | O | Digital out output terminal. | — | | | | | | | | |
| 76 | $\overline{TEST2}$ | I | Test terminal. Normally, keep at "H" level or open. | With pull-up resistor | | | | | | | | |
| 77 | VDDX | O | Oscillator supply voltage terminal. | — | | | | | | | | |
| 78 | XI | I | Crystal oscillator connecting terminal. | | | | | | | | | |
| 79 | XO | O | | | | | | | | | | |
| 80 | GNDX | O | Oscillator grand terminal. | — | | | | | | | | |

MAXIMUM RATINGS (Ta = 25°C)

| CHARACTERISTIC | SYMBOL | RATING | UNIT |
|-----------------------|------------------|---------------------------|------|
| Power Supply Voltage | V _{DD} | -0.3~6.0 | V |
| Input Voltage | V _{IN} | -0.3~V _{DD} +0.3 | V |
| Power Dissipation | P _D | 1250 | mW |
| Operating Temperature | T _{opr} | -35~85 | °C |
| Storage Temperature | T _{stg} | -55~150 | °C |

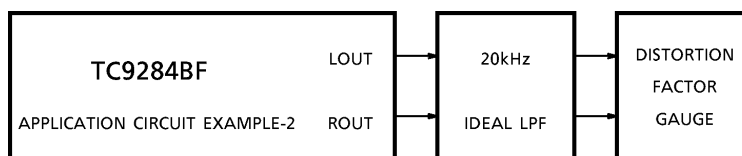
ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, V_{DD} = 5V, 2V_{REF} = 4.2V, V_{REF} = 2.1V, Ta = 25°C)

| CHARACTERISTIC | SYMBOL | TEST CIR-CUIT | TEST CONDITION | MIN. | TYP. | MAX. | UNIT | |
|---------------------------|-----------------|---------------------|--|--|------|----------------------|------|----------------------|
| Operating Supply Voltage | V _{DD} | — | Ta = -35~85°C | 4.5 | 5.0 | 5.5 | V | |
| Operating Supply Current | I _{DD} | — | XI = 16.9344MHz In normal mode | — | 40 | 70 | mA | |
| Input Voltage | "H" Level | V _{IH} (1) | Whole input terminals except BUS0~3, BUCK and CCE | 3.5 | — | V _{DD} +0.3 | V | |
| | "L" Level | V _{IL} (1) | | 0 | — | 1.5 | | |
| | "H" Level | V _{IH} (2) | | BUS0~3, BUCK, CCE (Schmitt input) | 4.0 | — | | V _{DD} +0.3 |
| | "L" Level | V _{IL} (2) | | | 0 | — | | 1.0 |
| Input Current | "H" Level | I _{IH} | V _{IH} = 5V | CMOS input terminals except analog input terminal | — | — | 1.0 | μA |
| | "L" Level | I _{IL} | V _{IL} = 0V | | -1.0 | — | — | |
| Try State Leak Current | "H" Level | I _{TLH} | V _{IH} = 5V | — | — | 1.0 | μA | |
| | "L" Level | I _{TLL} | V _{IL} = 0V | -1.0 | — | — | | |
| Output Current | "H" Level | I _{OH} (1) | V _{OH} = 4.6V | WDCK, CHCK, BCK, AOUT, DOUT, XO V _{OUT} = V _{DD} | — | — | -2.0 | mA |
| | "L" Level | I _{OL} (1) | V _{OL} = 0.4V | | 2.0 | — | — | |
| | "H" Level | I _{OH} (2) | V _{OH} = 4.6V | SBOK, PFCK, SUBSYN, SUBD, CLCK, SEL, HS, FCSI, FKIC, PDCNT, MONIT, COFS, SPDA V _{OUT} = V _{DD} | — | — | -0.5 | |
| | "L" Level | I _{OL} (2) | V _{OL} = 0.4V | | 1.0 | — | — | |
| | "H" Level | I _{OH} (3) | V _{OH} = 3.8V | TKIC, FMFB, DMFC, DMPC, TMAX V _{OUT} = 2V _{REF} | — | — | -0.4 | |
| | "L" Level | I _{OL} (3) | V _{OL} = 0.4V | | 1.0 | — | — | |
| | "H" Level | I _{OH} (4) | V _{OH} = 3.8V | PDO V _{OUT} = 2V _{REF} | — | — | -1.0 | |
| | "L" Level | I _{OL} (4) | V _{OL} = 0.4V | | 1.0 | — | — | |
| Analog Switch OFF Current | "H" Level | I _{OFH} | V _{IH} = 5V | — | — | 1.0 | μA | |
| | "L" Level | I _{OFL} | V _{IL} = 0V | -1.0 | — | — | | |

| CHARACTERISTIC | SYMBOL | TEST CIRCUIT | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|-----------------|--------------|---|------|------|------|------|
| Analog Switch ON Resistance | RON (1) | — | FEL1/2, TEL1/2, FMON, TGUL, TGUH1/2, DFCT, TEOF, DMON | — | — | 0.3 | kΩ |
| | RON (2) | | TESH | — | — | 0.6 | |
| Pull-up Resistance | RUP (1) | — | RST | — | 50 | — | kΩ |
| | RUP (2) | | TEST, TEST1~5 | — | 30 | — | |
| | RUP (3) | | BUS3~0 | 8 | — | — | |
| Oscillation Amplifier Feedback Resistance | RN | — | XI XO between | 2 | 4 | 6 | kΩ |
| Operating Frequency Ratio | f _{op} | — | XI | 6 | — | 28 | MHz |
| Total Harmonic Distortion + Noise | THD + N | 1 | 1kHz sine wave Full-scale input | — | -85 | -80 | dB |
| S/N Ratio | S/N | 1 | | 90 | 98 | — | dB |
| Dynamic Range | DR | 1 | 1kHz sine wave -60dB input conversion | 90 | 95 | — | dB |
| Cross-talk | CT | 1 | 1kHz sine wave Full-scale input | — | -95 | -85 | dB |

TEST CIRCUIT 1 : Application circuit example-2 is used.



LPF : SHIBASOKU 725C BUILT-IN FILTER
 DISTORTION FACTOR GAUGE : SHIBASOKU 725C OR EQUIVALENT

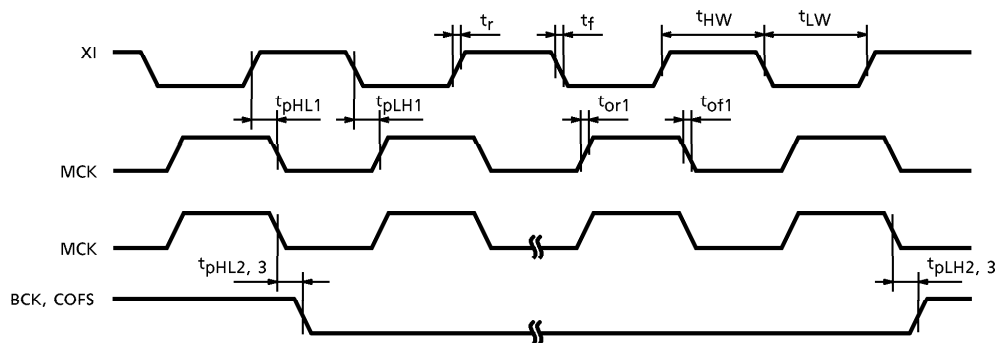
| MEASURING ITEM | DISTORTION FACTOR GAUGE FILTER SETTING A WEIGHT |
|----------------|---|
| THD + N, CT | OFF |
| S/N, DR | ON |

A WEIGHT : IEC-A OR EQUIVALENT

AC CHARACTERISTICS

(1) Clock system timing

| CHARACTERISTIC | | SYMBOL | TEST CIR-CUIT | TEST CONDITION | MIN. | TYP. | MAX. | UNIT | | |
|-------------------------|-----------|------------|---------------|----------------|------|------|------|------|----|----|
| Clock Pulse Width | "H" Level | t_{HW} | — | XI input | 18 | — | — | ns | | |
| | "L" Level | t_{LW} | | | 18 | — | — | | | |
| Input Rising Time | | t_r | | | — | — | — | | 10 | ns |
| Input Falling Time | | t_f | | | — | — | — | | 10 | |
| Transfer Time (1) | "H" Level | t_{pHL1} | — | XI→MCK | — | — | 60 | ns | | |
| | "L" Level | t_{pLH1} | | | — | — | 60 | | | |
| Transfer Time (2) | "H" Level | t_{pHL2} | — | MCK→BCK | — | — | 60 | | | |
| | "L" Level | t_{pLH2} | | | — | — | 60 | | | |
| Transfer Time (3) | "H" Level | t_{pHL3} | — | MCK→COFS | — | — | 100 | | | |
| | "L" Level | t_{pLH3} | | | — | — | 100 | | | |
| Output Rising Time (1) | | t_{or1} | — | MCK, BCK | — | — | 15 | ns | | |
| Output Falling Time (1) | | t_{of1} | | | — | — | 15 | | | |
| Output Rising Time (2) | | t_{or2} | — | COFS | — | — | 40 | ns | | |
| Output Falling Time (2) | | t_{of2} | | | — | — | 40 | | | |

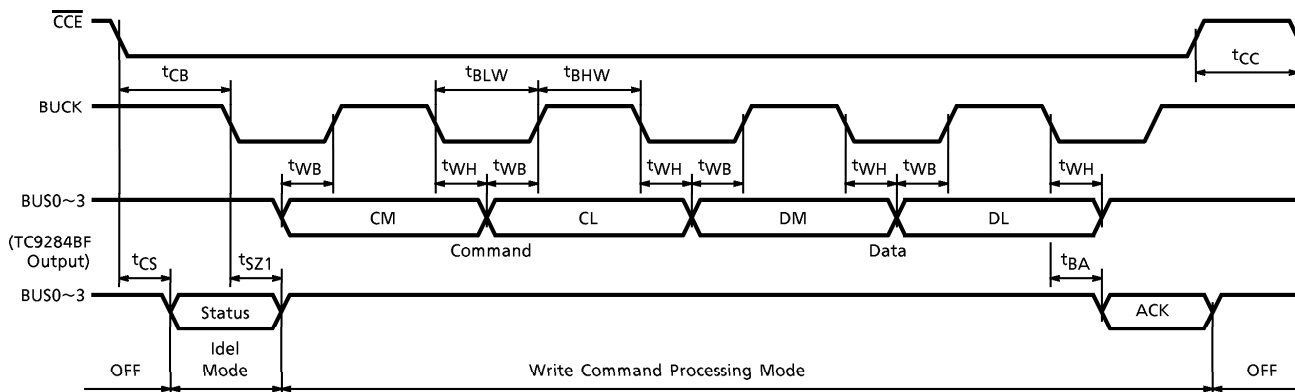


(2) Microcomputer interface timing

| CHARACTERISTIC | SYMBOL | TEST CIR-CUIT | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|-----------------------|-----------|---------------|--|------|------|------|---------|
| Clock Pulse Width (1) | "H" Level | t_{BHW} | BUCK | 10 | — | — | μS |
| | "L" Level | t_{BLW} | | 10 | — | — | |
| Clock Pulse Width (2) | "H" Level | t_{CC} | \overline{CCE} | 6 | — | — | μS |
| Delay Time (1) | t_{CB} | — | $\overline{CCE} \rightarrow BUCK$ | — | — | 6 | μS |
| Delay Time (2) | t_{WB} | — | Command Data \rightarrow BUCK | 0 | — | — | |
| Delay Time (3) | t_{CS} | — | $\overline{CCE} \rightarrow$ Status Output | — | — | 6 | |
| Delay Time (4) | t_{BC} | — | BUCK $\rightarrow \overline{CCE}$ | 6 | — | — | |
| Setup Time (1) | t_{RD} | — | BUCK \rightarrow Read Data Output | — | — | 6 | μS |
| Setup Time (2) | t_{BA} | — | BUCK \rightarrow ACK, Each Parity Output | — | — | 6 | |
| Hold time (1) | t_{SZ1} | — | BUCK \rightarrow Status, ACK, Each Parity Output | — | — | 6 | μS |
| Hold time (2) | t_{SZ2} | — | $\overline{CCE} \rightarrow$ Status Output | — | — | 6 | |
| Hold time (3) | t_{WH} | — | BUCK \rightarrow Command Data | 6 | — | — | |

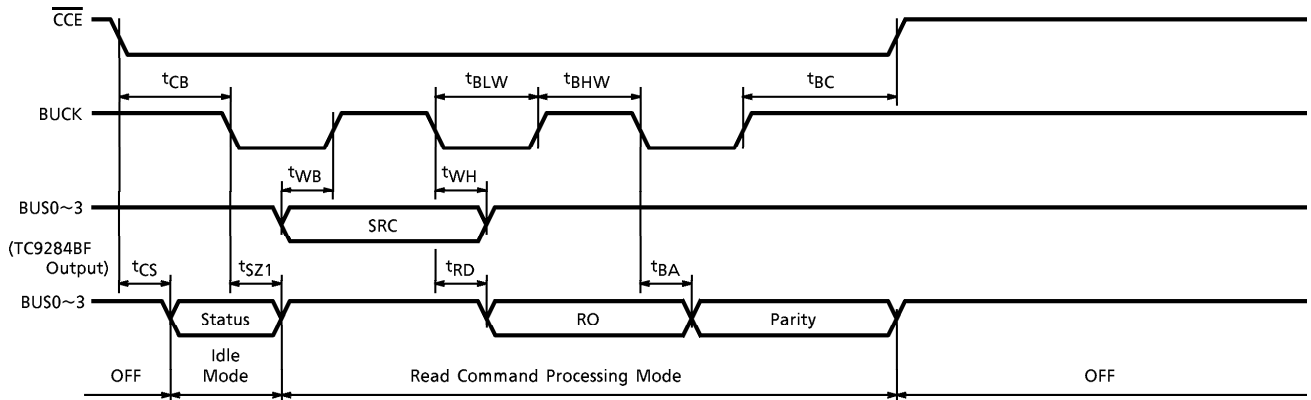
(a) Write command processing mode

(Microcomputer output)



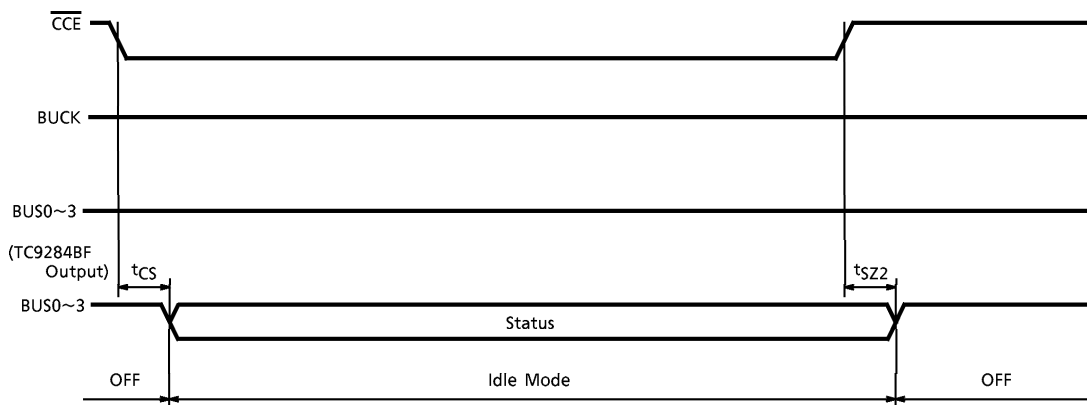
(b) Read command processing mode

(Microcomputer Output)



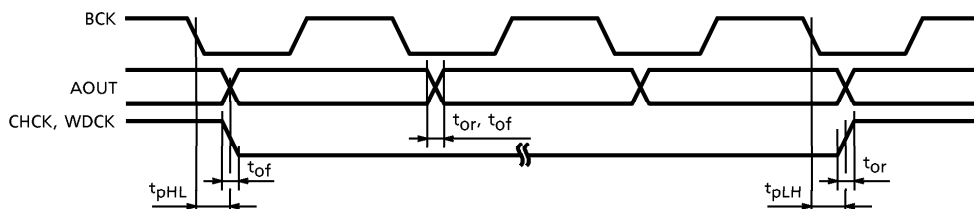
(c) Idle mode

(Microcomputer Output)



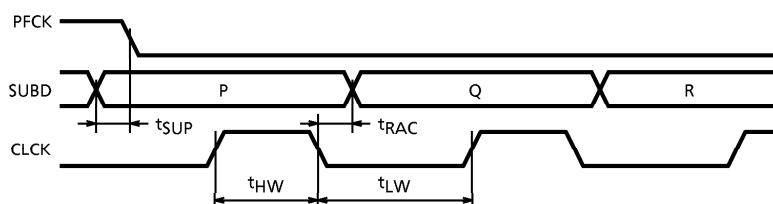
(3) Data output timing

| CHARACTERISTIC | | SYMBOL | TEST CIR-CUIT | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---------------------|-----------|-----------|---------------|----------------------|------|------|------|------|
| Transfer Time | "H" Level | t_{pHL} | — | BCK→AOUT, WDCK, CHCK | — | — | 30 | ns |
| | "L" Level | t_{pLH} | — | | — | — | 30 | |
| Output Rising Time | | t_{or} | — | AOUT, WDCK, CHCK | — | — | 15 | ns |
| Output Falling Time | | t_{of} | — | | — | — | 15 | |



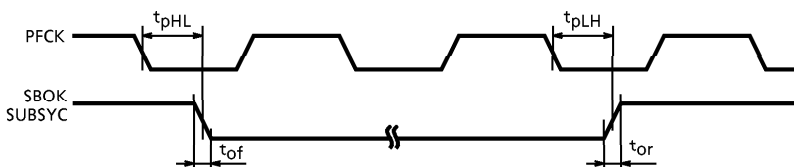
(4) Output timing for subcode P~W

| CHARACTERISTIC | SYMBOL | TEST CIRCUIT | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|-------------------|-----------|--------------|----------------|------|------|------|---------|
| Clock Pulse Width | "H" Level | t_{HW} | CLCK | 2 | — | — | μS |
| | "L" Level | t_{LW} | | 2 | — | — | |
| Setup Time | t_{SUP} | — | PFCK→SUBD | 0.4 | — | — | μS |
| Read Access Time | t_{RAC} | — | CLCK→SUBD | 1.2 | — | — | |



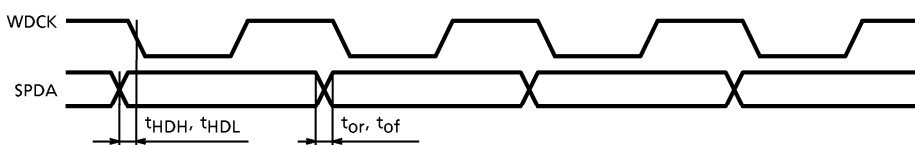
(5) Output timing for subcode Q

| CHARACTERISTIC | SYMBOL | TEST CIRCUIT | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---------------------|-----------|--------------|-------------------|------|------|------|------|
| Transfer Time | "H" Level | t_{pHL} | PFCK→SBOK, SUBSYC | -50 | — | 200 | ns |
| | "L" Level | t_{pLH} | | -50 | — | 200 | |
| Output Rising Time | t_{or} | — | SBOK, SUBSYC | — | — | 40 | ns |
| Output Falling Time | t_{of} | — | | — | — | 40 | |



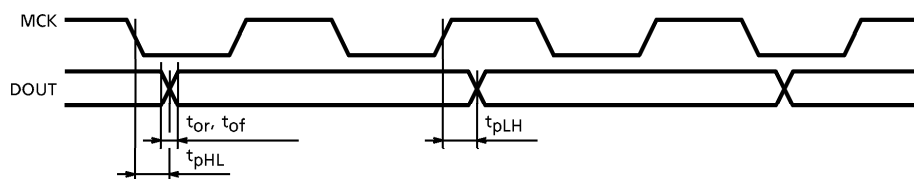
(6) Status signal output timing

| CHARACTERISTIC | SYMBOL | TEST CIRCUIT | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---------------------|-----------|--------------|----------------|------|------|------|------|
| Hold Time | "H" Level | t_{HDH} | WDCK→SPDA | — | — | 200 | ns |
| | "L" Level | t_{HDL} | | — | — | 200 | |
| Output Rising Time | t_{or} | — | SPDA | — | — | 40 | ns |
| Output Falling Time | t_{of} | — | | — | — | 40 | |

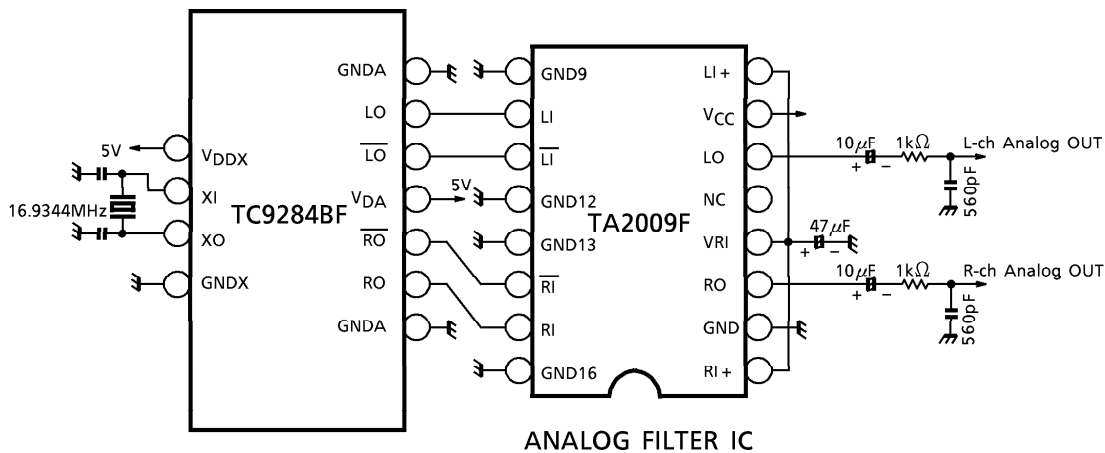


(7) Digital out output timing

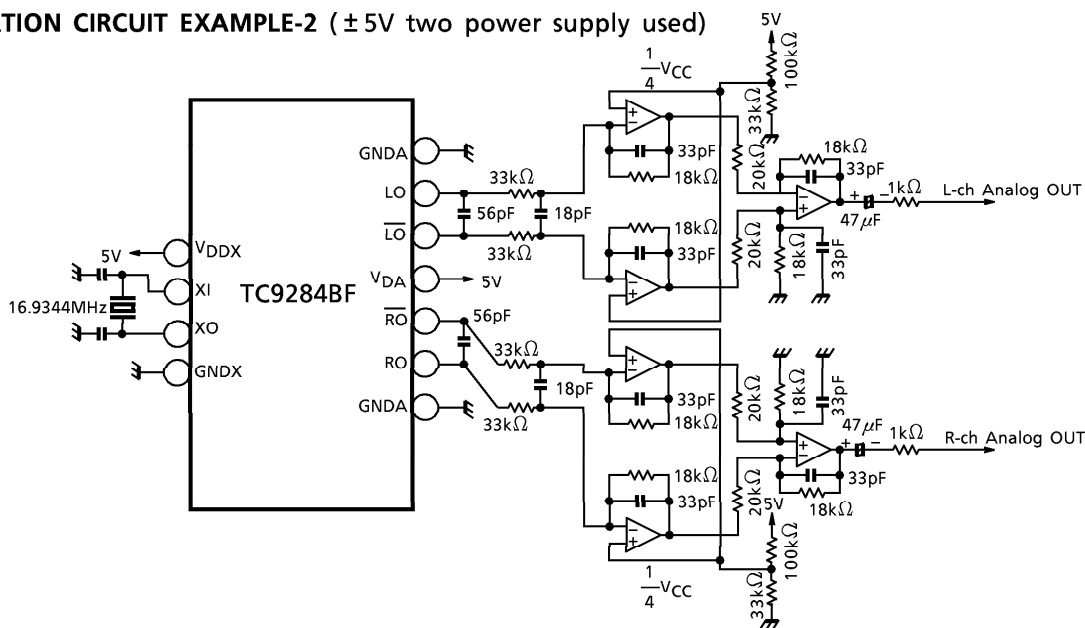
| CHARACTERISTIC | SYMBOL | TEST CIR-CUIT | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---------------------|-----------|---------------|----------------|------|------|------|------|
| Transfer Time | "H" Level | t_{pHL} | MCK→DOUT | — | — | 60 | ns |
| | "L" Level | t_{pLH} | | — | — | 60 | |
| Output Rising Time | t_{or} | — | DOUT | — | — | 14 | ns |
| Output Falling Time | t_{of} | — | | — | — | 14 | |



APPLICATION CIRCUIT EXAMPLE-1 (+5V single power supply used)



APPLICATION CIRCUIT EXAMPLE-2 ($\pm 5V$ two power supply used)

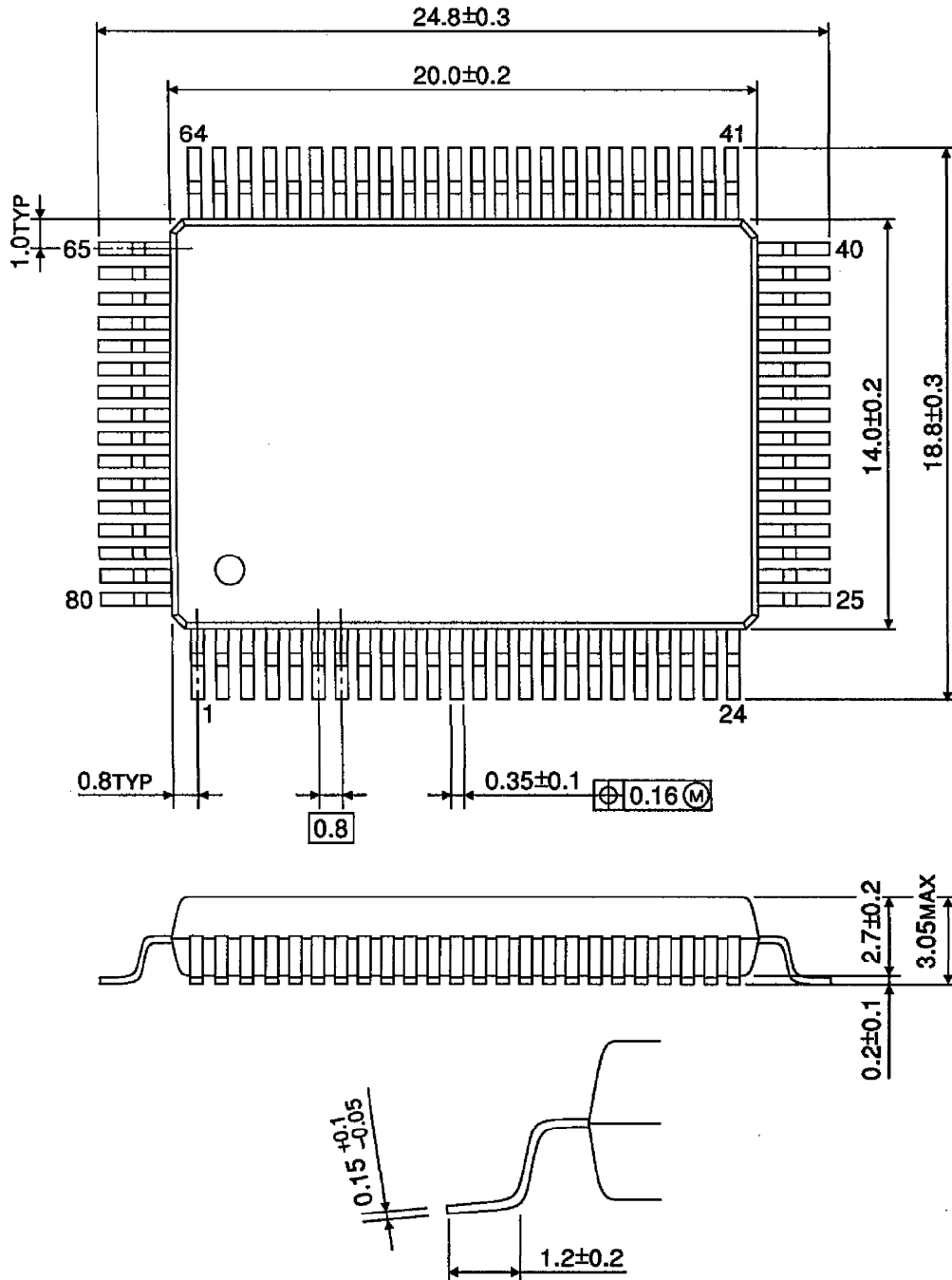


(Cautions)

- Quality of crystal oscillation wave form largely affect S/N ratio and noise distortion. Further, this is also true then system clock is input externally through the XI terminal.
- The wiring between the TC9284BF output and the TA2009F input must be made the shortest.
- The condenser between V_{DD} and GND shall be connected as close to the pin as possible.

OUTLINE DRAWING
QFP80-P-1420-0.80A

Unit : mm



Weight : 1.57g (Typ.)