

To all our customers

Regarding the change of names mentioned in the document, such as Mitsubishi Electric and Mitsubishi XX, to Renesas Technology Corp.

The semiconductor operations of Hitachi and Mitsubishi Electric were transferred to Renesas Technology Corporation on April 1st 2003. These operations include microcomputer, logic, analog and discrete devices, and memory chips other than DRAMs (flash memory, SRAMs etc.) Accordingly, although Mitsubishi Electric, Mitsubishi Electric Corporation, Mitsubishi Semiconductors, and other Mitsubishi brand names are mentioned in the document, these names have in fact all been changed to Renesas Technology Corp. Thank you for your understanding. Except for our corporate trademark, logo and corporate statement, no changes whatsoever have been made to the contents of the document, and these changes do not constitute any alteration to the contents of the document itself.

Note : Mitsubishi Electric will continue the business operations of high frequency & optical devices and power devices.

Renesas Technology Corp.
Customer Support Dept.
April 1, 2003

PRELIMINARY

Notice ; This is not a final specification.

Some parametric limits are subject to change.

TUNER SINGLE CHIP

DESCRIPTION

The M61130FP is a semiconductor integrated circuit consisting of Tuner signal processing for NTSC color TV sets and VCRs. The circuit includes Mixer circuit in Tuning system, Oscillator circuit, PLL frequency synthesizer and VIF/SIF, which permits a smaller tuner system.

FEATURES

- VIF/SIF
 - Inter carrier type for NTSC
 - Coil-less VCO
 - Adjustment free AFT
 - High-speed IF AGC
- PLL
 - Low phase noise and High-speed lock-up
 - Built-in band switch driver (4 port)
 - I²C bus control
 - Available for both XO and external reference
- Mixer/Oscillator
 - Built-in U&V oscillator and mixer
 - Built-in UV band switch

APPLICATION

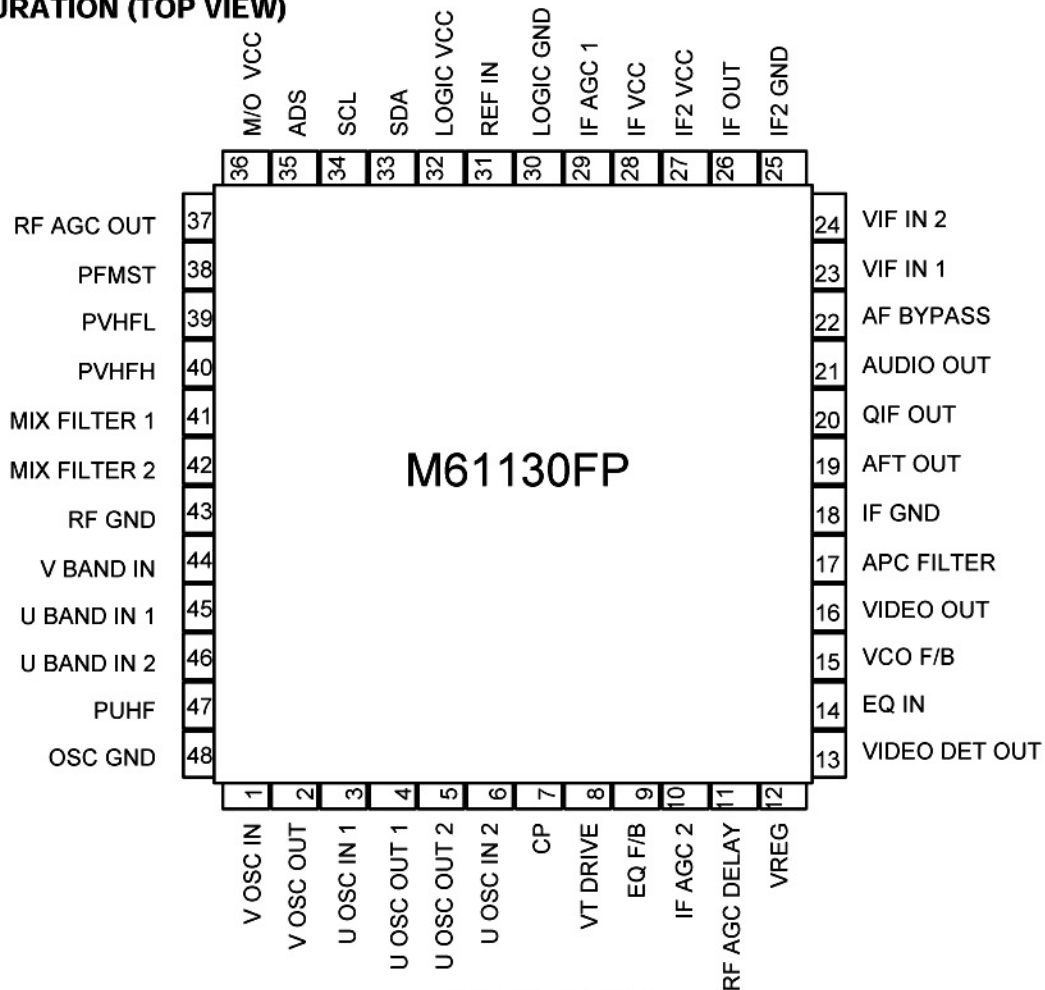
TV, VTR

RECOMMENDED OPERATING CONDITIONS

Supply voltage range.....4.75 to 5.25V

Recommended supply voltage.....5.0V

PIN CONFIGURATION (TOP VIEW)



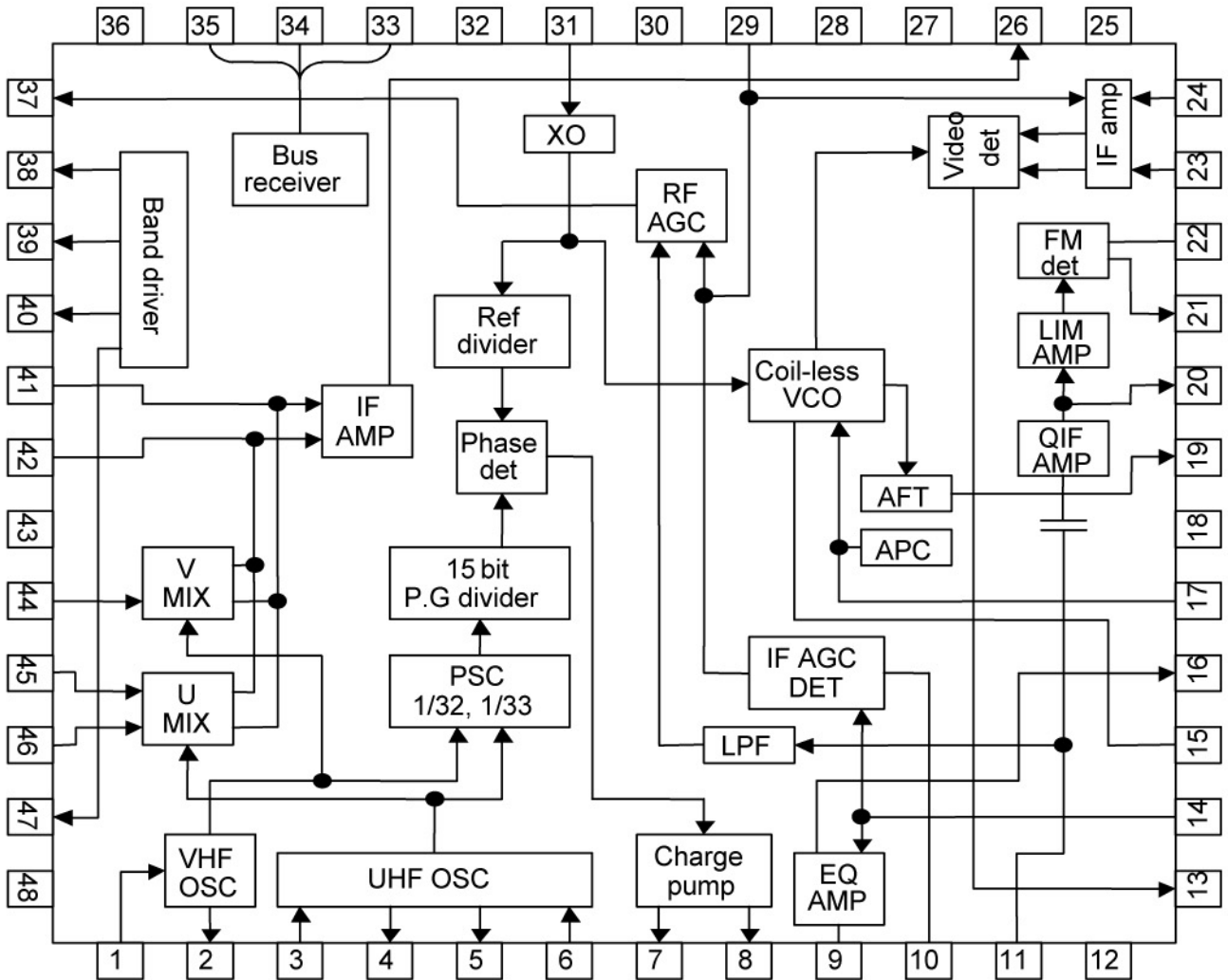
Outline 48P6Q

PRELIMINARY

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TUNER SINGLE CHIP

BLOCK DIAGRAM



PRELIMINARY

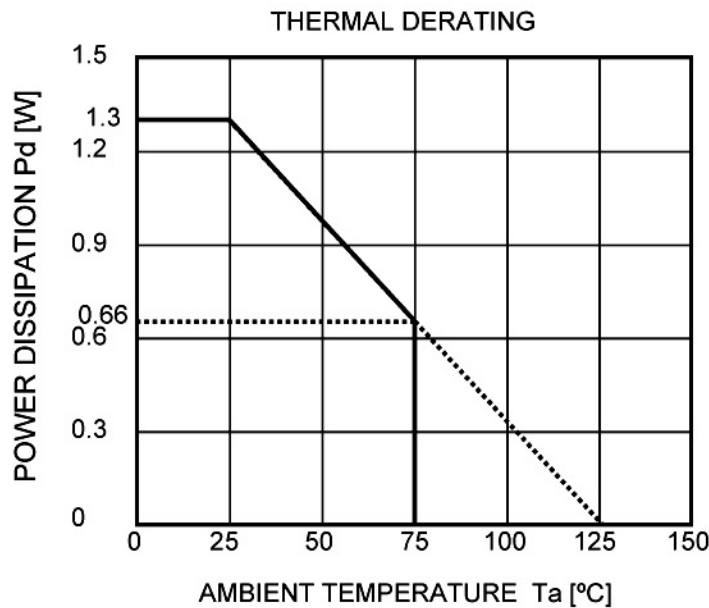
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TUNER SINGLE CHIP

ABSOLUTE MAXIMUM RATINGS (Ta=25°C, unless otherwise noted)

| Symbol | Parameter | Rating | Unit |
|--------|-----------------------|-------------|------|
| Vcc | Supply Voltage | 6.0 | V |
| Pd | Power Dissipation | 658 | mW |
| Topr | Operating temperature | -20 to +75 | °C |
| Tstg | Storage temperature | -40 to +150 | °C |

TYPICAL CHARACTERISTICS

**ELECTRICAL CHARACTERISTICS** (Ta=25°C, unless otherwise noted)

| Symbol | Parameter | Measure Point | Test conditions | Limits | | | Unit |
|------------|-----------------------------|---------------|-------------------------|--------|-----|------|-------|
| | | | | Min | Typ | Max | |
| IF Icc | IF Vcc current | 28 | | - | 70 | 84 | mA |
| MO Icc | M/O Vcc current | 36 | | - | 21 | 25 | mA |
| Log Icc | Logic Vcc current | 32 | Port output off | - | 14 | 20 | mA |
| Log Icc(U) | Logic Vcc current(UHF) | 32 | I _{oBS} =-22mA | - | 40 | 46 | mA |
| Log Icc(V) | Logic Vcc current(VHF) | 32 | I _{oBS} =-25mA | - | 43 | 50 | mA |
| Log Icc(F) | Logic Vcc current(FM) | 32 | I _{oBS} =-15mA | - | 32 | 38 | mA |
| Ibavideo | Video out bias current | 16 | | 1.4 | 1.9 | 2.4 | mA |
| IbaAudio | Audio out bias current | 21 | | 1.0 | 1.3 | 1.6 | mA |
| IbaQIF | 4.5MHz QIF out bias current | 20 | | 0.9 | 1.2 | 1.5 | mA |
| Vreg | Regulator voltage | 12 | | 2.65 | 2.8 | 2.95 | V |
| fxosc | X'tal frequency | 31 | PLL function range | 3.0 | 4.0 | 4.8 | MHz |
| frefin | Ref. signal frequency | 31 | PLL function range | 3.0 | 4.0 | 5.0 | MHz |
| Vifrefin | Ref. signal input level | 31 | | 50 | - | 600 | mVp-p |

PRELIMINARY

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TUNER SINGLE CHIP

ELECTRICAL CHARACTERISTICS (cont.)

M/O

| Symbol | Parameter | Measure Point | Test conditions | Limits | | | Unit |
|---------------------|----------------------|---------------|-----------------------|--------|-----|-----|------|
| | | | | Min | Typ | Max | |
| Band VHF Mixer | | | RL=75Ω | | | | |
| GpVHF1 | Conversion gain1 | 26,44 | fRF=57.5MHz | 16 | 19 | 22 | dB |
| GpVHF2 | Conversion gain2 | 26,44 | fRF=357.5MHz | 16 | 19 | 22 | dB |
| NFVHF | Noise figure | 26,44 | fRf=57.5~357.5MHz | | 11 | | dB |
| CM1VHF | 1% cross modulation1 | 26,44 | fRF=55.25MHz | 90 | | | dB□V |
| CM2VHF | 1% cross modulation2 | 26,44 | fRF=361.25MHz | 90 | | | dB□V |
| Band UHF Mixer | | | RL=75Ω | | | | |
| GpUHF1 | Conversion gain1 | 26,45,46 | fRF=369.5MHz | 26 | 29 | 32 | dB |
| GpUHF2 | Conversion gain2 | 26,45,46 | fRF=803.5MHz | 26 | 29 | 32 | dB |
| NFUHF | Noise figure | 26,45,46 | fRF=369.5~803.5MHz | | 10 | | dB |
| CM1UHF | 1% cross modulation1 | 26,45,46 | fRF=367.25MHz | 80 | | | dB□V |
| CM2UHF | 1% cross modulation2 | 26,45,46 | fRF=801.25MHz | 80 | | | dB□V |
| Band VHF Oscillator | | | | | | | |
| foVHF | Operation range | 26 | | 101 | | 407 | MHz |
| fosc(v) | Supply voltage drift | 26 | Vcc=5% | | 100 | | KHz |
| foV(t) | SW ON drift | 26 | 3sec~3min after SW ON | | 200 | | KHz |
| Band UHF Oscillator | | | | | | | |
| foUHF | Operation range | 26 | | 413 | | 847 | MHz |
| fosc(U) | Supply voltage drift | 26 | Vcc=5% | | 100 | | KHz |
| foU(t) | SW ON drift | 26 | 3sec~3min after SW ON | | 200 | | KHz |

PLL

| Symbol | Parameter | Measure Point | Test conditions | Limits | | | Unit |
|-----------------|-------------------|----------------|----------------------------------|--------|-----|---------|------|
| | | | | Min | Typ | Max | |
| Input terminals | | | | | | | |
| ViH | Hi input voltage | 33,34 | | 3.0 | - | Vcc+0.3 | V |
| ViL | Lo input voltage | 33,34 | | - | - | 1.5 | V |
| IiH1 | Hi input current | 33,34 | Vcc=5.5V,Vi=4.0V | - | - | 10 | □A |
| IiL1 | Lo input current | 33,34 | Vcc=5.5V,Vi=0.4V | - | - | -10 | □A |
| SDA output | | | | | | | |
| VsIL | Lo output voltage | 34 | Vcc=5.5V,Io=3mA | - | - | 0.4 | V |
| IsLK | Leakage current | 34 | Vcc=5.5V,Vo=5.5V | - | -2 | -10 | □A |
| ADS input | | | | | | | |
| IiH2 | Hi input current | 35 | Vcc=5.5V,Vi=5.0V | - | - | 10 | □A |
| IiL2 | Lo input current | 35 | Vcc=5.5V,Vi=1.5V | - | -15 | -30 | □A |
| Band output | | | | | | | |
| VoBS1 | Output voltage1 | 39,40 | Vcc=5.0V,Io=-25mA PVHFL,PVHFH | 4.6 | 4.8 | - | V |
| VoBS2 | Output voltage2 | 47 | Vcc=5.0V,Io=-22mA,PUHF | 4.6 | 4.8 | - | V |
| VoBS3 | Output voltage3 | 38 | Vcc=5.0V,Io=-5mA,PFMST | 4.6 | 4.8 | - | V |
| IoBSLK | Leakage current | 38,39,40 47 | Vcc=5.5V,Output is OFF | - | - | 10 | □A |
| Charge pump | | | | | | | |
| IcpH | Hi output current | 7 | Vcc=5.5V,Vo=2.5V,CP=1 | 160 | 270 | 360 | □A |
| IcpL | Lo output current | 7 | Vcc=5.5V,Vo=2.5V,CP=0 | 50 | 70 | 110 | □A |
| IcpLK | Leakage current | 7 | Vcc=5.5V,Vo=5.5V,T2,T1=0 | - | - | 50 | nA |

PRELIMINARY

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TUNER SINGLE CHIP

ELECTRICAL CHARACTERISTICS (cont.)

VIF/SIF

| Symbol | Parameter | Measure Point | Test conditions | Limits | | | Unit |
|--------|---------------------------|---------------|------------------------------|--------|-----|-----|--------|
| | | | | Min | Typ | Max | |
| VoDET | Video output level | 16 | IF 77.78%, 15.7KHz AM, 90dB□ | 1.1 | 1.3 | 1.5 | Vp-p |
| Vsync | Sync tip voltage | 13 | | 1.1 | 1.3 | 1.5 | V |
| VSN | Video S/N | 13 | with 6MHz LPF, 90dB□V | 48 | 50 | - | dB |
| BW | Video out freq. response | 16 | loss 6MHz | - | 3 | 5 | dB |
| VINMIN | Input sensitivity | 13,23,24 | -3dB down point | | 45 | 49 | dB□V |
| VINMAX | Max. IF input | 13,23,24 | +3dB up point | 101 | 105 | - | dB□V |
| GR | AGC range | - | | 54 | 60 | - | dB |
| V10 | IF AGC voltage | 10 | | 2.7 | 2.9 | 3.1 | V |
| V10L | IF AGC min. voltage | 10 | 110dB□V | 1.9 | 2.1 | 2.3 | V |
| CL-U | Capture range U | 23,24 | 45.75MHz, 90dB□V | 1.5 | 2.5 | - | MHz |
| CL-L | Capture range L | 23,24 | 45.75MHz, 90dB□V | 1.5 | 1.9 | - | MHz |
| D/G | D/G | 13 | | - | 3 | 5 | % |
| D/P | D/P | 13 | | - | 3 | 5 | deg |
| RINV | VIF input impedance | 23,24 | DC | - | 2k | - | Ω |
| CINV | VIF input capacitance | 23,24 | 40MHz | - | 5 | - | pF |
| foC1 | AFT Center freq. 45.75MHz | 19,23,24 | pin19 voltage = Vcc/2 | -30 | fo | +30 | KHz |
| foC2 | AFT Center freq. 58.75MHz | 19,23,24 | pin19 voltage = Vcc/2 | -30 | fo | +30 | KHz |
| V19H | Hi output voltage | 19 | Vcc=5.0V | 4.3 | 4.7 | 5.0 | V |
| V19L | Lo output voltage | 19 | | 0 | 0.3 | 0.7 | V |
| V19C | Center voltage | 19 | 45.75MHz | 2.3 | 2.5 | 2.7 | V |
| □ | Sensitivity | 19 | 360KΩ//360KΩ | 10 | 24 | 36 | mV/KHz |
| VRFH | RFAGC Hi output voltage | 37 | open | 4.4 | 4.7 | 5.0 | V |
| VRFLV | RFAGC Lo output voltage | 37 | open | 0 | 0.3 | 0.6 | V |
| RFDLY | RFAGC Delay point | 23,24,37 | @11pin 2V | 87 | 90 | 93 | dB□V |
| VoAF | Audio out level | 21 | 4.5MHz±25kHz 1kHz | 660 | 770 | 880 | mVrms |
| THDAF | Audio out THD | 21 | 4.5MHz±25kHz 1kHz | - | 0.2 | 0.9 | % |
| AFSN | Audio out S/N | 21 | 4.5MHz±25kHz 1kHz | 54 | 57 | - | dB |
| LIM | Limiting sensitivity | 11,21 | | - | 50 | 55 | dB□V |
| AMR | AMR | 21 | | 50 | 55 | - | dB |
| VoQIF | QIF output | 20 | | 94 | 100 | - | dB□V |

PRELIMINARY

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TUNER SINGLE CHIP

CONTROL TABLE

VIF frequency select

| | | |
|-------|---------------|------------------|
| | VIF frequency | 20pin condition |
| US | 45.75 MHz | none |
| JAPAN | 58.75 MHz | pull down (1.5K) |

Ref input

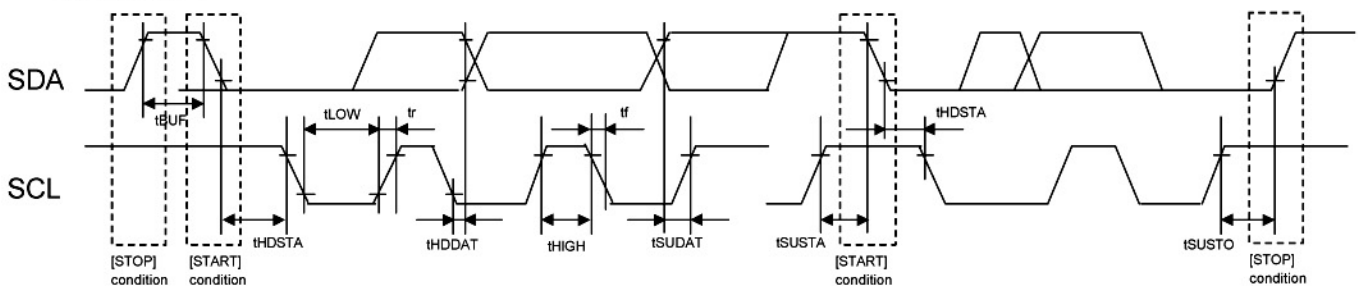
| | |
|----------------|-----------------|
| Ref in (31pin) | 31pin condition |
| INT | none |
| EXT | pull down (2K) |

BUS CONTROL

1)ELECTRICAL CHARACTERISTICS

| Symbol | Parameter | Measure Point | Test conditions | Limits | | | Unit |
|--------|--------------------|---------------|-----------------|--------|-----|-----|------|
| | | | | Min | Typ | Max | |
| fSCL | Clock frequency | 33 | | 0 | 100 | 400 | KHz |
| tBUF | Bus free time | 34 | | 1.3 | - | - | □sec |
| tHDSTA | Data hold time | 34 | | 0.6 | - | - | □sec |
| tLOW | SCL LOW hold time | 33 | | 1.3 | - | - | □sec |
| tHIGH | SCL HIGH hold time | 33 | | 0.6 | - | - | □sec |
| tSUSTA | Set up time | 33,34 | | 0.6 | - | - | □sec |
| tHDDAT | Data hold time | 33,34 | | 0 | - | - | □sec |
| tSUDAT | Data set up time | 33,34 | | 100 | - | - | nsec |
| tR | Rise time | 33,34 | | - | - | 300 | nsec |
| tF | Fall time | 33,34 | | - | - | 300 | nsec |
| tSUSTO | Set up time | 33 | | 0.6 | - | - | □sec |

Timing Chart 1



2)Setting Data

The input information consisting of data of 2 or 4 bytes after chip address is received into I²C bus receiver. The definition of bus protocol admitted is shown as below.

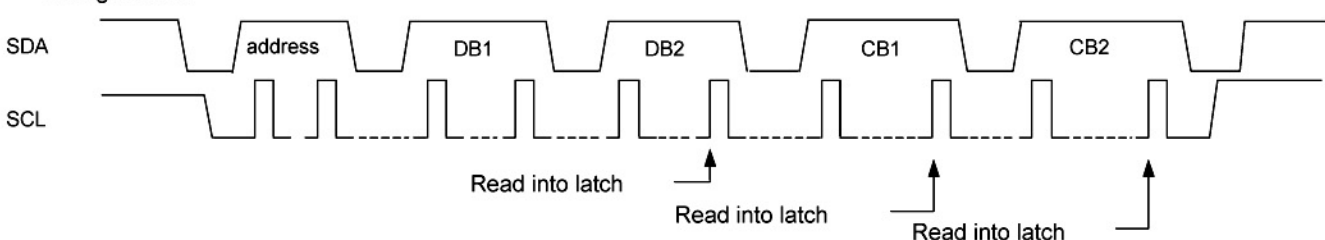
| | | | | | | | | | |
|--------|-----|----|-----|-----|-----|-----|-----|-----|-----------------------|
| Mode_1 | STA | CA | DB1 | DB2 | CB1 | CB2 | STO | STA | : Start condition |
| Mode_2 | STA | CA | CB1 | CB2 | DB1 | DB2 | STO | STO | : Stop condition |
| Mode_3 | STA | CA | DB1 | DB2 | STO | | | CA | : Chip address |
| Mode_4 | STA | CA | CB1 | CB2 | STO | | | DB1 | : Divider data byte 1 |
| | | | | | | | | DB2 | : Divider data byte 2 |
| | | | | | | | | CB1 | : Control data byte 1 |
| | | | | | | | | CB2 | : Band data byte 2 |

The information of 5 bytes required for circuit operational chip address, control data and band SW data of 2 bytes and divider data of 2 bytes. After the chip address input, 2 or 4 bytes can be received. Function bit is contained in the first and the third data byte to distinguish between divider and 'control data/band SW data', with "0" going ahead of divider data, and "1" going ahead of control data/band SW data'.

The timing of Writing data for bus protocol Mode is shown in the figure below. Divider data uses 15 bits and is read in at the rise of the eighth clock bit of the second byte divider data (D2).

Control data (CB) and band SW-data (BB) are each read in at the rise of their eighth clock bit.

Timing Chart 2



PRELIMINARY

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TUNER SINGLE CHIP

Write mode data format

| Byte | MSB | | | | | | LSB | | | |
|---------------------|-----|-----|-----|-----|------|-------|-------|-------|-------|---|
| Address Byte (CA) | 1 | 1 | 0 | 0 | 0 | 0 | MA1 | MA0 | R/W=0 | A |
| Divider Byte1 (DB1) | 0 | N14 | N13 | N12 | N11 | N10 | N9 | N8 | N8 | A |
| Divider Byte2 (DB2) | N7 | N6 | N5 | N4 | N3 | N2 | N1 | N0 | N0 | A |
| Control Byte (CB1) | 1 | CP | T2 | T1 | T0 | Rsa | Rsb | OS | OS | A |
| Band Byte (CB2) | RE | AFT | X | X | PUHF | PFMST | PVHFH | PVHFL | PVHFL | A |

MA1,MA0 : Programmable Address Bit

| Address input voltage applied to ADS [V] | MA1 | MA0 |
|--|-----|-----|
| 0 to 0.1×Vcc | 0 | 0 |
| Always Valid | 0 | 1 |
| 0.4×Vcc to 0.6×Vcc | 1 | 0 |
| 0.9×Vcc to Vcc | 1 | 1 |

N14 to N0 : How to set division ratio of the programmable divider

Division ratio N: $N=N14(2^{14})+N13(2^{13})+ \dots +N0(2^0)$
 Range of division ratio N: N=1,024 to 32,767
 Frequency of VCO f_{vco}: $f_{vco}=f_{ref} \times N$

CP : Set up the charge pump current

| CP | Charge pump current |
|----|---------------------|
| 0 | 70□A |
| 1 | 270□A |

In the case of setting current 270□A,
when PLL is locked, charge pump current is
automatically switched to CP=0 (70□A).

T2,T1,T0 : Set up for test mode

| CP | T2 | T1 | T0 | Charge pump | Test output | Test SW | Mode |
|----|----|----|----|---------------------------|-------------|---------|-------------|
| 0 | 0 | 0 | X | CP switched off | - | OFF | Normal mode |
| 1 | 0 | 0 | X | CP switched on | - | OFF | Normal mode |
| X | 0 | 1 | X | High impedance | - | OFF | Test mode |
| 0 | 1 | 1 | 0 | Sink, CP current "Low" | - | OFF | Test mode |
| 1 | 1 | 1 | 0 | Sink, CP current "High" | - | OFF | Test mode |
| 0 | 1 | 1 | 1 | Source, CP current "Low" | - | OFF | Test mode |
| 1 | 1 | 1 | 1 | Source, CP current "High" | - | OFF | Test mode |
| 0 | 1 | 0 | 0 | High impedance | fREF | OFF | Test mode |
| 1 | 1 | 0 | X | CP switched on | - | ON | Test mode |
| 0 | 1 | 0 | 1 | High impedance | f1/N | OFF | Test mode |

Note : fREF and f1/N is available on pin PFMST
: Test SW is for the mix filter damping switch

Rsa,Rsb : Set up tuning step

| Rsa | Rsb | Division ratio | tuning step frequency |
|-----|-----|----------------|-----------------------|
| 0 | 1 | 1/128 | 31.25KHz |
| 1 | 1 | 1/64 | 62.5KHz |
| X | 0 | 1/80 | 50.0KHz |

@4MHz X'tal

OS : Set up drive output

| OS | Drive output | Mode |
|----|---------------|-------------|
| 0 | ON | Normal mode |
| 1 | OFF("L")level | Test mode |

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TUNER SINGLE CHIP

RE: Select of Reference frequency for automatic adjustment of VIF VCO free-running frequency.

| RE | Reference frequency |
|----|---------------------|
| 0 | 3.58MHz |
| 1 | 4.00MHz |

AFT:Set up AFT mute

| AFT | AFT mute voltage |
|-----|------------------|
| 0 | Low |
| 1 | center |

PFMST , PUHF , PVHFL,PVHFH : PORT

| FMST,PUHF,PVHFL,PVHFH | Output |
|-----------------------|--------|
| 0 | OFF |
| 1 | ON |

PNP open collector output. When PUHF is "OFF",
Mixer and Oscillator active VHF mode.

Read mode data format

| Byte | MSB | | | | | | LSB | | |
|--------------|-----|----|------|---|---|-----|-----|-------|---|
| Address Byte | 1 | 1 | 0 | 0 | 0 | MA1 | MA0 | R/W=1 | A |
| Status Byte | POR | FL | ACPS | X | X | X | X | X | A |

X: 0 or 1 Don't care

POR: Power on reset flag. Output is "1" at power-on

FL: Lock detector flag. Output is "1" at locked, output is "0" at unlocked.

ACPS: Automatic charge pump current flag. Output is "0" at charge pump
current automatically switched mode , output is "1" at other mode.

Power on reset

The initial status are shown as below when supply voltage is turned on.
If supply voltage becomes less than about 3.0V, the initial status is set.

| Byte | MSB | | | | | | LSB | | |
|---------------------|-----|---|---|---|---|---|-----|---|---|
| Divider Byte1 (DB1) | 0 | X | X | X | X | X | X | X | X |
| Divider Byte2 (DB2) | X | X | X | X | X | X | X | X | X |
| Control Byte (CB1) | 1 | 1 | 0 | 1 | X | 1 | 1 | 1 | 1 |
| Band Byte (CB2) | 0 | 0 | X | X | 0 | 0 | 0 | 0 | 0 |

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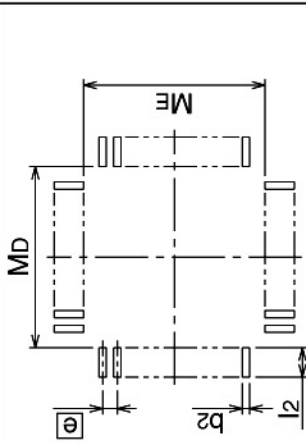
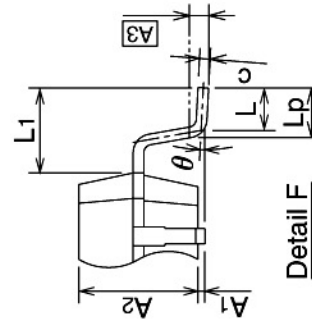
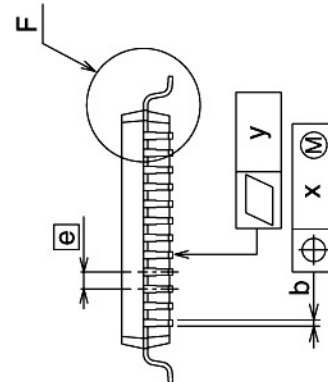
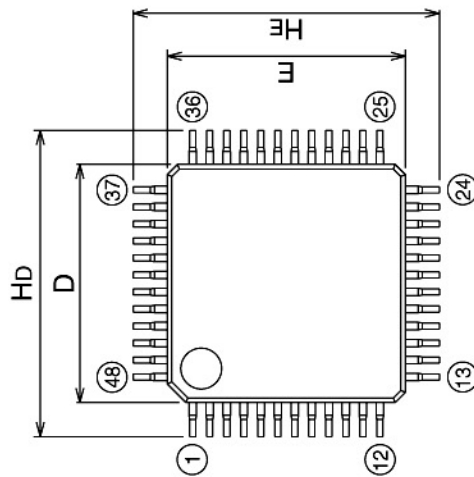
PRELIMINARY

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DETAILED DIAGRAM OF PACKAGE OUTLINE

48P6Q-A (MMP) Plastic 48pin 7 7mm body LQFP

| | | | |
|---------------------------------------|-----------------|----------------|---------------------------|
| EIAJ Package Code LQFP48-P-77-0.50 | JEDEC Code - | Weight(g) - | Lead Material Cu Alloy |
|---------------------------------------|-----------------|----------------|---------------------------|



Recommended Mount Pad

| Symbol | Dimension in Millimeters | | |
|--------|--------------------------|-------|-------|
| | Min | Norm | Max |
| A | - | - | 1.7 |
| A1 | 0 | 0.1 | 0.2 |
| A2 | - | 1.4 | - |
| b | 0.17 | 0.22 | 0.27 |
| c | 0.105 | 0.125 | 0.175 |
| D | 6.9 | 7.0 | 7.1 |
| E | 6.9 | 7.0 | 7.1 |
| e | - | 0.5 | - |
| HD | 8.8 | 9.0 | 9.2 |
| HE | 8.8 | 9.0 | 9.2 |
| L | 0.35 | 0.5 | 0.65 |
| L1 | - | 1.0 | - |
| Lp | 0.45 | 0.6 | 0.75 |
| A3 | - | 0.25 | - |
| x | - | - | 0.08 |
| y | - | - | 0.1 |
| theta | 0° | - | 8° |
| b2 | - | 0.225 | - |
| l2 | 1.0 | - | - |
| MD | - | 7.4 | - |
| ME | - | 7.4 | - |

PRELIMINARY

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