

AN22011A

3-beam MD system pre-amplifier

■ Overview

The AN22011A incorporates such functions as RF signal processing, servo signal processing, ADIP signal processing and laser control. This is an RF IC that can constitute the MD system using 3-beam pick-up in combination with the digital signal processing LSI MN66621.

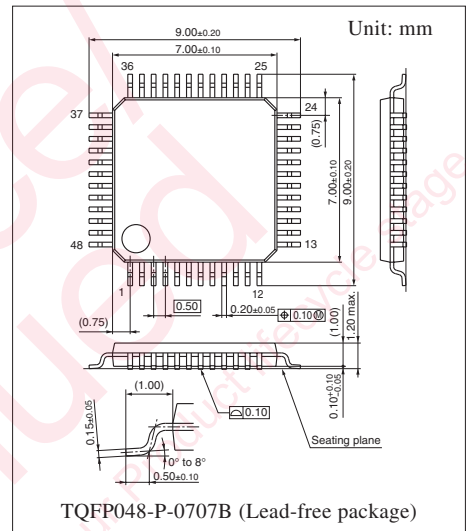
The IC allows us to achieve a considerable low power dissipation as well as its low supply voltage operation ($V_{CC} = 2.1 \text{ V}$ to 3.6 V) due to our introduction of digital matrix ($P_D = 11 \text{ mW}$ at $V_{CC} = 2.1 \text{ V}$). The IC can be used in a wide range of applications from a stand-alone system to a portable system.

■ Features

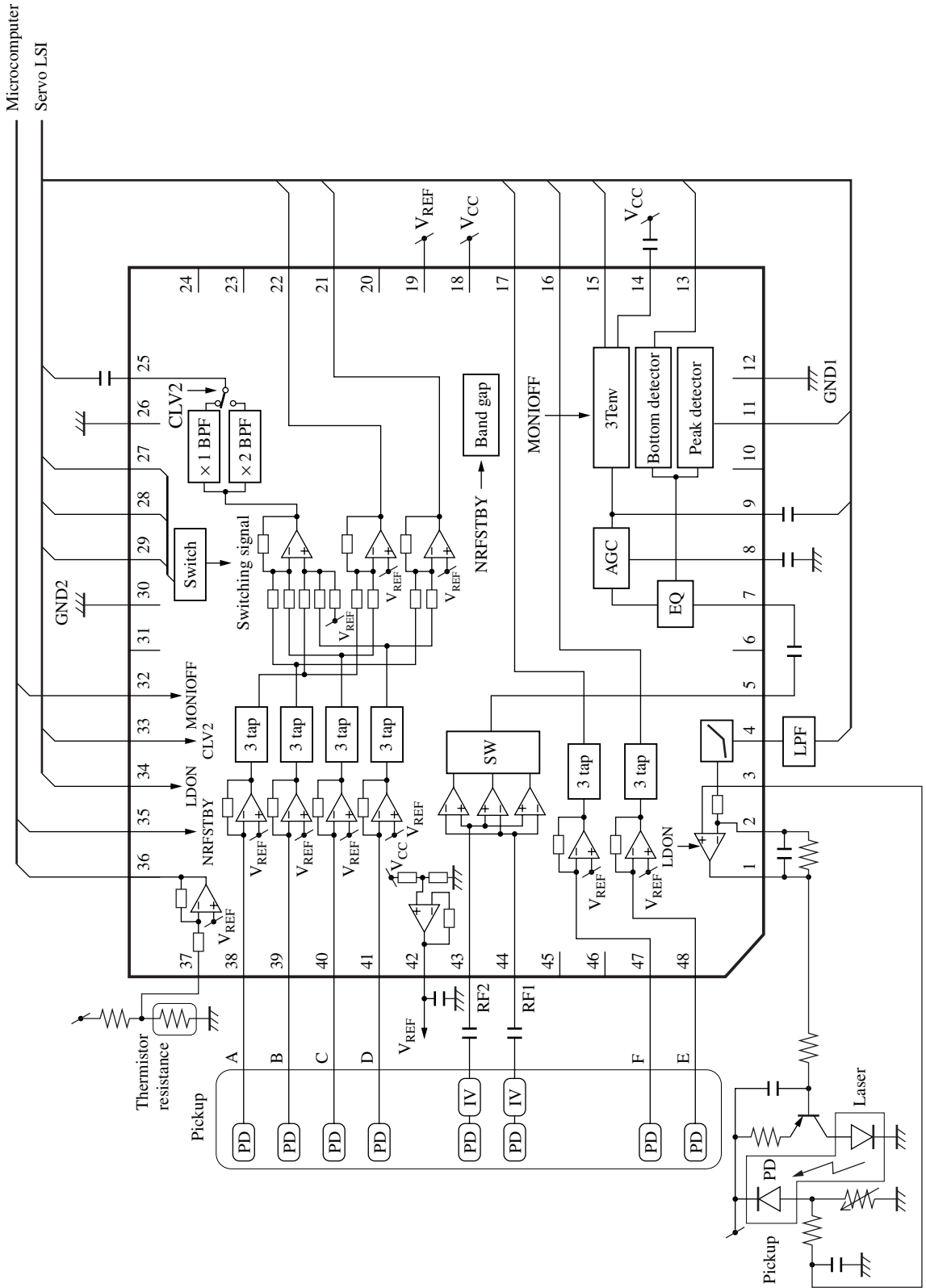
- 3-beam system pick-up
- RF signal processing
- Servo signal processing
- Laser power control function
- Low supply voltage operation (2.1 V to 3.6 V)
- Ultra low power consumption (min. 11 mW)
- Thin package adopted (Mold thickness: 1 mm)

■ Applications

- MD player/recorder
 - Home audio systems/mini systems
 - Portable audio
 - Car audio



■ Block Diagram



■ Pin Descriptions

| Pin No. | Symbol | Description | Pin No. | Symbol | Description |
|---------|-----------------|---|---------|------------------|---|
| 1 | LDO | LD amplifier output pin | 26 | OFSON | Te stray light canceling operation setting pin |
| 2 | LDIN | LD amplifier reverse input pin | | | |
| 3 | APCPD | Photo diode light quantity detector pin | 27 | NREC | Rec/playback switching signal input pin |
| 4 | APCREF | APC amplifier reference voltage input pin | 28 | RFSWHL | Reflection ratio H/L switching signal input pin |
| 5 | ARFO | RF amplifier output pin | | | |
| 6 | N.C. | — | 29 | RFSWPG | Pit/Grv switching signal input pin |
| 7 | EQIN | EQ input pin | 30 | GND2 | GND pin 2 |
| 8 | CRFAGC | RFAGC capacitor pin | 31 | N.C. | — |
| 9 | OUTRF | EFM output pin | 32 | MONIOFF | 3TMON circuit control signal input pin |
| 10 | N.C. | — | 33 | CLV2 | ADIP BPF switching signal input pin |
| 11 | PEAK | EFM bright level detection output pin | 34 | LDON | APC circuit control signal input pin |
| 12 | GND1 | GND pin 1 | 35 | NRFSTBY | Standby control signal input pin |
| 13 | BOTM | EFM dark level detection output pin | 36 | TEMP | Temperature sensor amplifier output pin |
| 14 | CEA | 3T envelope detection capacitor pin | 37 | TEMPIN | Temperature sensor amplifier input pin |
| 15 | MON3T | 3T envelope output pin | 38 | A | A signal input pin |
| 16 | EE | E signal I-V converting output pin | 39 | B | B signal input pin |
| 17 | FF | F signal I-V converting output pin | 40 | C | C signal input pin |
| 18 | V _{CC} | V _{CC} pin | 41 | D | D signal input pin |
| 19 | OFSIN | Te stray light canceling pin | 42 | V _{REF} | Reference signal output pin |
| 20 | N.C. | — | 43 | RF2 | RF2 signal input pin |
| 21 | FF2 | (A+C) signal I-V converting output pin | 44 | RF1 | RF1 signal input pin |
| 22 | FF1 | (B+D) signal I-V converting output pin | 45 | N.C. | — |
| 23 | N.C. | — | 46 | N.C. | — |
| 24 | N.C. | — | 47 | F | F signal input pin |
| 25 | ADIP | ADIP signal output pin | 48 | E | E signal input pin |

■ Absolute Maximum Ratings

| Parameter | Symbol | Rating | Unit |
|----------------------------------|------------------|-------------|------|
| Supply voltage | V _{CC} | 4.0 | V |
| Supply current | I _{CC} | 7.5 | mA |
| Setting pin upper limit *2 | V _{INH} | 3.6 | V |
| Power dissipation *1 | P _D | 30 | mW |
| Operating ambient temperature *1 | T _{opr} | −30 to +85 | °C |
| Storage temperature *1 | T _{stg} | −55 to +125 | °C |

Note) *1: Except for power dissipation, operating ambient temperature and storage temperature, all ratings are for T_a = 25°C.

*2: Setting pin refers to OFSON (pin 26), NREC (pin 27), RFSWHL (pin 28), RFSWPG (pin 29), MONIOFF (pin 32), CLV2 (pin 33), LDON (pin 34), NRFSTBY (pin 35).

■ Recommended Operating Range

| Parameter | Symbol | Range | Unit |
|----------------|----------|------------|------|
| Supply voltage | V_{CC} | 2.1 to 3.6 | V |

■ Electrical Characteristics at $T_a = 25^\circ\text{C}$

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|-------------------|--|------|------|------|------------------|
| No load consumption current 1 | I_{TOTAL1} | Normal mode | 4.5 | 5.5 | 6.5 | mA |
| No load consumption current 2 | I_{TOTAL2} | Sleep mode | 200 | 300 | 400 | μA |
| V_{REF} offset | ΔV_{OVb} | Normal mode | -50 | 0 | 50 | mV |
| V_{REF} output impedance | Z_{VB} | $I_{42} = \pm 1.5 \text{ mA}$ | — | — | 5 | Ω |
| LD amplifier OFF operation | V_{LDOFF} | APC OFF mode | — | — | 0.2 | V |
| LD amplifier gain playback mode | G_{LDP} | APC ON mode | -23 | -20 | -17 | dB |
| LD amplifier gain recording mode | G_{LDR} | APC ON mode | -5.5 | -2.5 | 0.5 | dB |
| Temperature amplifier gain | G_{TM} | $V_{37} = V_{REF} \pm 0.75 \text{ V}$ | -2 | 0 | 2 | dB |
| FF1 offset | ΔV_{F1} | Pit high reflection ratio mode | -100 | 0 | 100 | mV |
| FF2 offset | ΔV_{F2} | Pit high reflection ratio mode | -100 | 0 | 100 | mV |
| FF1 gain pit high reflection ratio mode | Z_{FIRO} | Pit high reflection ratio mode | 46.2 | 57.7 | 69.2 | $\text{k}\Omega$ |
| FF1 gain pit low reflection ratio mode | Z_{FIRA} | Pit low reflection ratio mode | 197 | 250 | 303 | $\text{k}\Omega$ |
| FF1 gain record mode | Z_{FIRE} | Record mode | 17.5 | 21.9 | 26.3 | $\text{k}\Omega$ |
| FF2 relative gain pit high reflection ratio mode | ΔZ_{F2RO} | Pit high reflection ratio mode | -2 | 0 | 2 | dB |
| FF2 relative gain pit low reflection ratio mode | ΔZ_{F2RA} | Pit low reflection ratio mode | -2 | 0 | 2 | dB |
| FF2 relative gain record mode | ΔZ_{F2RE} | Record mode | -2 | 0 | 2 | dB |
| FF1 frequency characteristic | ΔG_{F1} | Pit high reflection ratio mode V_{38} : 3 kHz, 30 kHz Sine wave | -9 | -6 | -3 | dB |
| FF2 frequency characteristic | ΔG_{F2} | Pit high reflection ratio mode V_{39} : 3 kHz, 30 kHz Sine wave | -9 | -6 | -3 | dB |
| EE offset | ΔV_{EE} | Pit high reflection ratio mode | -750 | -600 | -450 | mV |
| FF offset | ΔV_{FF} | Pit high reflection ratio mode | -750 | -600 | -450 | mV |
| EE gain pit high reflection ratio mode | Z_{EERO} | Pit high reflection ratio mode | 148 | 185 | 222 | $\text{k}\Omega$ |
| EE gain pit low reflection ratio mode | Z_{EERA} | Pit low reflection ratio mode | 776 | 970 | 1164 | $\text{k}\Omega$ |
| EE gain record mode | Z_{EERE} | Record mode | 88 | 110 | 132 | $\text{k}\Omega$ |
| FF relative gain pit high reflection ratio mode | ΔZ_{FFRO} | Pit high reflection ratio mode | -2 | 0 | 2 | dB |
| FF relative gain pit low reflection ratio mode | ΔZ_{FFRA} | Pit low reflection ratio mode | -2 | 0 | 2 | dB |

■ Electrical Characteristics at $T_a = 25^\circ\text{C}$ (continued)

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|--------------------------|--|-------|------|------|---------------|
| FF relative gain record mode | ΔZ_{FFRE} | Record mode | -2 | 0 | 2 | dB |
| EE frequency characteristics | ΔG_{EE} | Pit high reflection ratio mode V_{48} : 1.5 kHz, 15 kHz Sine wave | -6 | -3 | -0.5 | dB |
| FF frequency characteristics | ΔG_{FF} | Pit high reflection ratio mode V_{47} : 1.5 kHz, 15 kHz Sine wave | -6 | -3 | -0.5 | dB |
| Te stray light canceling operation | ΔTOFS | Ram mode Stray light canceling mode | 0.4 | 0.5 | 0.6 | — |
| ADIP gain | G_{AD1} | Record mode Line double speed mode | 24.0 | 27.0 | 30.0 | dB |
| ADIP center frequency | F_{AD1} | Record mode Line double speed mode | 35.2 | 44.0 | 52.8 | kHz |
| ADIP band width | ΔF_{AD1} | Record mode Line double speed mode | 23.7 | 29.6 | 35.5 | kHz |
| ADIP relative gain typical speed mode | ΔG_{AD2} | Record mode Typical speed mode | -3 | 0 | 3 | dB |
| RF amplifier gain groove mode | G_{RFG} | V_{43} : 100 kHz Sine wave Groove mode | 19 | 22 | 25 | dB |
| RF amplifier gain pit low reflection ratio mode | G_{RFPL} | V_{43} : 100 kHz Sine wave Pit low reflection ratio mode | 3 | 6 | 9 | dB |
| RF amplifier gain pit high reflection ratio mode | G_{RFPH} | V_{43} : 100 kHz Sine wave Pit high reflection ratio mode | -11.5 | -8.5 | -5.5 | dB |
| RF amplifier frequency characteristics groove mode | ΔG_{RFG} | V_{43} : 5 MHz Sine wave Groove mode | -3 | — | — | dB |
| RF amplifier frequency characteristics pit low reflection ratio mode | ΔG_{RFPL} | V_{43} : 5 MHz Sine wave Pit low reflection ratio mode | -3 | — | — | dB |
| RF amplifier frequency characteristics pit high reflection ratio mode | ΔG_{RFPH} | V_{43} : 5 MHz Sine wave Pit high reflection ratio mode | -3 | — | — | dB |
| EQ boost gain | ΔG_{EQ} | V_7 : 400 kHz, 1.44 MHz Sine wave $V_8 = V_{\text{REF}}$ | 2.5 | 3.5 | 4.5 | dB |
| AGC operation | V_{OMRFV} | V_7 : 500 kHz Sine wave | 0.4 | 0.5 | 0.6 | V[p-p] |
| AGC discharge current | I_{AGC1} | V_7 : sin 500 mV[p-p], 720 kHz $V_8 = V_{\text{REF}}$ | -140 | -110 | -80 | μA |
| AGC charging current | I_{AGC2} | $V_7 = V_{\text{REF}}, V_8 = V_{\text{REF}}$ | 0.1 | 0.4 | 0.7 | μA |
| EFM Peak peak detecting offset | ΔV_{PE} | $V_7 = V_{\text{REF}}$ | -200 | 0 | 200 | mV |
| EFM Peak peak detecting level | V_{PEAK} | V_7 : 720 kHz AM modulation Sine wave (1 kHz, 30%) | 80 | 110 | 140 | mV[p-p] |
| EFM bottom detecting offset | ΔV_{BO} | $V_7 = V_{\text{REF}}$ | -200 | 0 | 200 | mV |
| EFM bottom detecting relative level | ΔV_{BOTM} | V_7 : 720 kHz AM modulation Sine wave (1 kHz, 30%) | -20 | 0 | 20 | mV[p-p] |
| 3T element envelope extracting level | $V_{3\text{TMON}}$ | V_7 : 720 kHz AM modulation Sine wave (5 kHz, 5%) | 125 | 185 | 245 | mV[p-p] |

■ Usage Notes

1. Operation mode setting

• Gain switch setting

| NREC (Pin27) | RFSWHL (Pin28) | RFSWPG (Pin29) | Operation mode |
|--------------|----------------|----------------|--------------------------------|
| H | H | H | Pit high reflection ratio mode |
| H | L | H | Pit low reflection ratio mode |
| H | L | L | Groove mode |
| L | L | L | Record mode |

• 3T detection circuit mode switch setting

| MONIOFF (Pin32) | Operation mode |
|-----------------|--------------------------|
| H | 3T detection circuit off |
| L | 3T detection circuit on |

• ADIP BPF mode switch setting

| CLV2 (Pin33) | Operation mode | BPF center frequency |
|--------------|------------------------|----------------------|
| H | Typical speed mode | $f_0 = 22.0$ kHz |
| L | Line double speed mode | $f_0 = 44.0$ kHz |

Note) The values shown on the list are for design purpose.

• APC mode setting

| LDON (Pin34) | Operation mode |
|--------------|-----------------|
| H | APC circuit on |
| L | APC circuit off |

• Power saving mode setting

| NRFSTBY (Pin35) | Operation mode |
|-----------------|------------------------|
| H | Normal operation |
| L | Power saving operation |

• Te stray light cancellation setting

| OFSON (Pin26) | Operation mode |
|---------------|--------------------------|
| H | Cancellation circuit on |
| L | Cancellation circuit off |

Note) This function is valid only for reading on the writable disk.

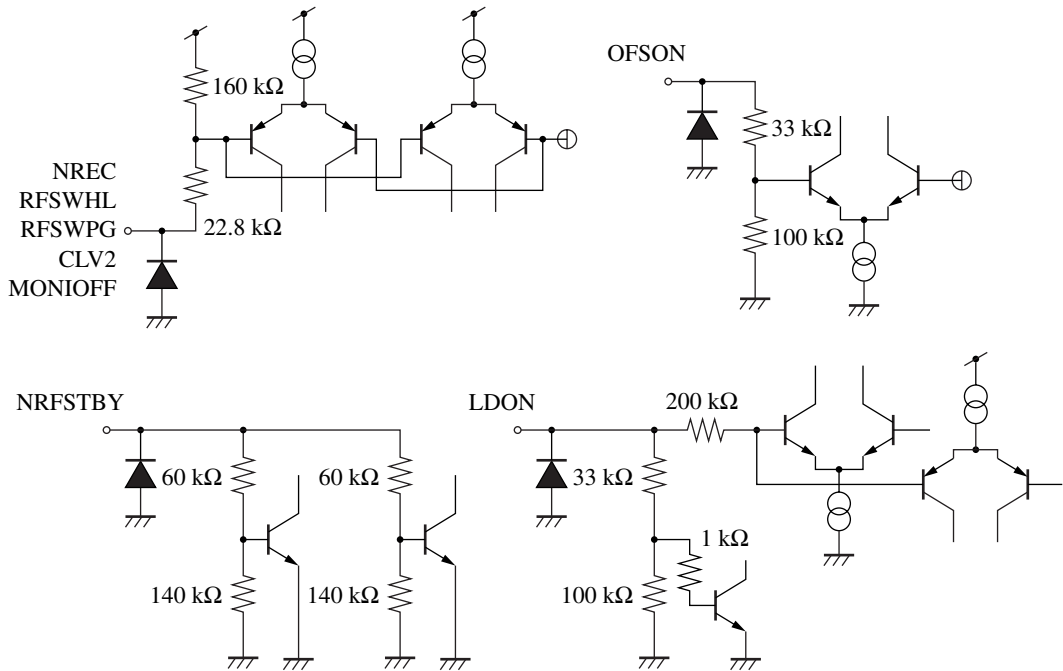
■ Usage Notes (continued)

2. Setting pin input voltage

Set the input voltages for OFSON (Pin26), NREC (Pin27), RFSWHL (Pin28), RFSWPG (Pin29), MONIOFF (Pin32), CLV2 (Pin33), LDON (Pin34) and NRFSTBY (Pin35). As listed below.

| Setting | Input voltage |
|---------|----------------|
| H | 1.4 V to 3.6 V |
| L | 0.7 V or less |

The related equivalent circuits are as follows.



Note) The resistance values are for designing.

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