Quad Operational Amplifier and Programmable Voltage Reference

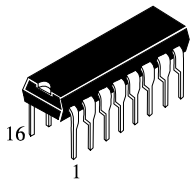
FTSM104A

OPERATIONAL AMPLIFIERS

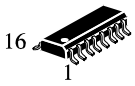
- LOW SUPPLY CURRENT : 375 μa/op. (@ Vcc = 5V)
- LOW INPUT BIAS CURRENT : 20nA
- MEDIUM SPEED : 0.9MHz
- LOW INPUT OFFSET VOLTAGE : 0.5mV typ
- WIDE POWER SUPPLY RANGE : ±1.5V to ±15V

VOLTAGE REFERENCE

- ADJUSTABLE OUTPUT VOLTAGE : Vref to 36V
- 0.4% AND 1% VOLTAGE PRECISION
- SINK CURRENT CAPABILITY : 1 to 100mA
- TYPICAL OUTPUT IMPEDANCE : 0.2Ω



DIP-16
(Plastic Package)



SO-16
(Plastic Micropac)

ORDERING NUMBER:

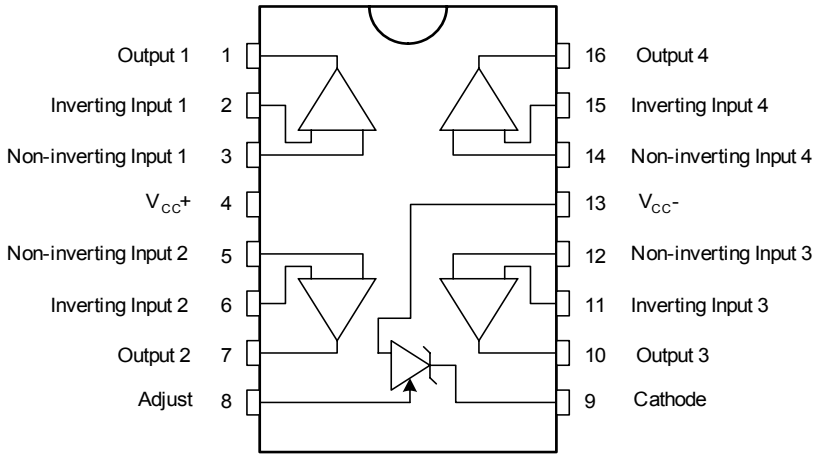
FTSM104AN	Plastic Package
FTSM104AD	Plastic Micropac

DESCRIPTION

The FTSM104A is a monolithic IC that includes four op-amps and an adjustable shunt voltage reference. This device is offering space and cost saving in many applications like power supply management or data acquisition systems.

Part number	Temperature Range		
		N	D
FTSM104A	-40 ºC, +105ºC	•	•

PIN CONNECTIONS



Absolute Maximum Ratings

Symbol	Parameter	Value	Unit
Vcc	Supply Voltage	36	V
V_{id}	Differential Input Voltage	36	V
V_i	Input Voltage	-0.3 to +36	V
Tj	Maximum Junction Temperature	150	ºC

Electrical Characteristics

Vcc^+ = 5V, Vcc^- = 0V, Tamb = 25°C (unless otherwise specified)

Symbol	Parameter	Min	Typ	Max	Unit
Icc	Total Supply Current, excluding Current in the Voltage Reference Vcc^+ = 5 V, no load Tmin < Tamb < Tmax Vcc^+ = 30 V, no load Tmin < Tamb < Tmax		 1.4 	 2.4 4	mA

OPERATIONAL AMPLIFIERS

Vcc^+ = 5 V, Vcc^- = Ground, V_o = 1.4 V, Tamb = 25 ºC (unless otherwise specified)

Symbol	Parameter	Min	Typ	Max	Unit
V_{io}	Input Offset Voltage T_{amb} = 25 ºC $T_{min} \le T_{amb} \le T_{max}$		0.5	3 4	mV
DV_{io}	Input Offset Voltage Drift			7	µV/ ºC
I_{io}	Input Offset Current $T_{min.} \le T_{amb} \le T_{max}$		2	30 50	nA
I_{ib}	Input Bias Current $T_{min.} \le T_{amb} \le T_{max}$		20	150 200	nA
Avd	Large Signal Voltage Gain Vcc = 15V, R_L = 2k, V_o = 1.4V to 11.4V $T_{min.} \le T_{amb} \le T_{max}$	50 25	100		V/mV
SVR	Supply Voltage Rejection Ratio Vcc = 5V to 30V	65	100		dB
Vicm	Input Common Mode Voltage Range Vcc = +30V – see note [1)] $T_{min.} \le T_{amb} \le T_{max}$	0 0		(Vcc^+) -1.5 (Vcc^+) -2	V
CMR	Common Mode Rejection Ratio $T_{min.} \le T_{amb} \le T_{max}$	70 60	85		dB
I_{source}	Output Current Source Vcc = +15V, Vo = 2V, V_{id} = +1V	20	40		mA
I_o	Short Circuit to Ground Vcc = +15V		40	60	mA
I_{sink}	Output Current Sink V_{id} = -1V, Vcc = +15V, Vo = +2V	10	20		mA
V_{OH}	High Level Output Voltage Vcc^+ = 30V, R_L = 10k Tamb = 25ºC, $T_{min.} \le T_{amb} \le T_{max}$	27 27	28		V
V_{OL}	Low Level Output Voltage R_L = 10k $T_{min.} \le T_{amb} \le T_{max}$		5	20 20	mV
SR	Slew Rate at Unity Gain V_i = 0.5 to 3V, Vcc = 15V R_L = 2k, C_L = 100pF, unity gain	0.1	0.3		V/ µs
GBP	Gain Bandwidth Product Vcc = 30V, R_L = 2k, C_L = 100pF f = 100kHz, V_{in} = 10mV	0.5	0.9		MHz
THD	Total Harmonic Distortion f = 1kHz A_V = 20dB, R_L = 2k, Vcc = 30V C_L = 100pF, Vo = $2V_{pp}$		0.02		%
en	Equivalent Input Noise Voltage f = 1kHz, Vcc = 30V, Rs = 100Ω		50		$\frac{nV}{\sqrt{Hz}}$
cs	Channel Separation 1kHz < f < 20kHz		120		dB

Note1: The input common-mode voltage of either input signal voltage should not be allowed to go negative by more than 0.3V. The upper end of the common-mode voltage range is Vcc^+ -1.5V.
But either of both inputs can go to +36V without damage.

VOLTAGE REFERENCE

Symbol	Parameter	Value	Unit
I_k	Cathode Current	1 to 100	mA

Symbol	Parameter	Min	Typ	Max	Unit
V_{ref}	Reference Input Voltage T_{amb} = 25 ºC $T_{min} \le T_{amb} \le T_{max}$	 2.49 2.48	 2.5	 2.51 2.52	V
ΔV_{ref}	Reference Input Voltage Deviation Over Temperature Range $V_{KA} = V_{ref}$, I_k = 10mA $T_{min} \le T_{amb} \le T_{max}$		 7	 30	mV
$\frac{\Delta Vref}{\Delta V_{KA}}$	Ratio of Change in Reference Input Voltage to Change in Cathode to Anode Voltage I_K = 10mA, ΔV_{KA} = 36V to 3V	 -2	 -1.1		mV/V
I_{ref}	Reference Input Current I_K = 10mA $T_{min} \le T_{amb} \le T_{max}$		 1.5	 2.5 3	µA
ΔI_{ref}	Reference Input Current Deviation over T° Range		0.8	1.2	µA
I_{min}	Minimum Cathode Current for Regulation $V_{KA} = V_{ref}$		 0.5	 1	mA
I_{off}	Off-State Cathode Current		180	500	nA
$\lvert Z_{KA} \rvert$	Dynamic Impedance – (note 1) $V_{KA} = V_{ref}$, ΔI_K = 1 to 100mA, f < 1kHz		0.2	0.5	Ω

Note 1: The Dynamic impedance is defined as $\lvert Z_{KA} \rvert = \Delta V_{KA} / \Delta I_K$

Typical Performance Characteristics

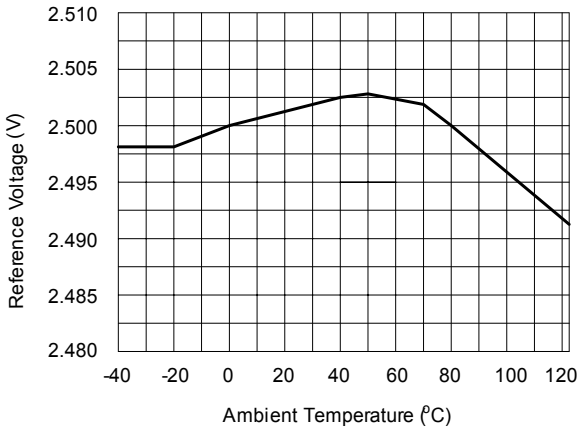


Figure 1. Reference Voltage vs. Ambient Temperature

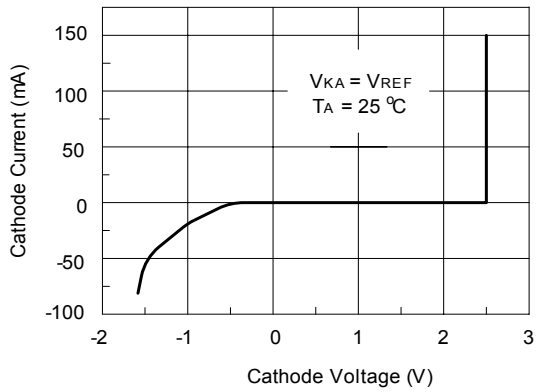


Figure 2. Cathode Current vs. Cathode Voltage

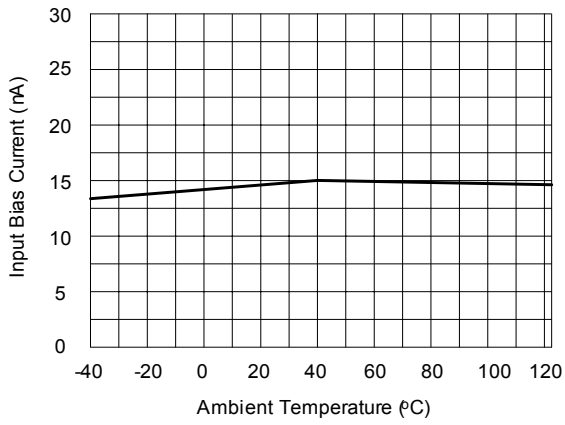


Figure 3. Input Bias Current vs. Ambient Temperature

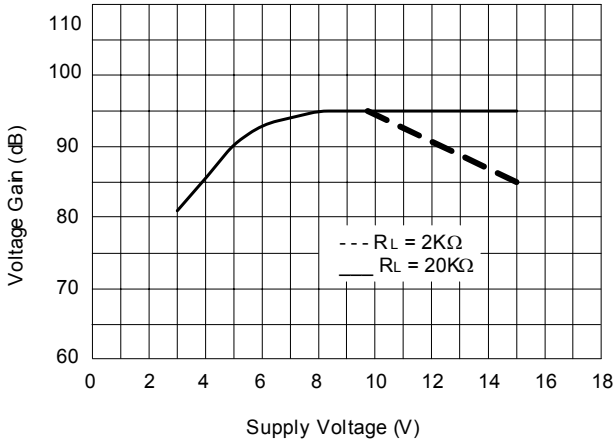
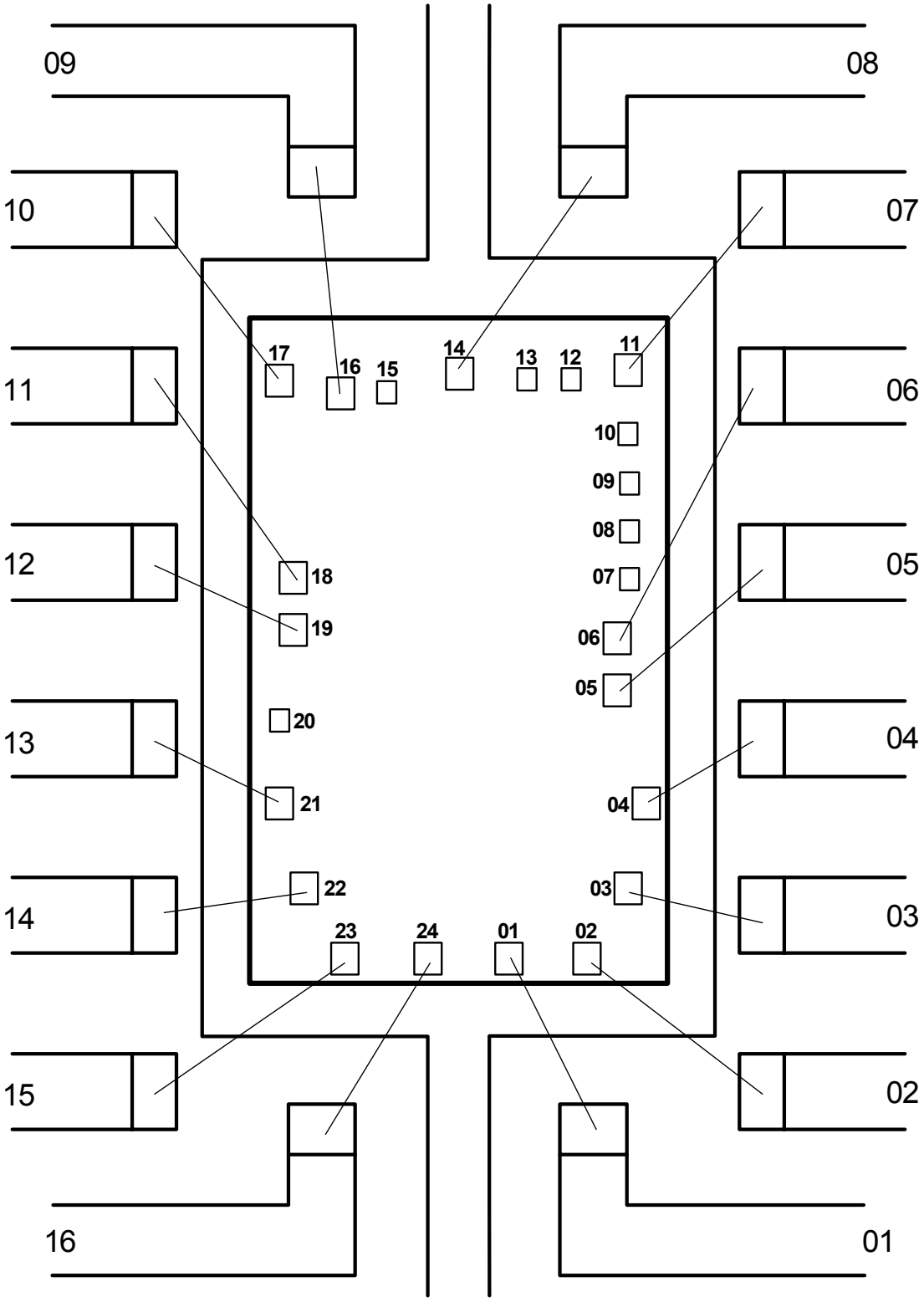
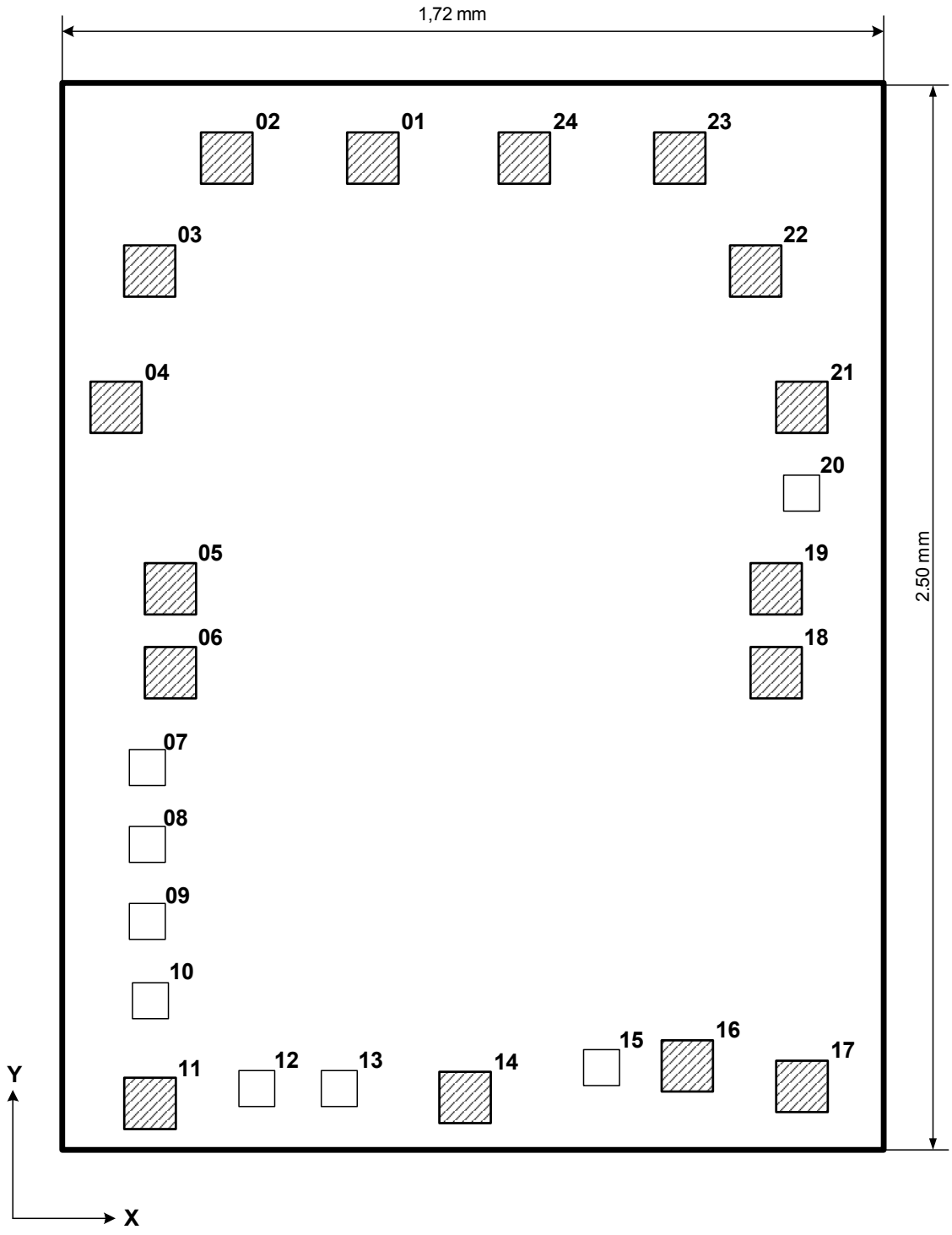


Figure 4. Operational Amplifier Voltage Gain



Bonding diagram of FTSM104A



Pad size 01 - 06, 11, 14, 16 - 19, 21 - 24 - have been bounded
Pad size 07 - 10, 12, 13, 15, 20 - have not been bounded

Pads location of FTSM104A

Die size Xr=1.72mm, Yr=2.50mm (pad size measured by layer “passivation”)
Coordinates of pads

No of pad (by layer “passivation”)	Coordinates left bottom, mkm		pad size, mkm
	X	Y	
01	691	2307	100×100
02	353	2307	100×100
03	139	2137	100×100
04	93	1664	100×100
05	139	1200	100×100
06	139	1040	100×100
07	121	855	70×70
08	121	667	70×70
09	121	479	70×70
10	121	291	70×70
11	99	131	100×100
12	256	145	70×70
13	378	145	70×70
14	732	132	100×100
15	1189	183	70×70
16	1305	172	100×100
17	1525	143	100×100
18	1377	1040	100×100
19	1377	1200	100×100
20	1550	1453	70×70
21	1520	1664	100×100
22	1479	2137	100×100
23	1265	2307	100×100
24	927	2307	100×100

No of pad	Pin	Function
01	01	Output 1
02	02	Inverting input 1
03	03	Non-inverting input 1
04	04	Vcc^+
05	05	Non-inverting input 2
06	06	Inverting input 2
11	07	Output 2
14	08	Adjust
16	09	Cathode
17	10	Output 3
18	11	Inverting input 3
19	12	Non-inverting input 3
21	13	Vcc^-
22	14	Non-inverting input 4
23	15	Inverting input 4
24	16	Output 4