FORCE TECHNOLOGIES LTD

FT1013/FT1014

Quad Precision Op Amp (FT1014)
Dual Precision Op Amp (FT1013

Features

- Single Supply Operation
  - Input Voltage Range Extends to Ground
  - Output Swings to Ground while Sinking Current
- Pin Compatible to 1458 and 324 with Precision Specs
- *Guaranteed* Offset Voltage: 150μV Max
- *Guaranteed* Low Drift: 2μV/°C Max
- *Guaranteed* Offset Current: 0.8nA Max
- *Guaranteed* High Gain
  - 5mA Load Current: 1.5 Million Min
  - 17mA Load Current: 0.8 Million Min
- *Guaranteed* Low Supply Current: 500μA Max
- Low Voltage Noise, 0.1Hz to 10Hz: 0.55μVp-p
- Low Current Noise—Better than 0P-07, 0.07pA/$\sqrt{Hz}$

Applications

- Battery-Powered Precision Instrumentation
  - Strain Gauge Signal Conditioners
  - Thermocouple Amplifiers
  - Instrumentation Amplifiers
- 4mA–20mA Current Loop Transmitters
- Multiple Limit Threshold Detection
- Active Filters
- Multiple Gain Blocks

Description

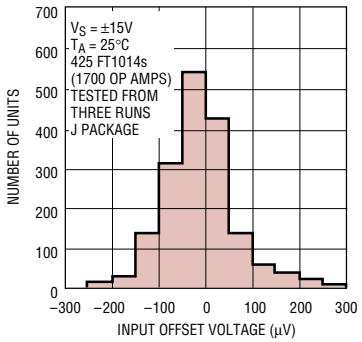
The FT1014 is the first precision quad operational amplifier which directly upgrades designs in the industry standard 14-pin DIP FT324/FT348/OP-11/4156 pin configuration. It is no longer necessary to compromise specifications, while saving board space and cost, as compared to single operational amplifiers.

The FT1014's low offset voltage of 50μV, drift of 0.3μV/°C, offset current of 0.15nA, gain of 8 million, common mode rejection of 117dB and power supply rejection of 120dB qualify it as four truly precision operational amplifiers. Particularly important is the low offset voltage, since no offset null terminals are provided in the quad configuration. Although supply current is only 350μA per amplifier, a new output stage design sources and sinks in excess of 20mA of load current, while retaining high voltage gain.

Similarly, the FT1013 is the first precision dual op amp in the 8-pin industry standard configuration, upgrading the performance of such popular devices as the MC1458/1558, FT158 and OP-221. The FT1013's specifications are similar to (even somewhat better than) the FT1014's.

Both the FT1013 and FT1014 can be operated off a single 5V power supply: input common mode range includes ground; the output can also swing to within a few millivolts of ground. Crossover distortion, so apparent on previous single-supply designs, is eliminated. A full set of specifications is provided with ±15V and single 5V supplies.

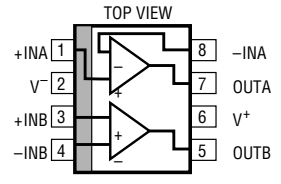
FT1014 Distribution of Offset Voltage



Absolute Maximum Ratings (Note 1)

Supply Voltage ..... ±22V
Differential Input Voltage ..... ±30V
Input Voltage ..... Equal to Positive Supply Voltage
..... 5V Below Negative Supply Voltage
Output Short-Circuit Duration ..... Indefinite
Storage Temperature Range
All Grades ..... −65°C to 150°C
Lead Temperature (Soldering, 10 sec.) ..... 300°C
Operating Temperature Range
FT1013AM/FT1013M/
FT1014AM/FT1014M ..... −55 °C to 125°C
FT1013AC/FT1013C/FT1013D
FT1014AC/FT1014C/FT1014D ..... 0°C to 70°C
FT1013I/ FT1014I ..... −40°C to 85°C

Package/Order Information

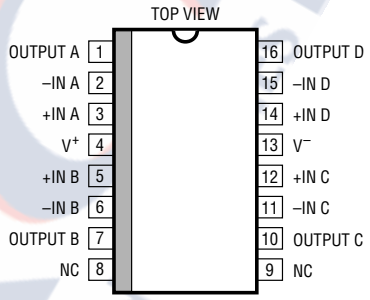


S8 PACKAGE
8-LEAD PLASTIC SO

NOTE: THIS PIN CONFIGURATION DIFFERS FROM THE STANDARD 8-PIN DUAL-IN-LINE CONFIGURATION

T_{JMAX} = 150°C, θ_{JA} = 190°C/W

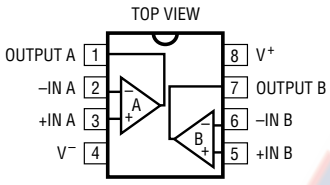
ORDER PART NUMBER
FT1013DS8 FT1013IS8
PART MARKING
1013 1013I



SW PACKAGE
16-LEAD PLASTIC SO

T_{JMAX} = 150°C, θ_{JA} = 130°C/W

ORDER PART NUMBER
FT1014DSW FT1014ISW
PART MARKING
FT1014DSW FT1014ISW



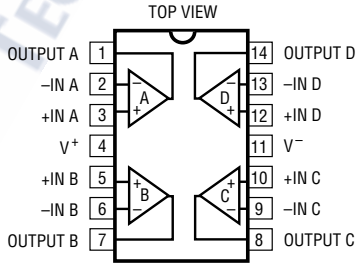
N8 PACKAGE
8-LEAD PDIP

T_{JMAX} = 150°C, θ_{JA} = 130°C/W

J8 PACKAGE
8-LEAD CERDIP

T_{JMAX} = 150°C, θ_{JA} = 100°C/W

ORDER PART NUMBER
FT1013ACN8 FT1013CN8 FT1013DN8 FT1013IN8 FT1013AMJ8 FT1013MJ8 FT1013ACJ8 FT1013CJ8



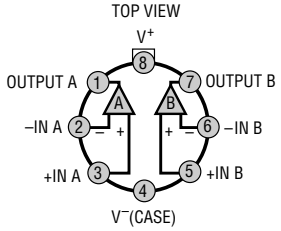
N PACKAGE
14-LEAD PDIP

T_{JMAX} = 150°C, θ_{JA} = 100°C/W

J PACKAGE
14-LEAD CERDIP

T_{JMAX} = 150°C, θ_{JA} = 100°C/W

ORDER PART NUMBER
FT1014ACN FT1014CN FT1014DN FT1014IN FT1014AMJ FT1014MJ FT1014ACJ FT1014CJ



V−(CASE)
H PACKAGE
8-LEAD TO-5 METAL CAN

T_{JMAX} = 150°C, θ_{JA} = 150°C/W, θ_{JC} = 45°C/W

ORDER PART NUMBER
FT1013AMH FT1013MH FT1013ACH FT1013CH

Electrical Characteristics

$T_A = 25°C$. $V_S = \pm 15V$, $V_{CM} = 0V$ unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS	FT1013AM/AC FT1014AM/AC MIN	TYP	MAX	FT1013C/D/I/M FT1014C/D/I/M MIN	TYP	MAX	UNITS
V_{OS}	Input Offset Voltage	FT1013	—	40	150	—	60	300	µV
		FT1014	—	50	180	—	60	300	µV
		FT1013D/I, FT1014D/I	—	—	—	—	200	800	µV
	Long Term Input Offset Voltage Stability		—	0.4	—	—	0.5	—	µV/Mo.
I_{SO}	Input Offset Current		—	0.15	0.8	—	0.2	1.5	nA
I_B	Input Bias Current		—	12	20	—	15	30	nA
e_n	Input Noise Voltage	0.1Hz to 10Hz	—	0.55	—	—	0.55	—	µVp-p
e_n	Input Noise Voltage Density	f_O = 10Hz	—	24	—	—	24	—	nV/√Hz
		f_O = 1000Hz	—	22	—	—	22	—	nV/√Hz
i_n	Input Noise Current Density	f_O = 10Hz	—	0.07	—	—	0.07	—	pA/√Hz
	Input Resistance – Differential	(Note 2)	100	400	—	70	300	—	MΩ
	Common Mode		—	5	—	—	4	—	GΩ
A_{VOL}	Large Signal Voltage Gain	$V_O = \pm 10V$, R_L = 2k	1.5	8.0	—	1.2	7.0	—	V/µV
		$V_O = \pm 10V$, R_L = 600Ω	0.8	2.5	—	0.5	2.0	—	V/µV
	Input Voltage Range		+13.5	+13.8	—	+13.5	+13.8	—	V
			−15.0	−15.3	—	−15.0	−15.3	—	V
CMRR	Common Mode Rejection Ratio	V_{CM} = +13.5V, −15.0V	100	117	—	97	114	—	dB
PSRR	Power Supply Rejection Ratio	$V_S = \pm 2V$ to $\pm 18V$	103	120	—	100	117	—	dB
	Channel Separation	$V_O = \pm 10V$, R_L = 2k	123	140	—	120	137	—	dB
V_{OUT}	Output Voltage Swing	R_L = 2k	±13	±14	—	±12.5	±14	—	V
	Slew Rate		0.2	0.4	—	0.2	0.4	—	V/µs
I_S	Supply Current	Per Amplifier	—	0.35	0.50	—	0.35	0.55	mA

$T_A = 25°C$. $V_S^+ = +5V$, $V_S^- = 0V$, $V_{OUT} = 1.4V$, $V_{CM} = 0V$ unless otherwise noted

SYMBOL	PARAMETER	CONDITIONS	FT1013AM/AC FT1014AM/AC MIN	TYP	MAX	FT1013C/D/I/M FT1014C/D/I/M MIN	TYP	MAX	UNITS
V_{OS}	Input Offset Voltage	FT1013	—	60	250	—	90	450	µV
		FT1014	—	70	280	—	90	450	µV
		FT1013D/I, FT1014D/I	—	—	—	—	250	950	µV
I_{OS}	Input Offset Current		—	0.2	1.3	—	0.3	2.0	nA
I_B	Input Bias Current		—	15	35	—	18	50	nA
A_{VOL}	Large Signal Voltage Gain	V_O = 5mV to 4V, R_L = 500Ω	—	1.0	—	—	1.0	—	V/µV
	Input Voltage Range		+3.5	+3.8	—	+3.5	+3.8	—	V
			0	−0.3	—	0	−0.3	—	V
V_{OUT}	Output Voltage Swing	Output Low, No Load	—	15	25	—	15	25	mV
		Output Low, 600Ω to Ground	—	5	10	—	5	10	mV
		Output Low, I_{SINK} = 1mA	—	220	350	—	220	350	mV
		Output High, No Load	4.0	4.4	—	4.0	4.4	—	V
		Output High, 600Ω to Ground	3.4	4.0	—	3.4	4.0	—	V
I_S	Supply Current	Per Amplifier	—	0.31	0.45	—	0.32	0.50	mA

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