

TOSHIBA BIPOLAR LINEAR INTEGRATED CIRCUIT SILICON MONOLITHIC

# TA8190F, TA8191F

## CD FOCUS TRACKING SERVO LSI

The TA8190F, TA8191F is a 3-beam type PUH compatible focus tracking servo LSIs to be used in the CD player system.

In combination with a CMOS single chip processor TC9236AF, a CD player system can be composed very simply.

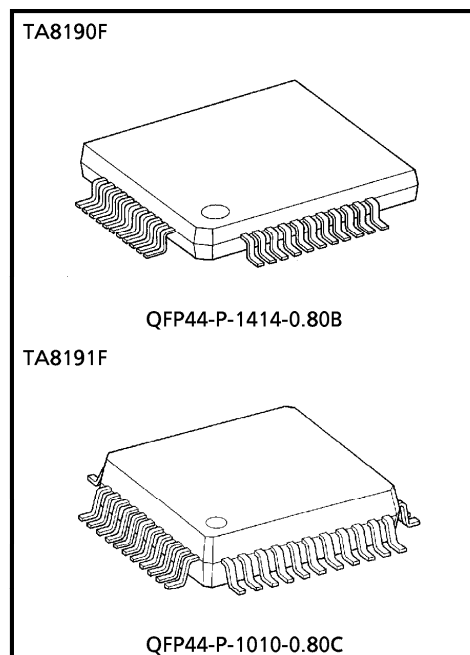
### FEATURES

- Built-in RF amp, focus error amp, and tracking error amp.
- Built-in focus tracking servo amp.
- Built-in phase compensation amp and LPF amp. (Regarding these amp, the pin connection differs between the TA8190F and the TA8191F.)
- Built-in ALPC amp.
- Connections between PUH and power driver IC for motor driver allow simplified structuring of CD player system.

TA8190F : Directly connectable to a transistor push-pull or power driver (TA8212F).

TA8191F : Directly connectable to BTL amp (TA8192F) or PWM driver (TA8460F).

- Differences between TA8190F and TA8191F are as follows :



Weight  
 QFP44-P-1414-0.80B : 1.15g (Typ.)  
 QFP44-P-1010-0.80C : 0.5g (Typ.)

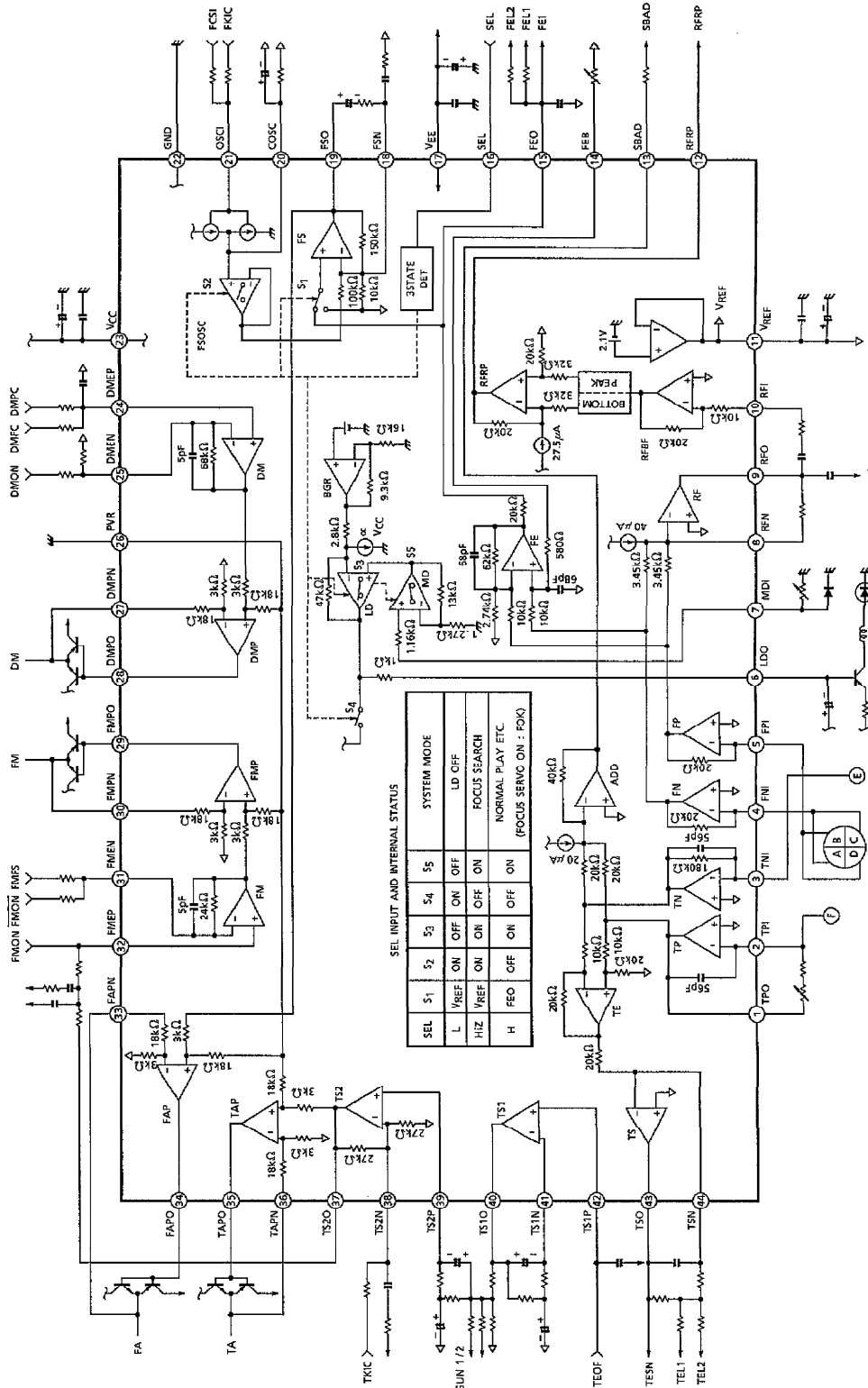
MODEL	REFERENCE VOLTAGE TERMINAL		PACKAGE (FLAT PACKAGE 44 PIN)	POWER SUPPLY	APPLICATION
	V <sub>REF</sub>	2V <sub>REF</sub>			
TA8190F	Yes	No	QFP44-P-1414B	± 5V double power supply	CD player
TA8191F	Yes	Yes	QFP44-P-1010C	+ 5V single power supply	Portable CD player Radio-cassette CD player

(V<sub>REF</sub> = 2.1V, 2V<sub>REF</sub> = 4.2V)

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BLOCK DIAGRAM  
TA8190F

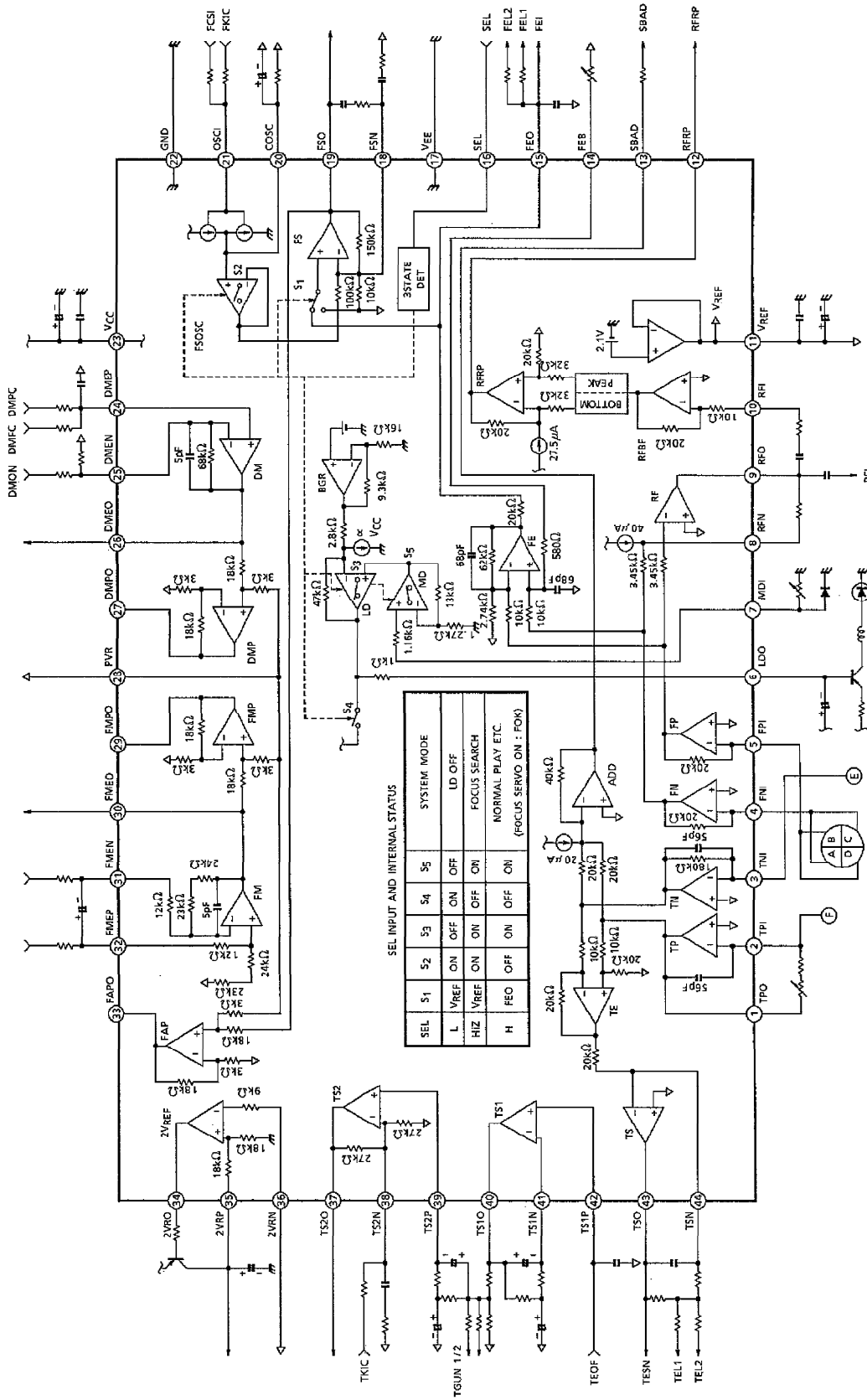


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- The information contained herein is subject to change without notice.

BLOCK DIAGRAM  
TA8191F



TA8190F,91F - 3

PIN FUNCTION  
(Common)

PIN No.	SYMBOL	I/O	FUNCTIONAL DESCRIPTION	REMARKS
1	TPO	O	Sub-beam I-V amp (TP AMP) output terminal.	Connected to TPI through adjusting feedback resistor.
2	TPI	I	Sub-beam I-V amp (TP AMP) input terminal.	Connected to PIN diode F.
3	TNI	I	Sub-beam I-V amp (TN AMP) input terminal.	Connected to PIN diode E.
4	FNI	I	Main-beam I-V amp (FN AMP) input terminal.	Connected to PIN diode A + C.
5	FPI	I	Main-beam I-V amp (FP AMP) input terminal.	Connected to PIN diode B + D.
6	LDO	O	Laser diode amp (LD AMP) input terminal.	Connected to laser diode circuit.
7	MDI	I	Monitor photo diode amp (MD AMP) input terminal.	Connected to monitor photo diode.
8	RFN	I	RF amp (RF AMP) negative phase input terminal.	Connected to RFO through feedback resistor.
9	RFO	O	RF amp (RF AMP) output terminal.	—
10	RFI	I	RF ripple signal generating circuit input terminal.	Connected to RFO through CR.
11	VREF	O	Reference voltage supply output terminal. (+2.1V)	—
12	RFRP	O	RF ripple signal output terminal.	—
13	SBAD	O	Defects detection signal output terminal.	—
14	FEB	I	Focus error balance adjusting input terminal.	Adjusting semi-fixed resistor connected.
15	FEO	O	Focus error amp (FE AMP) output terminal.	Gain adjusting resistor is connected.
16	SEL	I	Analog switch control signal input terminal.	—
17	VEE	—	Power source terminal. (TA8190F : -5V, TA8191F : GND)	—
18	FSN	I	Focus output amp (FS AMP) negative phase input terminal.	Connected to FSO through feedback CR.
19	FSO	O	Focus output amp (FS AMP) output terminal.	—
20	COSC	O	Focus search signal generating capacitor connecting terminal.	CR is connected.
21	OSCI	I	Focus search signal generating built-in current source control input terminal.	—
22	GND	—	Ground terminal.	—

(Common)

PIN No.	SYMBOL	I/O	FUNCTIONAL DESCRIPTION	REMARKS
23	VCC	—	Power source terminal. (+5V)	—
24	DMEP	I	Disc motor amp (DM AMP) positive phase input terminal.	—
25	DMEN	I	Disc motor amp (DM AMP) negative phase input terminal.	—
31	FMEN	I	Feed motor amp (FM AMP) negative phase input terminal.	—
32	FMEP	I	Feed motor amp (FM AMP) positive phase input terminal.	—
37	TS2O	O	Tracking servo amp 2 (TS2 AMP) output terminal.	—
38	TS2N	I	Tracking servo amp 2 (TS2 AMP) negative phase input terminal.	—
39	TS2P	I	Tracking servo amp 2 (TS2 AMP) positive phase input terminal.	—
40	TS1O	O	Tracking servo amp 1 (TS1 AMP) output terminal.	—
41	TS1N	I	Tracking servo amp 1 (TS1 AMP) negative phase input terminal.	Connected to TS1O through feedback CR.
42	TS1P	I	Tracking servo amp 1 (TS1 AMP) positive phase input terminal.	—
43	TSO	O	Tracking output amp (TS AMP) output terminal.	—
44	TSN	I	Tracking output amp (TS AMP) negative phase input terminal.	Connected to TSO through feedback CR.

(TA8190F)

PIN No.	SYMBOL	I/O	FUNCTIONAL DESCRIPTION	REMARKS
26	PVR	I	Driving amp reference voltage input terminal.	Connect to GND.
27	DMPN	I	Disc motor driving amp (DMP AMP) negative phase input terminal.	—
28	DMPO	O	Disc motor driving amp (DMP AMP) output terminal.	Connected to DMPN through external output Tr.
29	FMPO	O	Feed motor driving amp (FMP AMP) output terminal.	Connected to EMPN through external output Tr.
30	FMPN	I	Feed motor driving amp (FMP AMP) negative phase input terminal.	—
33	FAPN	I	Focus actuator driving amp (FAP AMP) negative phase input terminal.	—
34	FAPO	O	Focus actuator driving amp (FAP AMP) output terminal.	Connected to FAPN through external output Tr.
35	TAPO	O	Tracking actuator driving amp (TAP AMP) output terminal.	Connected to TAPN through external output Tr.
36	TAPN	I	Tracking actuator driving amp (TAP AMP) negative phase input terminal.	—

(TA8191F)

PIN No.	SYMBOL	I/O	FUNCTIONAL DESCRIPTION	REMARKS
26	DME0	O	Disc motor amp (DM AMP) output terminal.	—
27	DMPO	O	Disc motor driving amp (DM AMP) output terminal.	—
28	PVR	I	Driving amp reference voltage input terminal.	Connected to VREF.
29	FMPO	O	Feed motor driving amp (FMP AMP) output terminal.	—
30	FME0	O	Feed motor amp (FM AMP) output terminal.	—
33	FAPO	O	Focus actuator driving amp (FAP AMP) output terminal.	—
34	2VRO	O	2VREF amp (2VREF AMP) output terminal.	Connected to 2VRP through external output Tr.
35	2VRP	I	2VREF amp (2VREF AMP) positive phase input terminal.	—
36	2VRN	I	2VREF amp (2VREF AMP) negative phase input terminal.	—

**MAXIMUM RATINGS (Ta = 25°C)**

CHARACTERISTIC		SYMBOL	RATING	UNIT
Power Supply Voltage		V <sub>CC</sub> -V <sub>EE</sub>	0.3~12.0	V
Power Dissipation	TA8190F	P <sub>D</sub>	960 (*1)	mW
	TA8191F		780 (*2)	
Operating Temperature		T <sub>opr</sub>	-25~75	°C
Storage Temperature		T <sub>stg</sub>	-55~150	°C

(\*1) Derated above 25°C in the proportion of 7.7mW/°C.

(\*2) Derated above 25°C in the proportion of 6.2mW/°C.

**ELECTRICAL CHARACTERISTICS**

( Unless otherwise specified, TA8190F : V<sub>CC</sub> = 5V, V<sub>EE</sub> = -5V, Ta = 25°C  
 TA8191F : V<sub>CC</sub> = 5V, V<sub>EE</sub> = GND, Ta = 25°C )

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Power Source (TA8190F)	Power Supply Voltage	V <sub>CC</sub>	—	Ta = -25~75°C	4.5	5.0	5.5	V
		V <sub>EE</sub>	—		-5.5	-5.0	-4.5	
	Power Supply Current	I <sub>CC</sub>	1	SEL = HiZ	14.0	24.0	32.0	mA
		I <sub>EE</sub>	1	—	3.0	5.0	7.0	
Power Source (TA8191F)	Power Supply Voltage	V <sub>CC</sub>	—	Ta = -25~75°C	4.5	5.0	5.5	V
	Power Supply Current	I <sub>CC</sub>	3	—	14.0	24.0	32.0	mA
Reference Power Supply V <sub>REF</sub> (Common)	Reference Voltage	V <sub>REF</sub>	1, 3	—	1.95	2.10	2.25	V
	Reference Voltage Temperature Characteristic	ΔV/ΔT	1, 3	—	-3.0	-2.0	-1.0	mV/°C
	Output Current	I <sub>OH</sub>	1, 3	—	5.0	—	—	mA
	Input Current	I <sub>OL</sub>	1, 3	—	5.0	—	—	mA
FI ↓ RFO (Common)	Permissible Input Current	I <sub>IM</sub>	1, 3	per each ch	30	—	—	μA
	Transfer Resistance	R <sub>T</sub>	1, 3	f = 100kHz	115	127	140	kΩ
	Frequency Characteristic	f <sub>c</sub>	2, 4	-3dB point	3.0	—	—	MHz
	Output Signal Slew Rate	SR	2, 4	C <sub>RFO</sub> = 20pF	10	20	—	V/μs
	Total Harmonic Distortion	THD	1, 3	f = 100kHz V <sub>REO</sub> = 1.27V <sub>p-p</sub>	—	-40	-30	dB

CHARACTERISTIC		SYMBOL	TEST CIRCUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
FI ↓ RFO (Common)	Operation Reference Voltage	V <sub>OPR</sub>	1, 3	V <sub>REF</sub> reference	-1.13	-0.88	-0.72	V
	Upper Limit Output Voltage	V <sub>OH</sub>	1, 3	V <sub>REF</sub> reference	1.4	—	—	V
	Lower Limit Output Voltage	V <sub>OL</sub>	1, 3	V <sub>REF</sub> reference	—	—	-1.4	V
	Permissive Load Resistance	R <sub>LM</sub>	—	—	10	—	—	k $\Omega$
RFI ↓ RFRP (Common)	Input Operating Voltage	V <sub>I</sub>	1, 3	—	0.8	—	1.6	V <sub>p-p</sub>
	Voltage Gain	G <sub>V</sub>	1, 3	f = 1kHz	0.55	0.62	0.69	V/V
	Peak Hold Frequency Characteristic	f <sub>CPD</sub>	1, 3	—	60	120	240	kHz
	Bottom Hold Frequency Characteristics	f <sub>CBD</sub>	1, 3	—	60	120	240	kHz
	Operation Reference Voltage 1	V <sub>OPR</sub>	1, 3	V <sub>REF</sub> reference	-0.61	-0.55	-0.49	V
	Operation Reference Voltage 2	V <sub>OPR</sub>	1, 3	V <sub>REF</sub> reference 700kHz, 1V <sub>p-p</sub> input	-120	0	120	mV
	Permissive Load Resistance	R <sub>LM</sub>	—	—	10	—	—	k $\Omega$
FI ↓ FEO (Common)	Transfer Resistance	R <sub>T</sub>	1, 3	f = 1kHz	97	124	151	k $\Omega$
	Gain Balance	GB	1, 3	f = 1kHz	-1.5	—	1.5	dB
	Frequency Characteristic	f <sub>c</sub>	1, 3	-3dB point	20	30	60	kHz
	Total Harmonic Distortion	THD	1, 3	f = 1kHz V <sub>FEO</sub> = 1.7V <sub>p-p</sub>	—	—	-40	dB
	Output Offset Voltage	V <sub>OS</sub>	1, 3	V <sub>REF</sub> reference	-100	—	100	mV
	Offset Voltage Drift	$\Delta V / \Delta T$	1, 3	—	-400	—	400	$\mu V / ^\circ C$
	Upper Limit Output Voltage	V <sub>OH</sub>	1, 3	V <sub>REF</sub> reference	1.5	—	—	V
	Lower Limit Output Voltage	V <sub>OL</sub>	1, 3	V <sub>REF</sub> reference	—	—	-1.5	V



CHARACTERISTIC		SYMBOL	TEST CIRCUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
TI ↓ TSO (Common)	Permissive Input Current	I <sub>IM</sub>	1, 3	Per each ch	5.0	—	—	μA
	Transfer Resistance	R <sub>T</sub>	1, 3	f = 1kHz	354	432	554	kΩ
	Gain Balance	GB	1, 3	f = 1kHz	-2.0	—	2.0	dB
	Frequency Characteristic	f <sub>c</sub>	1, 3	-3dB point	10	16	30	kHz
	Total Harmonic Distortion	THD	1, 3	f = 1kHz V <sub>TSO</sub> = 0.8V <sub>p-p</sub>	—	—	-40	dB
	Output Offset Voltage	V <sub>OS</sub>	1, 3	V <sub>REF</sub> reference	-50	—	50	mV
	Offset Voltage Drift	ΔV/ΔT	1, 3	—	-200	—	200	μV/°C
	Upper Limit Output Voltage	V <sub>OH</sub>	1, 3	V <sub>REF</sub> reference	1.5	—	—	V
	Lower Limit Output Voltage	V <sub>OL</sub>	1, 3	V <sub>REF</sub> reference	—	—	-1.5	V
	Permissive Load Resistance	R <sub>LM</sub>	—	—	10	—	—	kΩ
TI ↓ SBAD (Common)	Permissive Input Current	I <sub>IM</sub>	1, 3	Total in both ch	7.0	—	—	μA
	Transfer Resistance	R <sub>T</sub>	1, 3	f = 1kHz	280	360	440	kΩ
	Frequency Characteristic	f <sub>c</sub>	1, 3	-3dB point	10	16	30	kHz
	Total Harmonic Distortion	THD	1, 3	f = 1kHz V <sub>SBAD</sub> = 1.6V <sub>p-p</sub>	—	—	-40	dB
	Operation Reference Voltage	V <sub>OPR</sub>	1, 3	V <sub>REF</sub> reference	-0.88	-0.80	-0.72	V
	Upper Limit Output Voltage	V <sub>OH</sub>	1, 3	V <sub>REF</sub> reference	1.5	—	—	V
	Lower Limit Output Voltage	V <sub>OL</sub>	1, 3	V <sub>REF</sub> reference	—	—	-1.5	V
	Permissive Load Resistance	R <sub>LM</sub>	—	—	10	—	—	kΩ
OSCI ↓ FSO (Common)	Output Amplitude	V <sub>O</sub>	—	f <sub>OSCI</sub> = 0.5Hz (CMOS level)	610	700	780	mV <sub>p-p</sub>
	Output Offset Voltage	V <sub>OS</sub>	—	OSCI : HiZ	-35	—	35	mV
	Output Switch Isolation	V <sub>ISO</sub>	—	f <sub>OSCI</sub> = 0.5Hz SEL : "H" level	—	—	25	mV <sub>p-p</sub>

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
FEO ↓ FSO (TA8190F)	Voltage Gain 1	G <sub>V1</sub>	—	f = 10kHz V <sub>FSO</sub> = 1V <sub>p-p</sub>	14.5	16.0	17.5	V/V
	Voltage Gain 2	G <sub>V2</sub>	—	R <sub>NF</sub> (FSO-FSN) : 12kΩ	1.79	2.11	2.43	V/V
	Upper Limit Output Voltage	V <sub>OH</sub>	—	GND reference	3.6	—	—	V
	Lower Limit Output Voltage	V <sub>OL</sub>	—	GND reference	—	—	0.5	V
	Output Offset Voltage	V <sub>OS</sub>	—	—	- 32	—	32	mV
	Total Harmonic Distortion	THD	—	f = 10kHz V <sub>FSO</sub> = 1V <sub>p-p</sub>	—	—	- 40	dB
FEO ↓ FSO (TA8191F)	Voltage Gain 1	G <sub>V1</sub>	—	f = 10kHz V <sub>FSO</sub> = 1V <sub>p-p</sub>	14.5	16.0	17.5	V/V
	Voltage Gain 2	G <sub>V2</sub>	—	R <sub>NF</sub> (FSO-FSN) : 12kΩ	1.79	2.11	2.43	V/V
	Upper Limit Output Voltage	V <sub>OH</sub>	—	GND reference	3.6	—	—	V
	Lower Limit Output Voltage	V <sub>OL</sub>	—	GND reference	—	—	0.5	V
	Output Offset Voltage	V <sub>OS</sub>	—	—	- 32	—	32	mV
	Total Harmonic Distortion	THD	—	f = 10kHz V <sub>FSO</sub> = 1V <sub>p-p</sub>	—	—	- 40	dB
FEO ↓ FAPO (TA8190F)	Voltage Gain	G <sub>V</sub>	—	f = 10kHz V <sub>FAPO</sub> = 1V <sub>p-p</sub>	80	96	114	V/V
	Upper Limit Output Voltage	V <sub>OH</sub>	—	GND reference	2.8	—	—	V
	Lower Limit Output Voltage	V <sub>OL</sub>	—	GND reference	—	—	- 2.8	V
	Output Offset Voltage	V <sub>OS</sub>	—	—	- 200	—	200	mV
	Total Harmonic Distortion	THD	—	f = 10kHz V <sub>FAPO</sub> = 1V <sub>p-p</sub> R <sub>L</sub> = 8Ω	—	—	- 40	dB

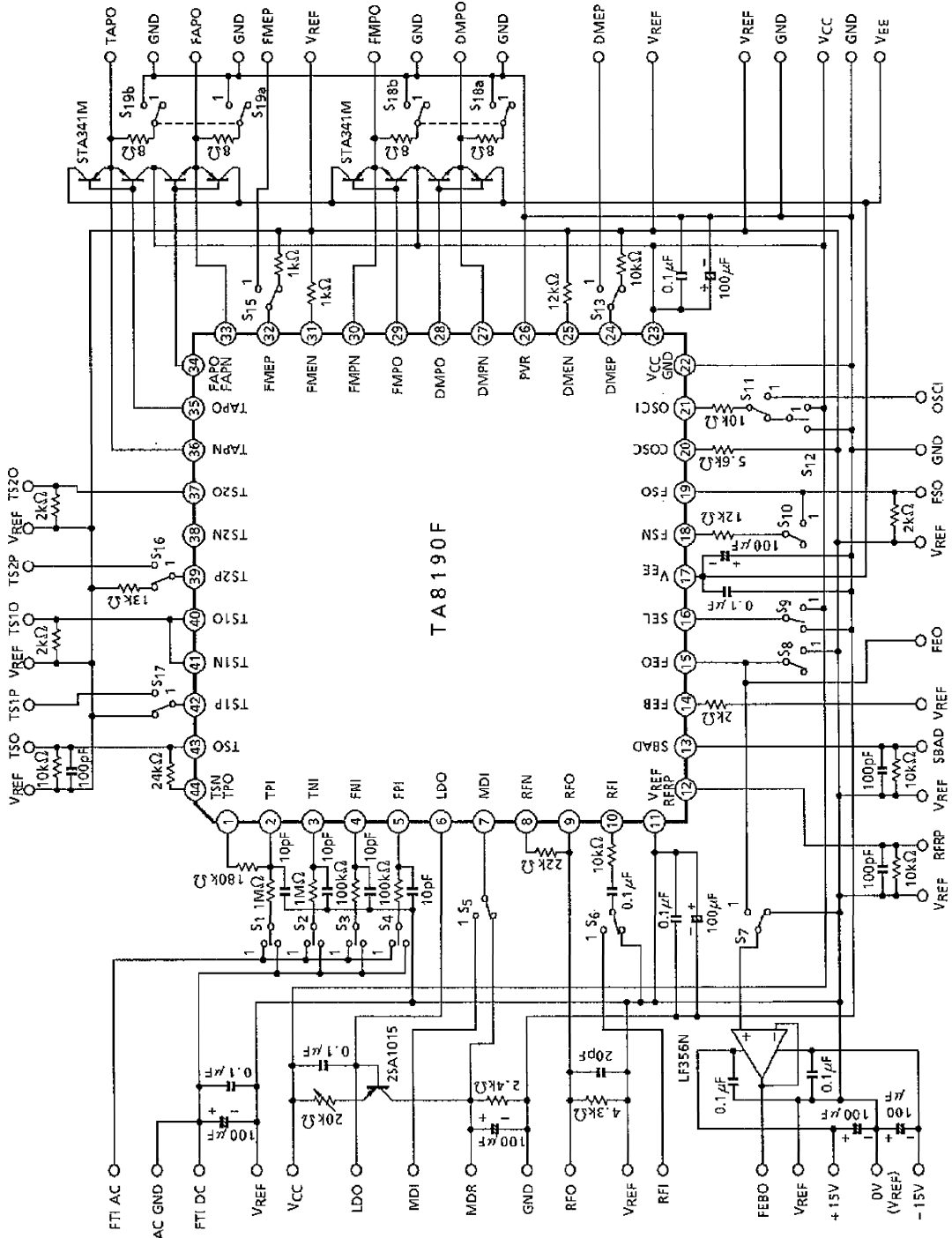
CHARACTERISTIC		SYMBOL	TEST CIRCUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
FEO ↓ FAPO (TA8191F)	Voltage Gain	G <sub>V</sub>	—	f = 10kHz V <sub>FAPO</sub> = 1V <sub>p-p</sub>	14.0	16.0	18.0	V/V
	Upper Limit Output Voltage	V <sub>OH</sub>	—	GND reference	3.6	—	—	V
	Lower Limit Output Voltage	V <sub>OL</sub>	—	GND reference	—	—	1.0	V
	Output Offset Voltage	V <sub>OS</sub>	—	—	-40	—	40	mV
	Total Harmonic Distortion	THD	—	f = 10kHz V <sub>FAPO</sub> = 1V <sub>p-p</sub>	—	—	-40	dB
TS1P ↓ TS1O (Common)	Voltage Gain	G <sub>V</sub>	—	f = 10kHz V <sub>TS1O</sub> = 1V <sub>p-p</sub>	0.95	1.00	1.05	V/V
	Upper Limit Output Voltage	V <sub>OH</sub>	—	GND reference	3.6	—	—	V
	Lower Limit Output Voltage	V <sub>OL</sub>	—	GND reference	—	—	1.0	V
	Output Offset Voltage	V <sub>OS</sub>	—	—	-5.0	—	5.0	mV
	Input Bias Current	I <sub>I</sub>	—	—	-100	—	100	nA
	Total Harmonic Distortion	THD	—	f = 10kHz V <sub>TS1O</sub> = 1V <sub>p-p</sub>	—	—	-40	dB
TS2P ↓ TS2O (Common)	Voltage Gain	G <sub>V</sub>	—	f = 10kHz V <sub>TS2O</sub> = 1V <sub>p-p</sub>	1.9	2.0	2.1	V/V
	Upper Limit Output Voltage	V <sub>OH</sub>	—	GND reference	3.6	—	—	V
	Lower Limit Output Voltage	V <sub>OL</sub>	—	GND reference	—	—	0.5	V
	Output Offset Voltage	V <sub>OS</sub>	—	—	-10	—	10	mV
	Input Bias Current	I <sub>I</sub>	—	—	-100	—	100	nA
	Total Harmonic Distortion	THD	—	f = 10kHz V <sub>TS2O</sub> = 1V <sub>p-p</sub>	—	—	-40	dB

CHARACTERISTIC		SYMBOL	TEST CIRCUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
TS2P ↓ TAPO (TA8190F)	Voltage Gain	G <sub>V</sub>	—	f = 10kHz V <sub>TAPO</sub> = 1V <sub>p-p</sub>	10.5	12.0	13.5	V/V
	Upper Limit Output Voltage	V <sub>OH</sub>	—	GND reference	2.8	—	—	V
	Lower Limit Output Voltage	V <sub>OL</sub>	—	GND reference	—	—	-2.8	V
	Output Offset Voltage	V <sub>OS</sub>	—	—	-80	—	80	mV
	Total Harmonic Distortion	THD	—	f = 10kHz V <sub>TAPO</sub> = 1V <sub>p-p</sub> R <sub>L</sub> = 8Ω	—	—	-40	dB
DMEP ↓ DME0 (TA8191F)	Voltage Gain	G <sub>V</sub>	—	f = 10kHz V <sub>DME0</sub> = 1V <sub>p-p</sub>	5.7	6.7	7.7	V/V
	Upper Limit Output Voltage	V <sub>OH</sub>	—	GND reference	3.6	—	—	V
	Lower Limit Output Voltage	V <sub>OL</sub>	—	GND reference	—	—	0.5	V
	Output Offset Voltage	V <sub>OS</sub>	—	—	-15	—	15	mV
	Total Harmonic Distortion	THD	—	f = 10kHz V <sub>DME0</sub> = 1V <sub>p-p</sub>	—	—	-40	dB
DMEP ↓ DMPO (TA8190F)	Voltage Gain	G <sub>V</sub>	—	f = 10kHz V <sub>DMPO</sub> = 1V <sub>p-p</sub>	32	40	50	V/V
	Upper Limit Output Voltage	V <sub>OH</sub>	—	GND reference	2.8	—	—	V
	Lower Limit Output Voltage	V <sub>OL</sub>	—	GND reference	—	—	-2.8	V
	Output Offset Voltage	V <sub>OS</sub>	—	—	-100	—	100	mV
	Total Harmonic Distortion	THD	—	f = 10kHz V <sub>DMPO</sub> = 1V <sub>p-p</sub> R <sub>L</sub> = 8Ω	—	—	-35	dB

CHARACTERISTIC		SYMBOL	TEST CIRCUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
DMEP ↓ DMPO (TA8191F)	Voltage Gain	G <sub>V</sub>	—	f = 10kHz V <sub>DMPO</sub> = 1V <sub>p-p</sub>	5.4	6.7	8.0	V/V
	Upper Limit Output Voltage	V <sub>OH</sub>	—	GND reference	3.6	—	—	V
	Lower Limit Output Voltage	V <sub>OL</sub>	—	GND reference	—	—	1.2	V
	Output Offset Voltage	V <sub>OS</sub>	—	—	-30	—	30	mV
	Total Harmonic Distortion	THD	—	f = 10kHz V <sub>DMPO</sub> = 1V <sub>p-p</sub>	—	—	-40	dB
FMPEP ↓ FMPEO (TA8191F)	Voltage Gain	G <sub>V</sub>	—	f = 10kHz V <sub>FMEO</sub> = 1V <sub>p-p</sub> V <sub>FMEN</sub> = V <sub>REF</sub>	3.6	3.9	4.3	V/V
	Upper Limit Output Voltage	V <sub>OH</sub>	—	GND reference	3.6	—	—	V
	Lower Limit Output Voltage	V <sub>OL</sub>	—	GND reference	—	—	0.5	V
	Output Offset Voltage	V <sub>OS</sub>	—	—	-15	—	15	mV
	Total Harmonic Distortion	THD	—	f = 10kHz V <sub>FMEO</sub> = 1V <sub>p-p</sub>	—	—	-40	dB
FMPEP ↓ FMPEO (TA8190F)	Voltage Gain	G <sub>V</sub>	—	f = 10kHz V <sub>FMPEO</sub> = 1V <sub>p-p</sub>	124	150	177	V/V
	Upper Limit Output Voltage	V <sub>OH</sub>	—	GND reference	2.8	—	—	V
	Lower Limit Output Voltage	V <sub>OL</sub>	—	GND reference	—	—	-2.8	V
	Output Offset Voltage	V <sub>OS</sub>	—	—	-500	—	500	mV
	Total Harmonic Distortion	THD	—	f = 10kHz V <sub>FMPEO</sub> = 1V <sub>p-p</sub> R <sub>L</sub> = 8Ω	—	—	-30	dB

CHARACTERISTIC		SYMBOL	TEST CIRCUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
FMEP ↓ FMPO (TA8191F)	Voltage Gain	$G_V$	—	$f = 10\text{kHz}$ $V_{FMPO} = 1V_{p-p}$ $V_{FMEN} = V_{REF}$	3.4	3.9	4.6	V/V
	Upper Limit Output Voltage	$V_{OH}$	—	GND reference	3.6	—	—	V
	Lower Limit Output Voltage	$V_{OL}$	—	GND reference	—	—	1.0	V
	Output Offset Voltage	$V_{OS}$	—	—	-20	—	20	mV
	Total Harmonic Distortion	THD	—	$f = 10\text{kHz}$ $V_{FMPO} = 1V_{p-p}$	—	—	-40	dB
2VRN ↓ 2VR (TA8191F)	DC Voltage Gain	$G_{VDC}$	—	$V_{2VR} = V_{REF}$	1.90	2.00	2.10	V/V
MDI ↓ LDO (Common)	Reference Operating Voltage	$V_{MDI}$	—	$V_{MDI}$ at which $V_{LDO}$ becomes 3.5V.	170	178	192	mV
	Voltage Gain	$G_V$	—	$f = 10\text{kHz}$ $V_{LDO} = 0.5V_{p-p}$	170	200	230	mV
	Input Bias Current	$I_I$	—	—	-200	—	200	nA
	Ripple Removing Ratio (With $V_{CC}$ )	RR	—	Input converted value	—	—	-56	dB
	Frequency Characteristic	$f_c$	—	-3dB point	20	—	—	kHz
	LD Off Voltage (With $V_{CC}$ )	$V_{LD\ OFF}$	—	SEL = L	-0.7	—	—	V

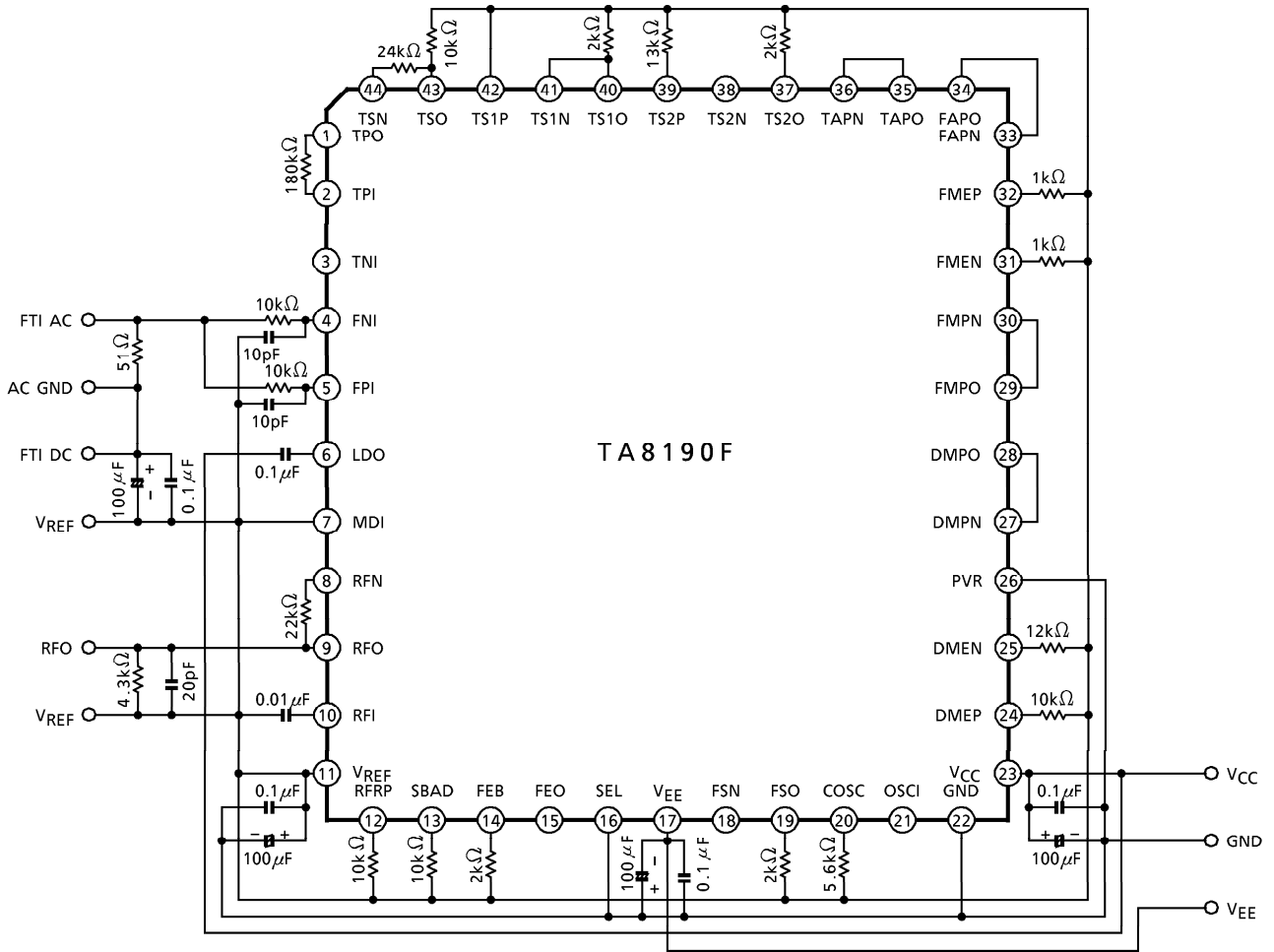
TEST CIRCUIT 1



TA8190F

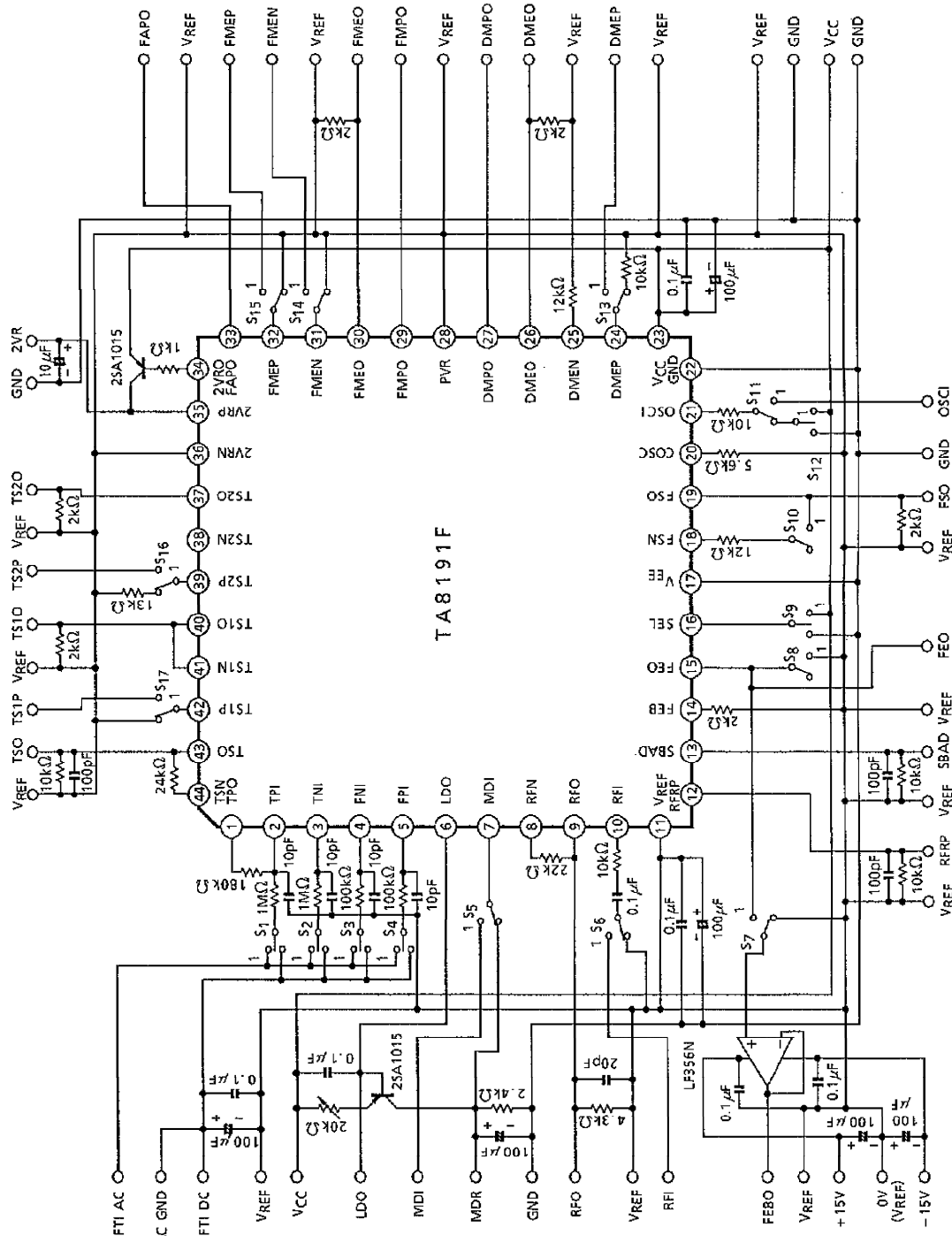
TA8190,91F - 15

TEST CIRCUIT 2





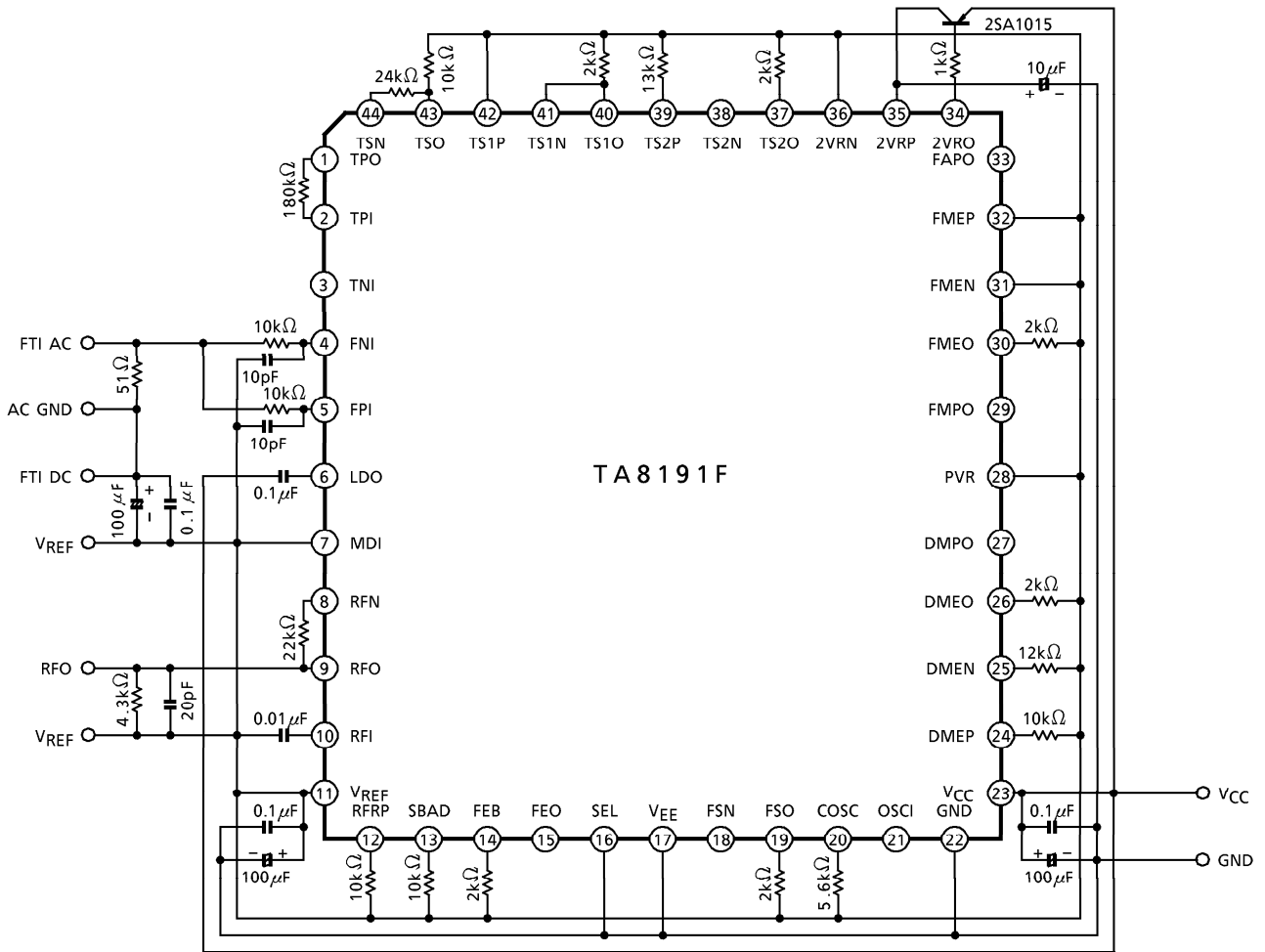
TEST CIRCUIT 3



TA8191F

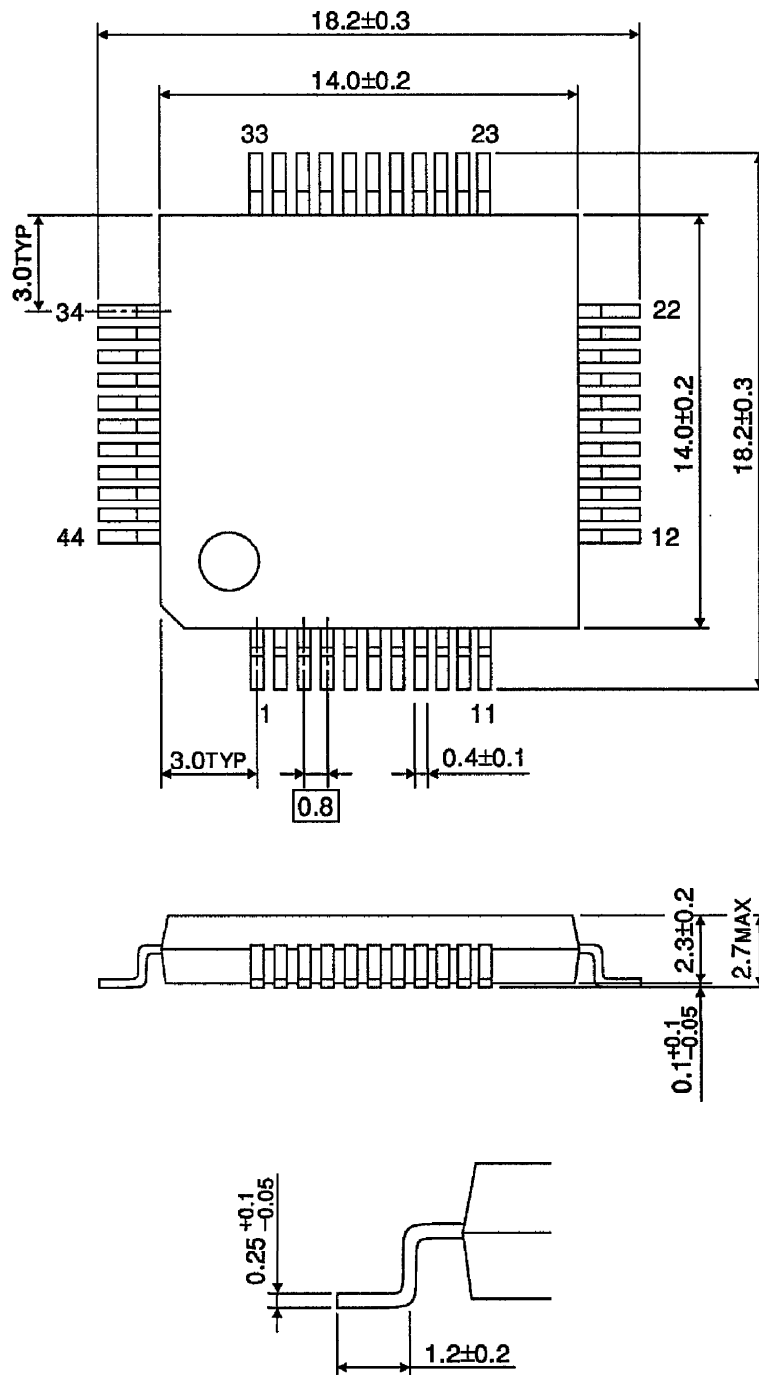
TA8190,91F - 17

TEST CIRCUIT 4



**OUTLINE DRAWING**  
QFP44-P-1414-0.80B

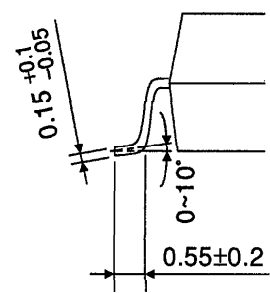
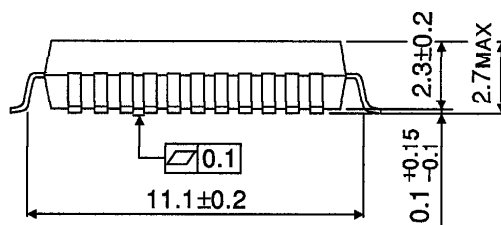
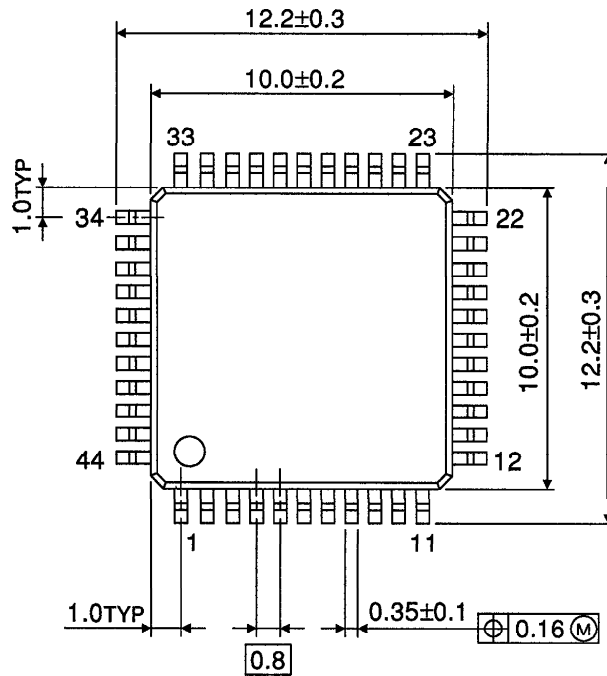
Unit : mm



Weight : 1.15g (Typ.)

**OUTLINE DRAWING**  
QFP44-P-1010-0.80C

Unit : mm



Weight : 0.5g (Typ.)