

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.

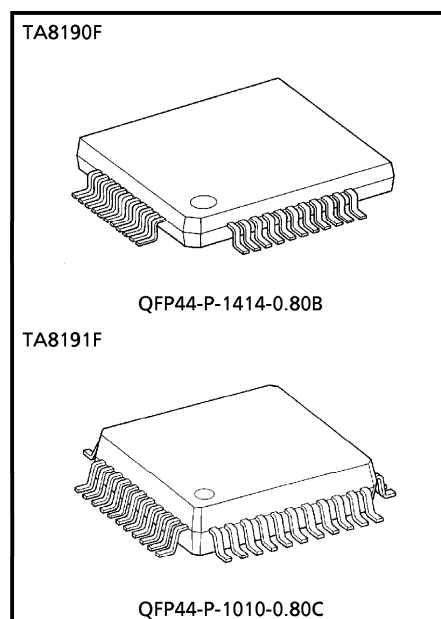
FEATURES

- 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.)

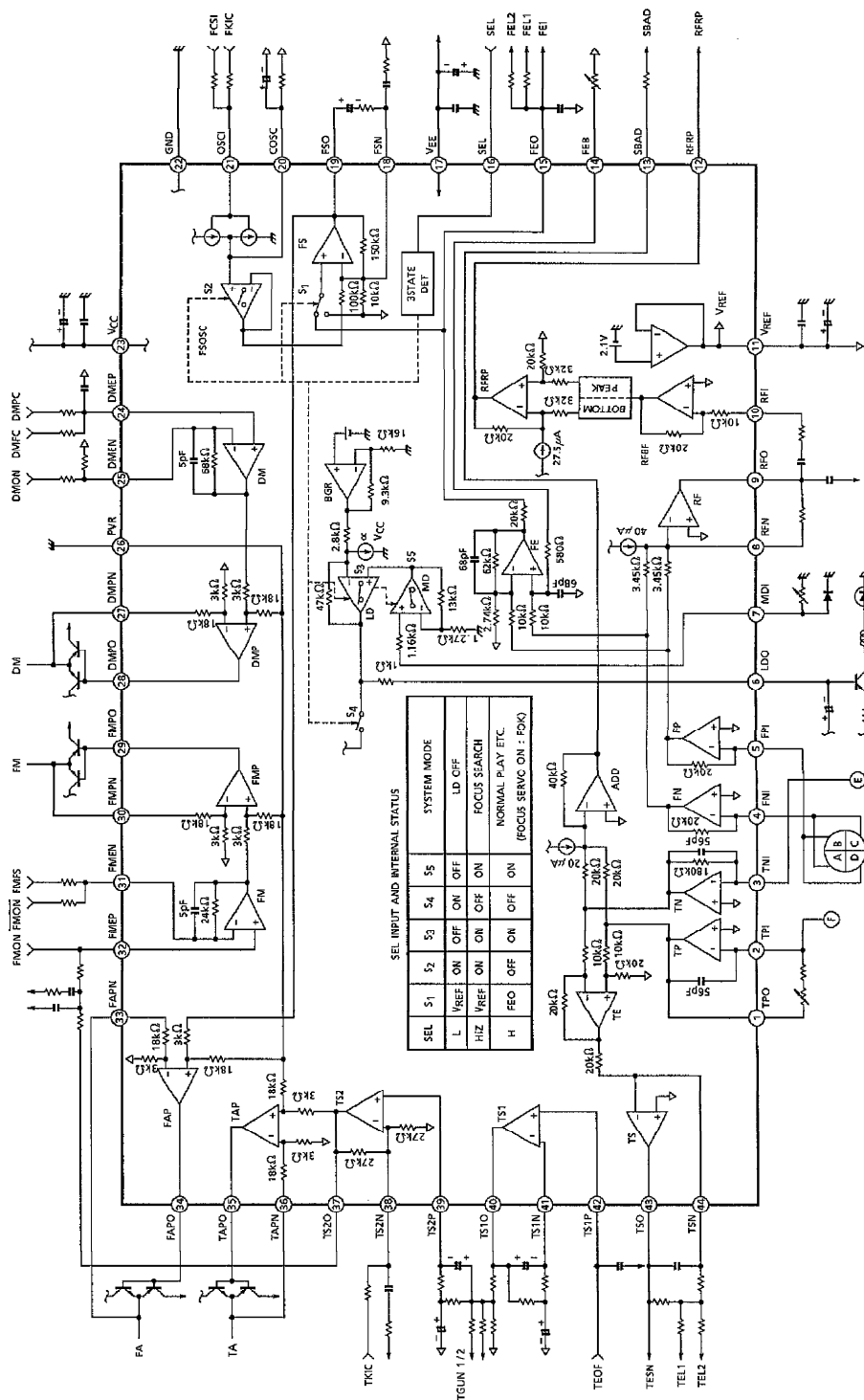
MODEL	REFERENCE VOLTAGE TERMINAL		PACKAGE (FLAT PACKAGE 44 PIN)	POWER SUPPLY	APPLICATION
	V _{REF}	2V _{REF}			
TA8190F	Yes	No	QFP44-P-1414B	± 5V double power supply	CD player
TA8191F	Yes	Yes	QFP44-P-1010C	+ 5V single power supply	Portable CD player Radio-cassette CD player

(V_{REF} = 2.1V, 2V_{REF} = 4.2V)

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BLOCK DIAGRAM
TA8190F

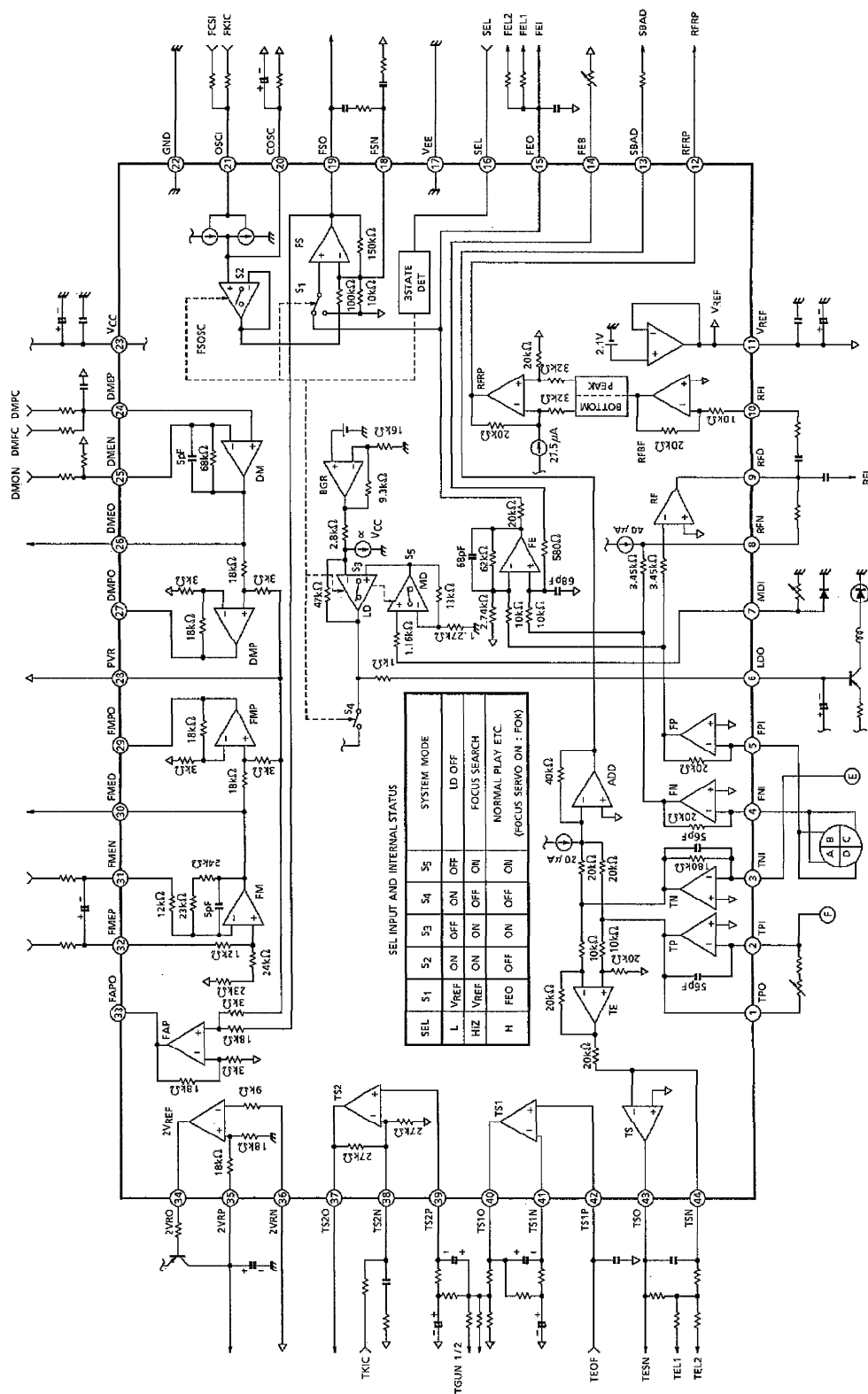


TA8190,91F-2

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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	V _{REF}	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	V _{EE}	—	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	V _{CC}	—	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	DMEO	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 V _{REF} .
29	FMPO	O	Feed motor driving amp (FMP AMP) output terminal.	—
30	FMEO	O	Feed motor amp (FM AMP) output terminal.	—
33	FAPO	O	Focus actuator driving amp (FAP AMP) output terminal.	—
34	2VRO	O	2V _{REF} amp (2V _{REF} AMP) output terminal.	Connected to 2VRP through external output Tr.
35	2VRP	I	2V _{REF} amp (2V _{REF} AMP) positive phase input terminal.	—
36	2VRN	I	2V _{REF} amp (2V _{REF} AMP) negative phase input terminal.	—

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC		SYMBOL	RATING	UNIT
Power Supply Voltage		$V_{CC}-V_{EE}$	0.3~12.0	V
Power Dissipation	TA8190F	P_D	960 (*1)	mW
	TA8191F		780 (*2)	
Operating Temperature		T_{opr}	-25~75	°C
Storage Temperature		T_{stg}	-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 : $V_{CC}=5V$, $V_{EE}=-5V$, $T_a=25^\circ C$
 TA8191F : $V_{CC}=5V$, $V_{EE}=GND$, $T_a=25^\circ C$)

CHARACTERISTIC		SYMBOL	TEST CIRCUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Power Source (TA8190F)	Power Supply Voltage	V_{CC}	—	$T_a = -25 \sim 75^\circ C$	4.5	5.0	5.5	V
		V_{EE}	—		-5.5	-5.0	-4.5	
	Power Supply Current	I_{CC}	1	SEL = HiZ	14.0	24.0	32.0	mA
		I_{EE}	1	—	3.0	5.0	7.0	
Power Source (TA8191F)	Power Supply Voltage	V_{CC}	—	$T_a = -25 \sim 75^\circ C$	4.5	5.0	5.5	V
	Power Supply Current	I_{CC}	3	—	14.0	24.0	32.0	mA
Reference Power Supply V_{REF} (Common)	Reference Voltage	V_{REF}	1, 3	—	1.95	2.10	2.25	V
	Reference Voltage Temperature Characteristic	$\Delta V / \Delta T$	1, 3	—	-3.0	-2.0	-1.0	mV/°C
	Output Current	I_{OH}	1, 3	—	5.0	—	—	mA
	Input Current	I_{OL}	1, 3	—	5.0	—	—	mA
FI ↓ RFO (Common)	Permissive Input Current	I_{IM}	1, 3	per each ch	30	—	—	μA
	Transfer Resistance	R_T	1, 3	$f = 100kHz$	115	127	140	$k\Omega$
	Frequency Characteristic	f_c	2, 4	-3dB point	3.0	—	—	MHz
	Output Signal Slew Rate	SR	2, 4	$CR_{FO} = 20pF$	10	20	—	V/ μs
	Total Harmonic Distortion	THD	1, 3	$f = 100kHz$ $V_{REO} = 1.27V_{p-p}$	—	-40	-30	dB

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
FI ↓ RFO (Common)	Operation Reference Voltage	V _{OPR}	1, 3	V _{REF} reference	-1.13	-0.88	-0.72	V
	Upper Limit Output Voltage	V _{OH}	1, 3	V _{REF} reference	1.4	—	—	V
	Lower Limit Output Voltage	V _{OL}	1, 3	V _{REF} reference	—	—	-1.4	V
	Permissive Load Resistance	R _{LM}	—	—	10	—	—	kΩ
RFI ↓ RFRP (Common)	Input Operating Voltage	V _I	1, 3	—	0.8	—	1.6	V _{p-p}
	Voltage Gain	G _V	1, 3	f = 1kHz	0.55	0.62	0.69	V/V
	Peak Hold Frequency Characteristic	f _{CPD}	1, 3	—	60	120	240	kHz
	Bottom Hold Frequency Characteristics	f _{CBD}	1, 3	—	60	120	240	kHz
	Operation Reference Voltage 1	V _{OPR}	1, 3	V _{REF} reference	-0.61	-0.55	-0.49	V
	Operation Reference Voltage 2	V _{OPR}	1, 3	V _{REF} reference 700kHz, 1V _{p-p} input	-120	0	120	mV
	Permissive Load Resistance	R _{LM}	—	—	10	—	—	kΩ
FI ↓ FEO (Common)	Transfer Resistance	R _T	1, 3	f = 1kHz	97	124	151	kΩ
	Gain Balance	GB	1, 3	f = 1kHz	-1.5	—	1.5	dB
	Frequency Characteristic	f _c	1, 3	-3dB point	20	30	60	kHz
	Total Harmonic Distortion	THD	1, 3	f = 1kHz V _{FEO} = 1.7V _{p-p}	—	—	-40	dB
	Output Offset Voltage	V _{OS}	1, 3	V _{REF} reference	-100	—	100	mV
	Offset Voltage Drift	ΔV/ΔT	1, 3	—	-400	—	400	μV/°C
	Upper Limit Output Voltage	V _{OH}	1, 3	V _{REF} reference	1.5	—	—	V
	Lower Limit Output Voltage	V _{OL}	1, 3	V _{REF} reference	—	—	-1.5	V

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

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

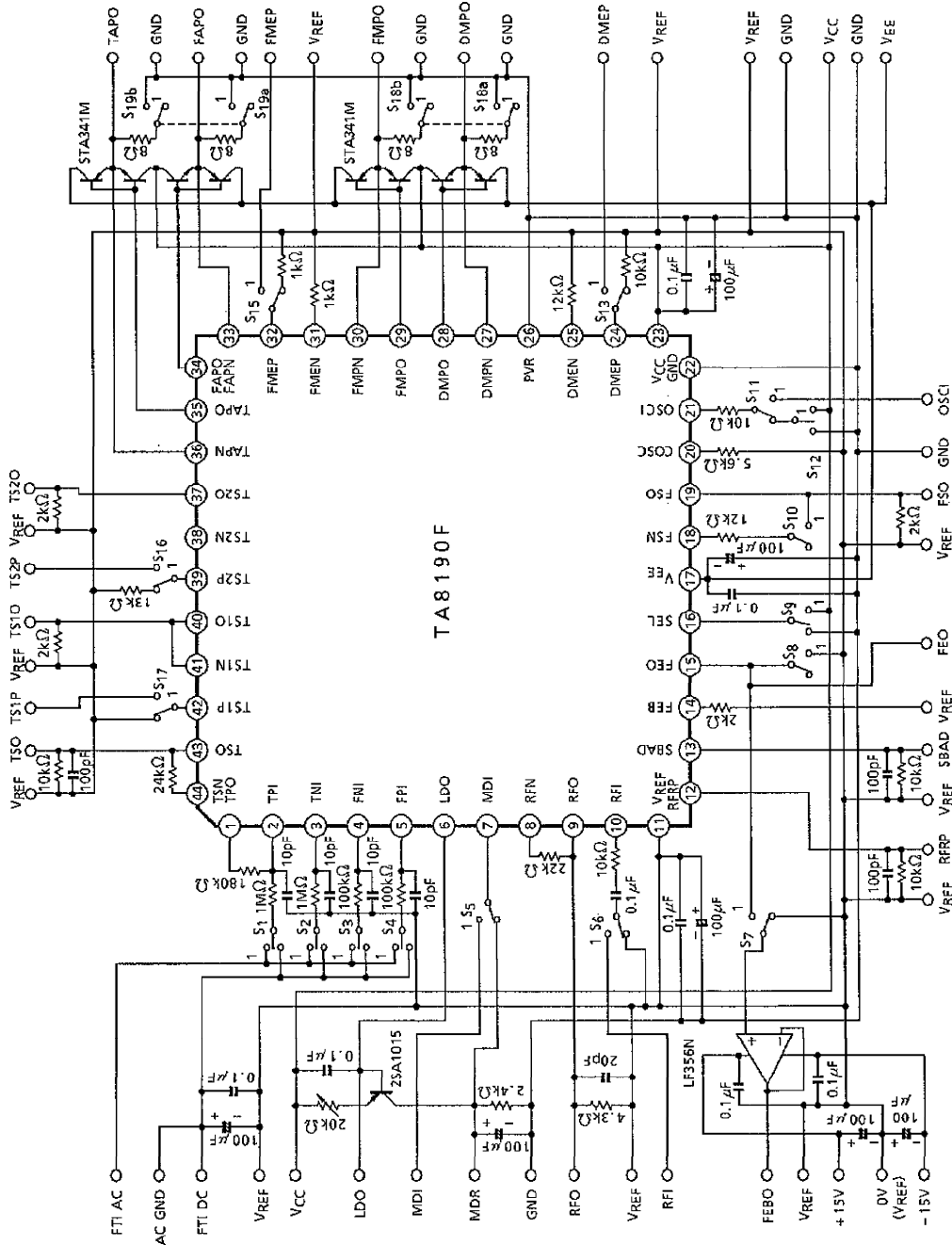
CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
FEO ↓ FAPO (TA8191F)	Voltage Gain	G_V	—	$f = 10\text{kHz}$ $V_{FAPO} = 1V_{p-p}$	14.0	16.0	18.0	V/V
	Upper Limit Output Voltage	V_{OH}	—	GND reference	3.6	—	—	V
	Lower Limit Output Voltage	V_{OL}	—	GND reference	—	—	1.0	V
	Output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

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
TS2P ↓ TAPO (TA8190F)	Voltage Gain	G_V	—	$f = 10\text{kHz}$ $V_{TAPO} = 1V_{p-p}$	10.5	12.0	13.5	V/V
	Upper Limit Output Voltage	V_{OH}	—	GND reference	2.8	—	—	V
	Lower Limit Output Voltage	V_{OL}	—	GND reference	—	—	-2.8	V
	Output Offset Voltage	V_{OS}	—	—	-80	—	80	mV
	Total Harmonic Distortion	THD	—	$f = 10\text{kHz}$ $V_{TAPO} = 1V_{p-p}$ $R_L = 8\Omega$	—	—	-40	dB
DMEP ↓ DME0 (TA8191F)	Voltage Gain	G_V	—	$f = 10\text{kHz}$ $V_{DME0} = 1V_{p-p}$	5.7	6.7	7.7	V/V
	Upper Limit Output Voltage	V_{OH}	—	GND reference	3.6	—	—	V
	Lower Limit Output Voltage	V_{OL}	—	GND reference	—	—	0.5	V
	Output Offset Voltage	V_{OS}	—	—	-15	—	15	mV
	Total Harmonic Distortion	THD	—	$f = 10\text{kHz}$ $V_{DME0} = 1V_{p-p}$	—	—	-40	dB
DMEP ↓ DMPO (TA8190F)	Voltage Gain	G_V	—	$f = 10\text{kHz}$ $V_{DMPO} = 1V_{p-p}$	32	40	50	V/V
	Upper Limit Output Voltage	V_{OH}	—	GND reference	2.8	—	—	V
	Lower Limit Output Voltage	V_{OL}	—	GND reference	—	—	-2.8	V
	Output Offset Voltage	V_{OS}	—	—	-100	—	100	mV
	Total Harmonic Distortion	THD	—	$f = 10\text{kHz}$ $V_{DMPO} = 1V_{p-p}$ $R_L = 8\Omega$	—	—	-35	dB

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

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	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

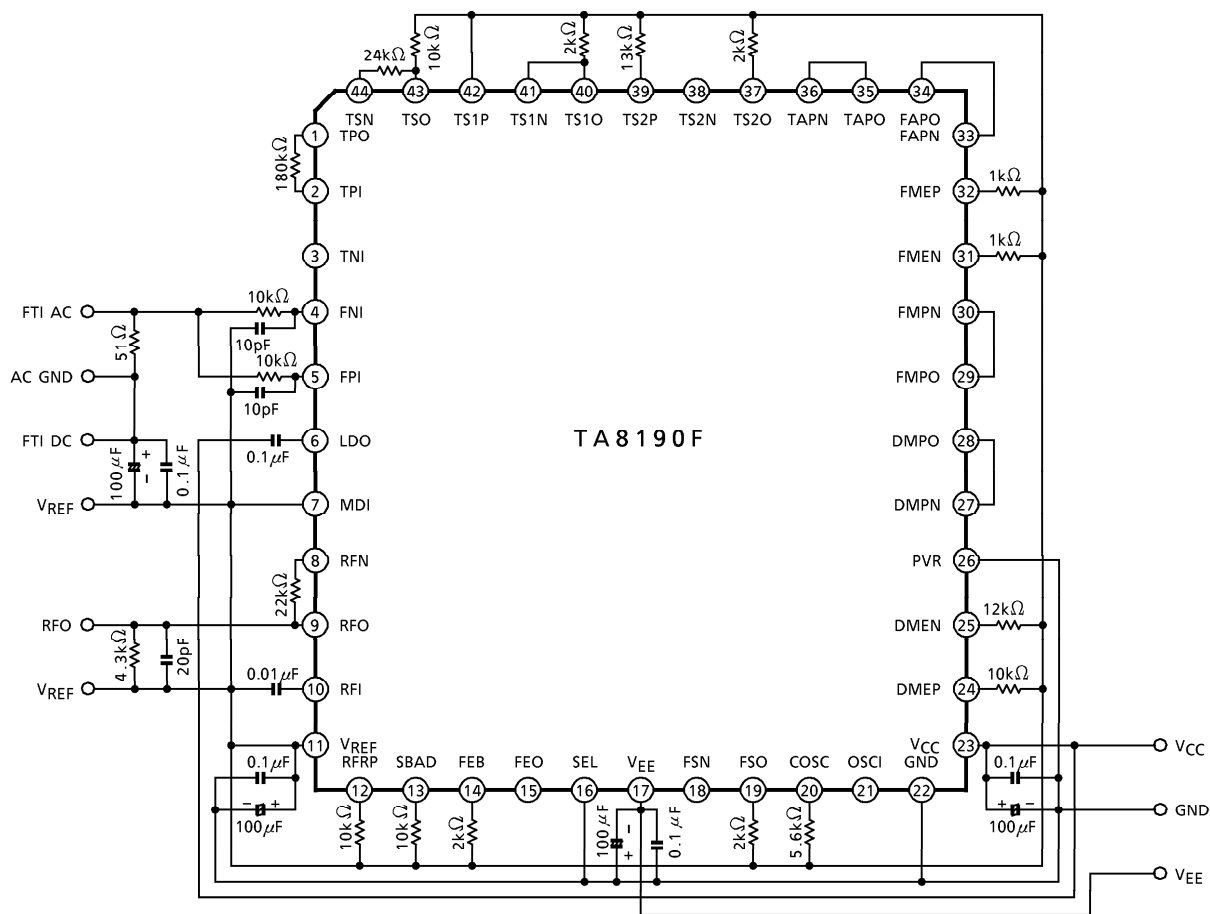
TEST CIRCUIT 1



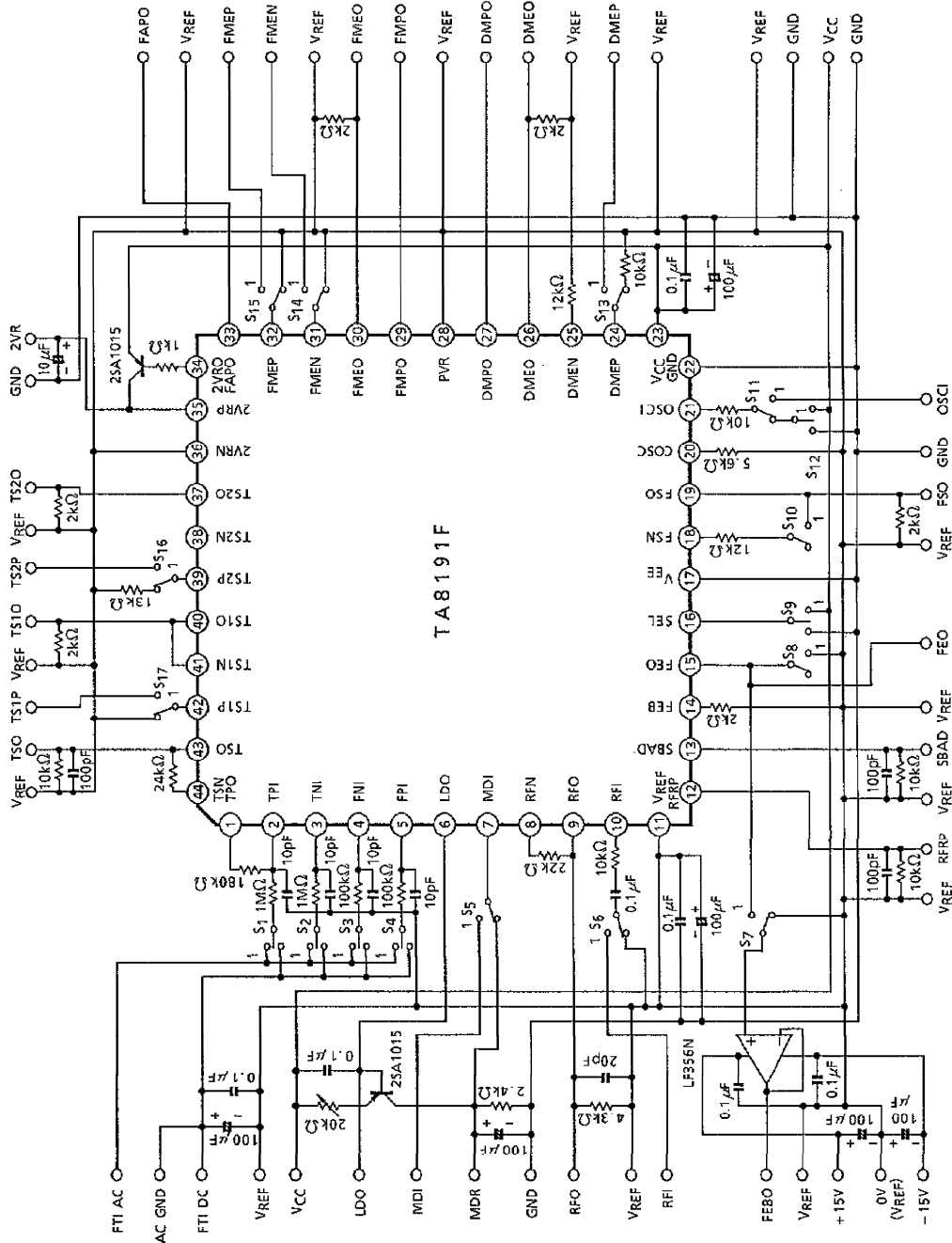
TA8190F

TA8190,91F-15

TEST CIRCUIT 2



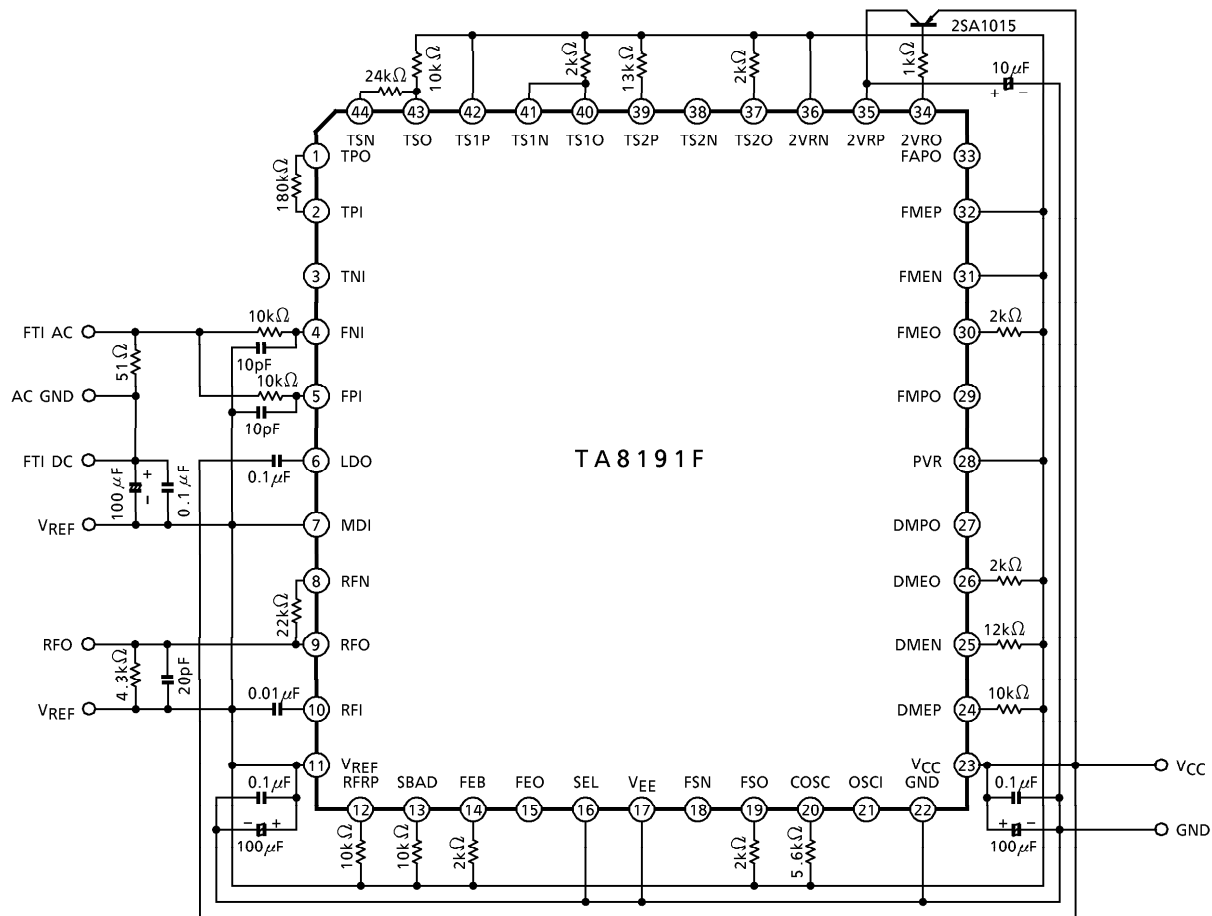
TEST CIRCUIT 3



TA8191F

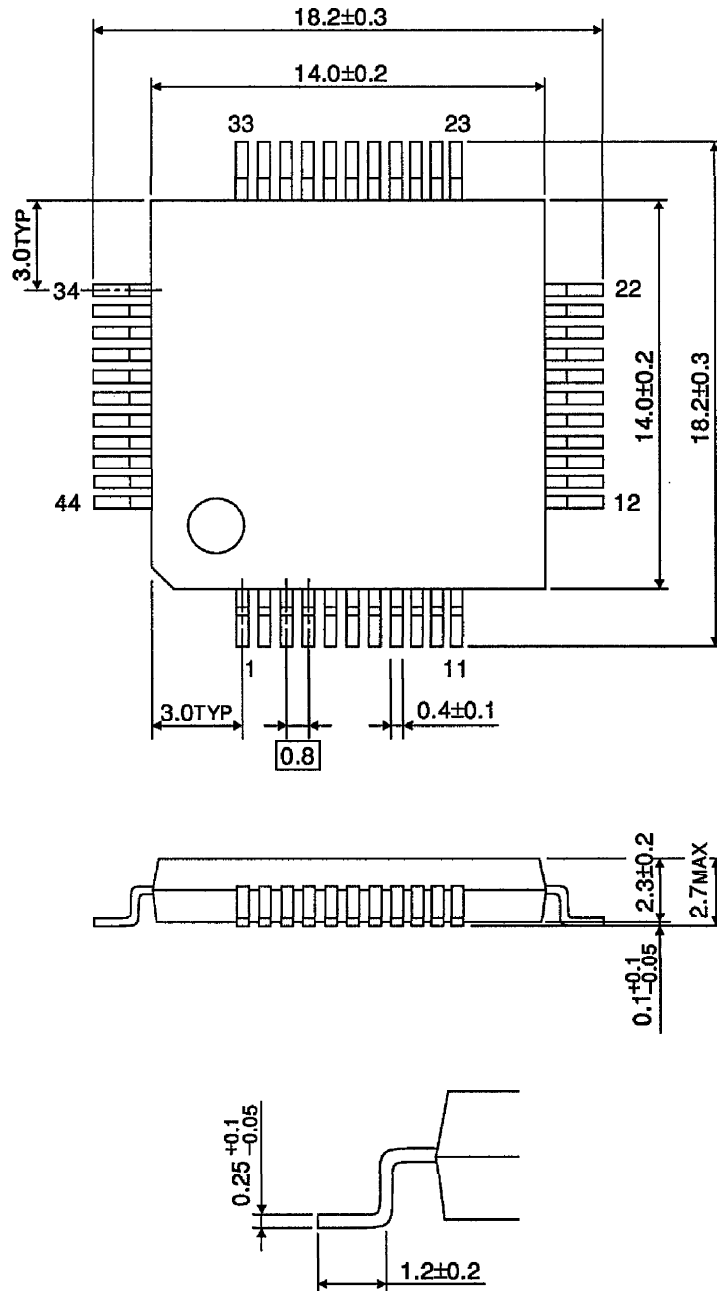
TA8190,91F-17

TEST CIRCUIT 4



OUTLINE DRAWING
QFP44-P-1414-0.80B

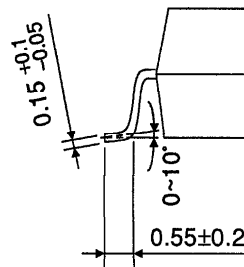
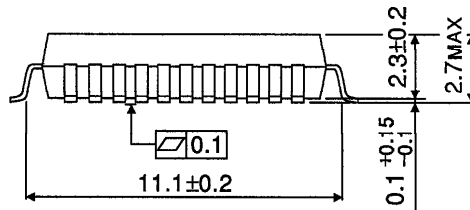
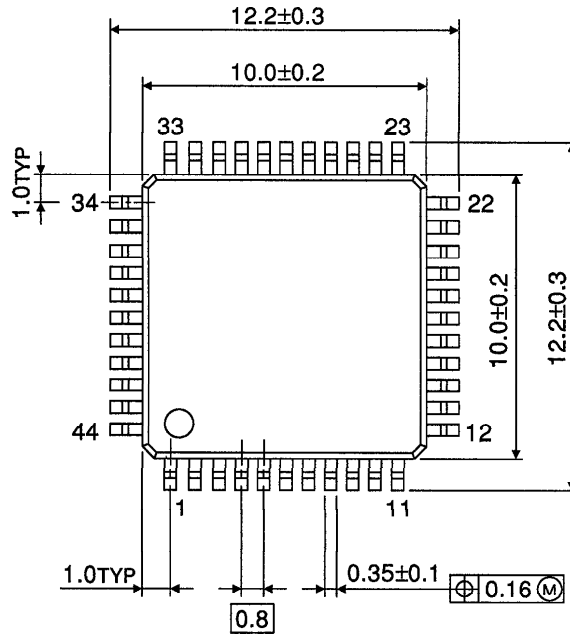
Unit : mm



Weight : 1.15g (Typ.)

OUTLINE DRAWING
QFP44-P-1010-0.80C

Unit : mm



Weight : 0.5g (Typ.)