DATA SHEET

CEL

BIPOLAR ANALOG INTEGRATED CIRCUIT

μPC3228T5S

LOW DISTORTION DOWN-CONVERTER + AGC AMPLIFIER + VIDEO AMPLIFIER

DESCRIPTION

The μPC3228T5S is a silicon bipolar monolithic IC designed for use as IF down-converter for digital TV, digital CATV. This IC consists of AGC amplifier, mixer and video amplifier.

The package is 32-pin plastic QFN (Quad Flat Non-lead) package suitable for surface mount.

This IC is manufactured using our 30 GHz f_{max} UHS0 (Ultra High Speed Process) silicon bipolar process.

This process uses silicon nitride passivation film. This material can protect chip surface from external pollution and prevent corrosion/migration. Thus, this IC has excellent performance, uniformly and reliability.

FEATURES

- Total performance : I_{CC} = 85 mA TYP. @ V_{CC} = 5 V
- AGC AMPLIFIER + MIXER + DRIVER BLOCK : $f_{RF\ (BW)}$ = 20 to 800 MHz
  : CG = 28 dB TYP.
  : GCR = 70 dB TYP.
  : IM_3 = 47 dBc MIN./57 dBc TYP. @ Single Ended-OUT = 0.5 V_{p-p}/tone
- VIDEO AMPLIFIER BLOCK : G_V = 59 dB TYP.
  : $f_{IF\ (BW)}$ = 20 to 100 MHz
  : IM_3 = 45 dBc MIN./55 dBc TYP. @ Output = 110 dBu/tone, Differential-out
- High-density surface mounting : 32-pin plastic QFN package (5.0 × 5.0 × 0.75 mm)

APPLICATION

- Digital CATV
- Cable modem receivers

ORDERING INFORMATION

Part Number	Order Number	Package	Marking	Supplying Form
μPC3228T5S-E2	μPC3228T5S-E2-A	32-pin plastic QFN (Pb-Free)	C3228	• Embossed tape 12 mm wide • Pin 8,9 face the perforation side of the tape • Qty 2.5 kpcs/reel • Dry pack specification

Remark To order evaluation samples, contact your nearby sales office.
Part number for sample order: μPC3228T5S

Caution Observe precautions when handling because these devices are sensitive to electrostatic discharge.

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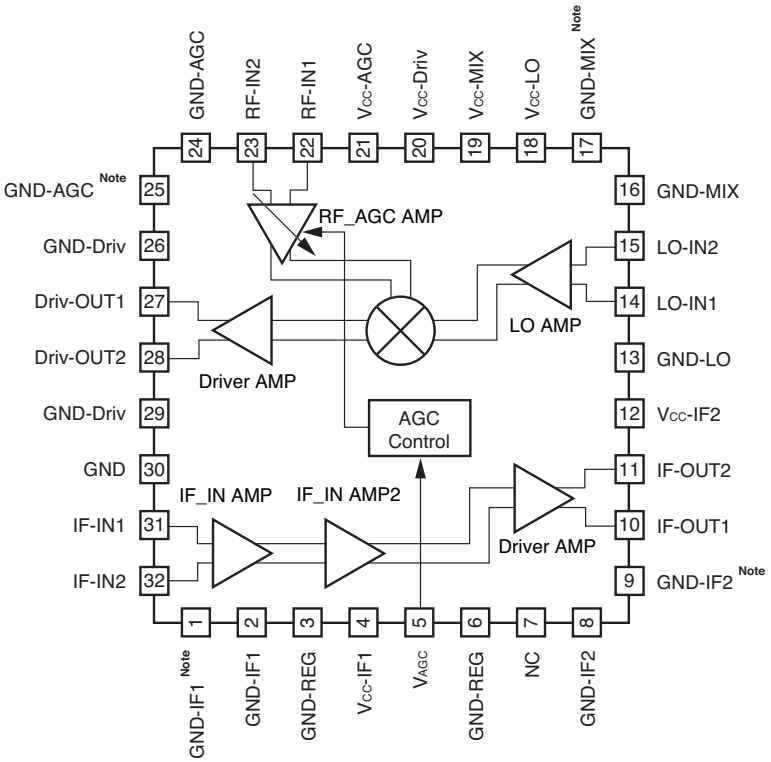
INTERNAL BLOCK DIAGRAM AND PIN CONFIGURATION

(Top View)



Note 1, 9, 17, 25-pin: Connected to the lead frame.

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Conditions	Ratings	Unit
Supply Voltage	V_{CC}	T_A = +25°C	6.0	V
Power Dissipation	P_D	T_A = +80°C **Note**	800	mW
Operating Ambient Temperature	T_A	**Note**	–20 to +80	°C
Storage Temperature	T_{stg}		–55 to +150	°C

Note Mounted on double-sided copper-clad 50 × 50 × 1.6 mm epoxy glass PWB

RECOMMENDED OPERATING RANGE (T_A = +25°C, unless otherwise specified)

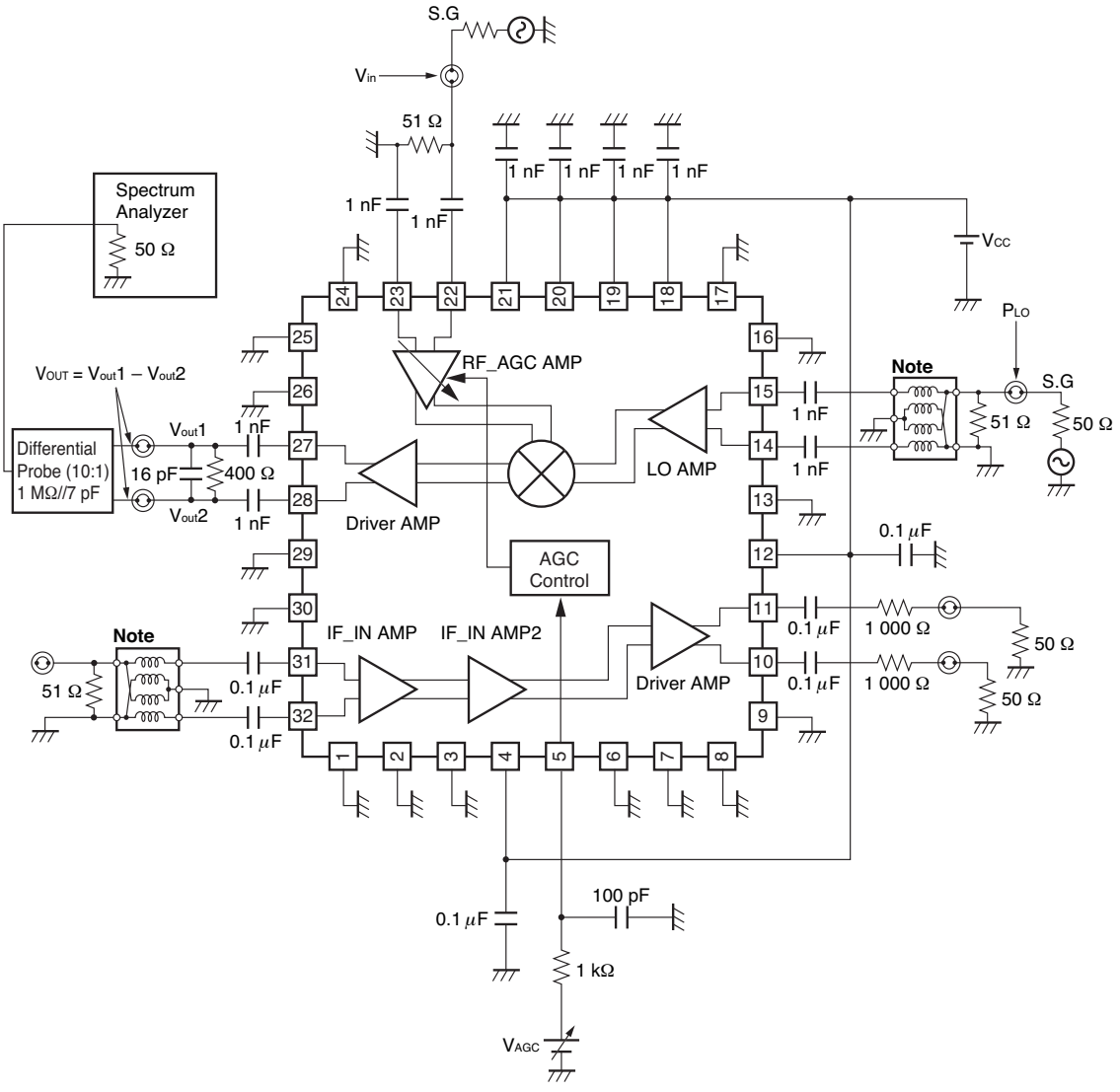
Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Supply Voltage	V_{CC}		4.5	5.0	5.5	V
Operating Ambient Temperature	T_A	V_{CC} = 4.5 to 5.5 V	–20	+25	+80	°C
Gain Control Voltage Range	V_{AGC}		0	–	3.3	V
RF Operating Frequency Range	$f_{RF\ (BW)}$		20	–	800	MHz
IF Operating Frequency Range	$f_{IF\ (BW)}$		20	–	100	MHz

ELECTRICAL CHARACTERISTICS (T_A = +25°C, V_{CC} = 5 V, unless otherwise specified)

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
DC Characteristics						
Circuit Current	I_{CC}	No input signal **Note 1**	65	85	110	mA
AGC Voltage High Level	$V_{AGC (H)}$	@ Maximum gain **Note 1**	2.5	–	3.5	V
AGC Voltage Low Level	$V_{AGC (L)}$	@ Minimum gain **Note 1**	–	0	–	V
RF Characteristics (RF AGC Amplifier Block + Mixer Block + Driver Amplifier: f_{RF} = 80 MHz, f_{LO} = 130 MHz, P_{LO} = –10 dBm, Z_S = 50 Ω, Z_L = 400 Ω/16 pF)						
RF Input Frequency Range	f_{RF}	f_C = –3 dB **Note 1**	20	–	800	MHz
RF Gain Control Range	GCR1	V_{AGC} = 0 to 2.5 V **Note 1**	62	70	–	dB
Mixer Conversion Gain	CG	V_{AGC} = 2.5 V Differential-IN: V_{in} = +18 dBmV **Note 1**	25	28	31	dB
3rd Order Intermodulaion Distortion	$IM_3$1	f1 = 44 MHz, f2 = 45 MHz, V_{in} = +30 dBmV/tone, Single Ended-OUT = 0.5 V_{p-p}/tone **Note 1**	47	57	–	dBc
Noise Figure	NF1	V_{AGC} = 2.5 V, f = 50 MHz, Differential-Output **Note 2**	–	8.3	–	dB
IF Characteristics (IF Amplifier Block + Driver Amplifier: f_{IF} = 50 MHz, Z_S = 50 Ω, Z_L = 2 100 Ω)						
IF Input Frequency Range	f_{IF}	f_C = –3 dB **Note 5**	20	–	100	MHz
IF Amplifier Gain	G_V	V_{in} = –7 dBmV, Differential-IN/OUT **Note 5**	56	59	62	dB
3rd Order Intermodulaion Distortion	$IM_3$2	f1 = 49.5 MHz, f2 = 50.5 MHz, V_{out} = 110 dBu/tone, Differential-IN/OUT **Note 5**	45	55	–	dBc
IF Output Voltage	V_{out}	Single Ended-Output **Note 5**	–	1.0	–	V_{p-p}
Noise Figure	NF2	V_{AGC} = 0 V, f = 50 MHz, Single Ended-Output **Note 2**	–	3.0	–	dB
Total Block (RF AGC Amplifier + Mixer + Driver Amplifier + SAW Filter + IF Ampliter + Driver Amplifier), SAW Filter : EPCOS X6889M (f_{IF} = 49 MHz, P_{LO} = –10 dBm, f_{RF} = 70 to 130 MHz, Z_S = 50 Ω, Z_L = 1 050 Ω)						
LO-RF Leakage	LO_{RF}	V_{AGC} = 2.5 V, 22-pin 75 Ω Termination f_{LO} = 110 to 180 MHz **Note 3**	–	–54	–44	dBmV
LO-IF Leakage	LO_{IF}	V_{AGC} = 2.5 V, V_{out} = 0.7 V_{p-p} Single Ended-Output f_{RF} = 130 MHz, f_{LO} = 179 MHz **Note 4**	–	–40	–25	dBc

Notes 1. By measurement circuit 1
2. By measurement circuit 2
3. By measurement circuit 3
4. By measurement circuit 4
5. By measurement circuit 5

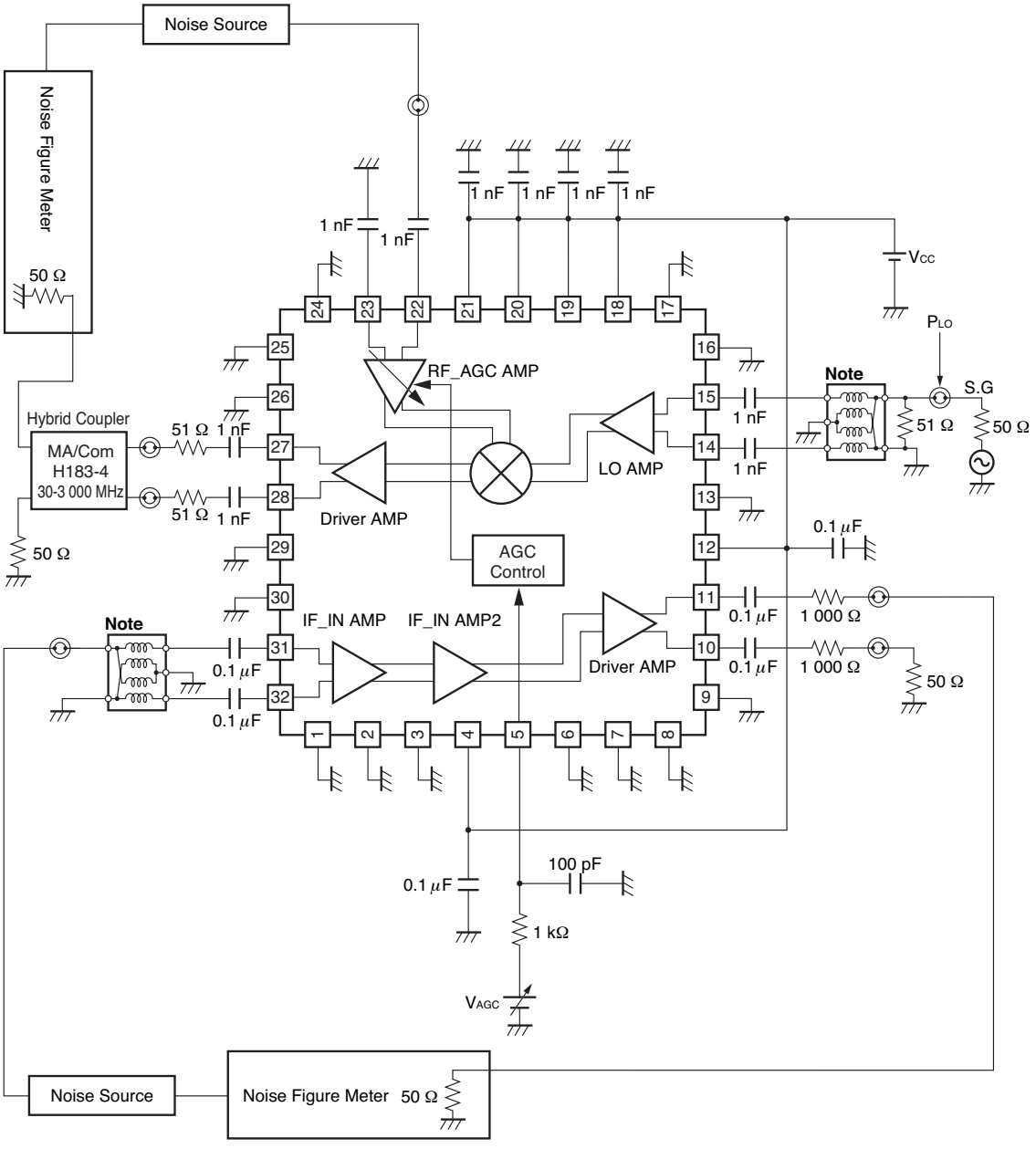
MEASUREMENT CIRCUIT 1



Note Balun Transformer : TOKO 617DB-1674 B4F (Double balanced type)

MEASUREMENT CIRCUIT 2

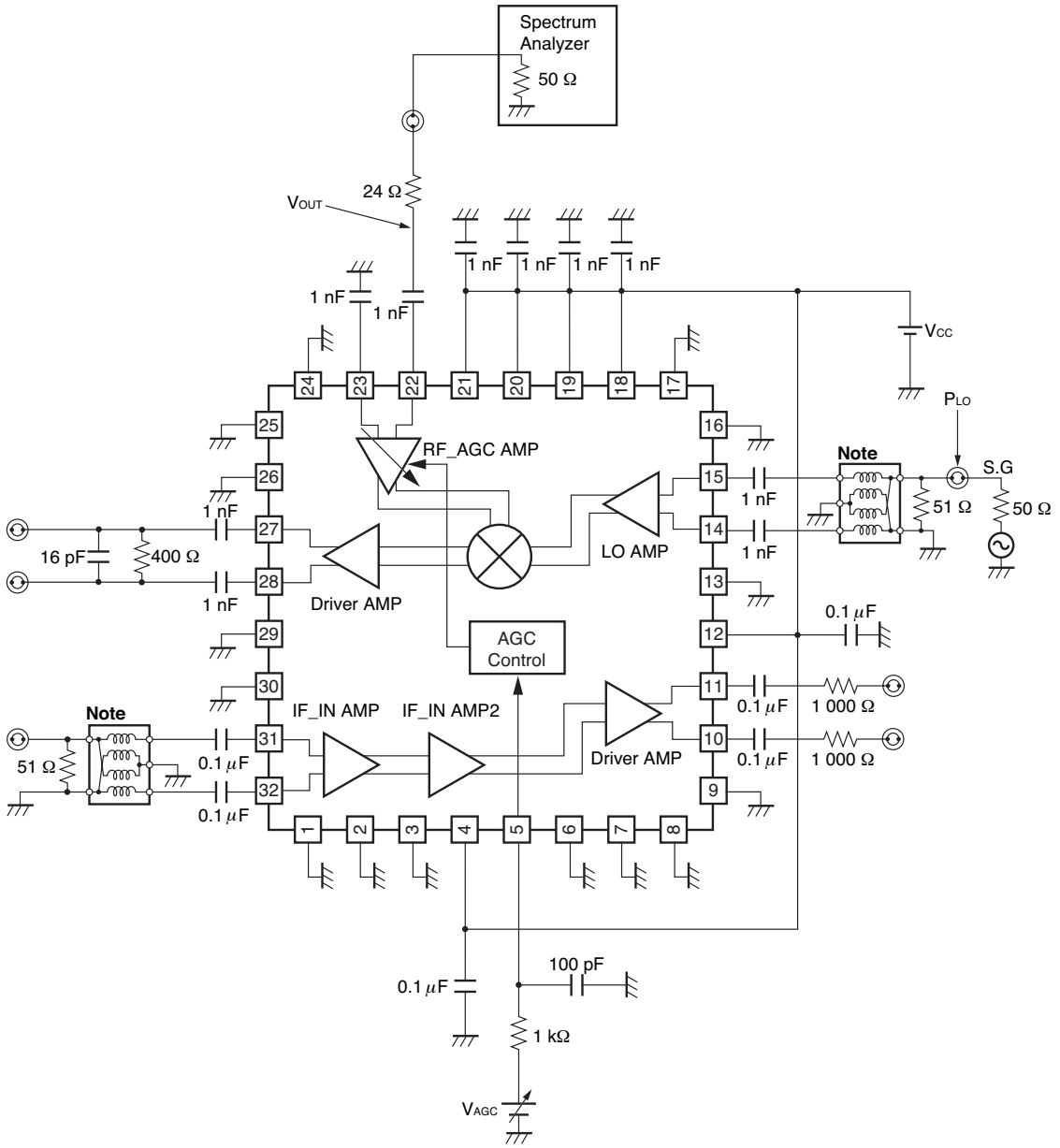
Noise Figure



Note Balun Transformer : TOKO 617DB-1674 B4F (Double balanced type)

MEASUREMENT CIRCUIT 3

Lo-RF Leakage

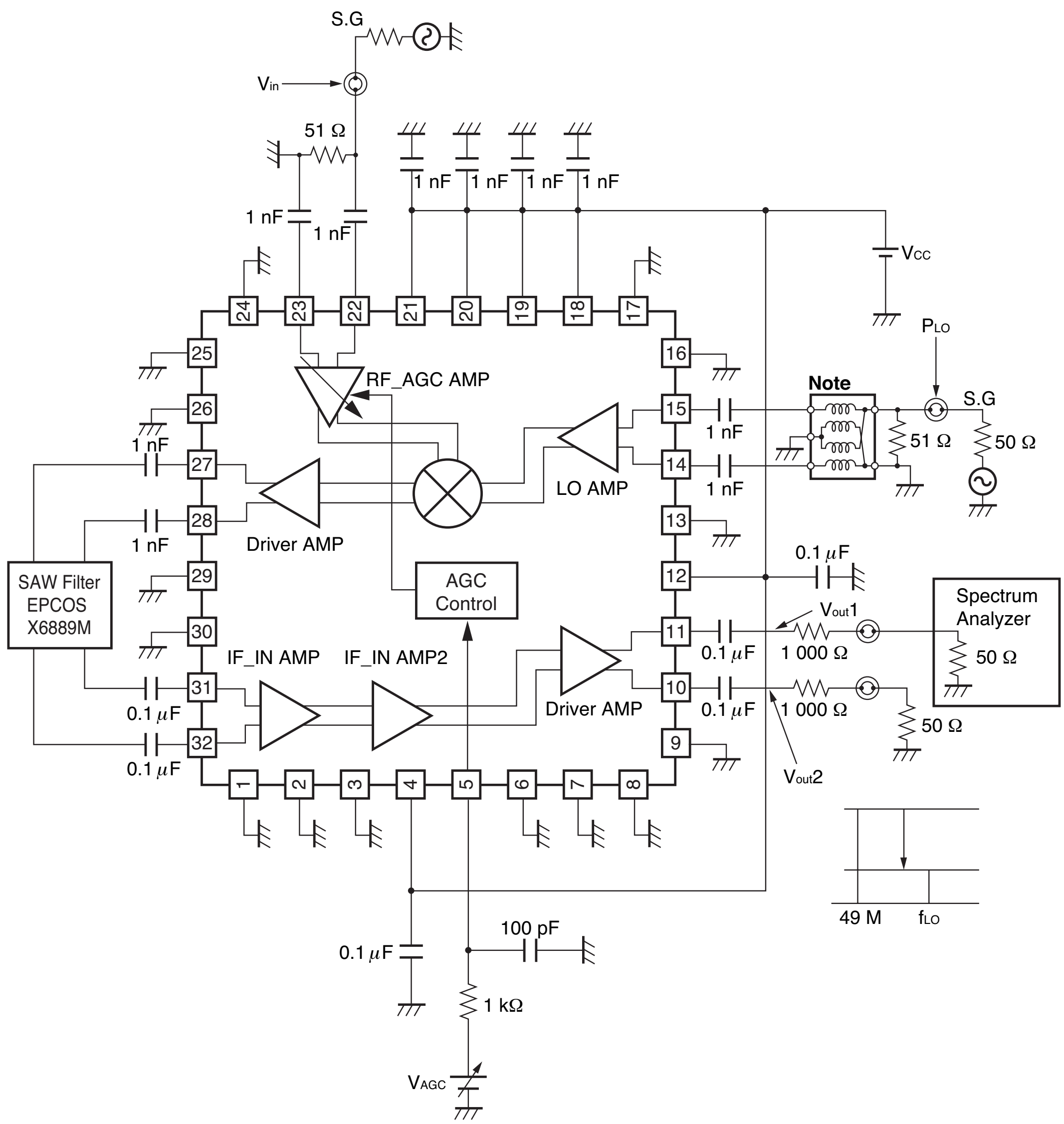


Note Balun Transformer : TOKO 617DB-1674 B4F (Double balanced type)

MEASUREMENT CIRCUIT 4

(f_{RF} = 70 to 130 MHz (f_{IF} = 49.1 MHz ± 0.6 MHz), f_{LO} = 119 to 179 MHz, P_{LO} = −10 dBm, V_{out} = 0.7 V_{p-p} (Single Ended))

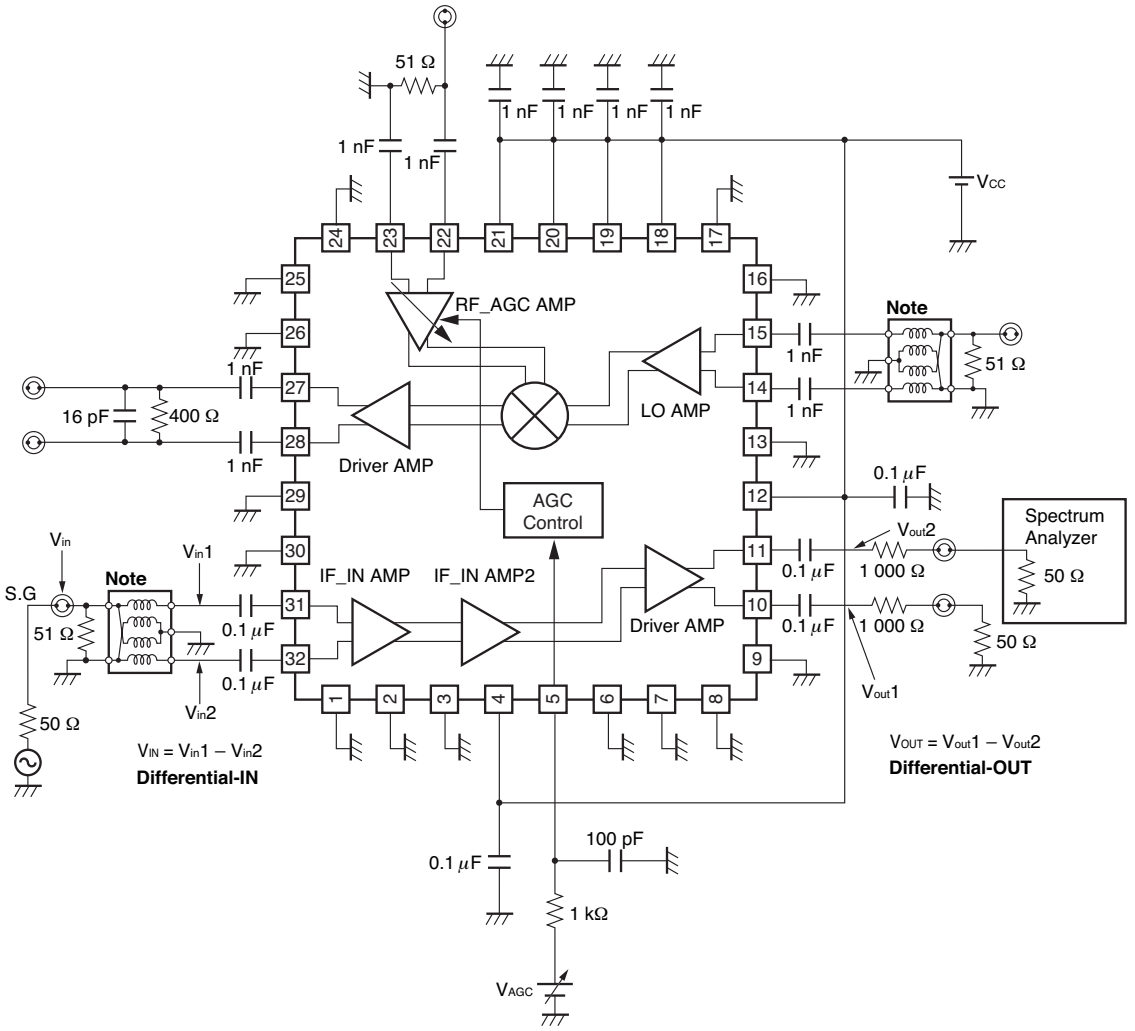
LO-IF Leakage



Note Balun Transformer : TOKO 617DB-1674 B4F (Double balanced type)

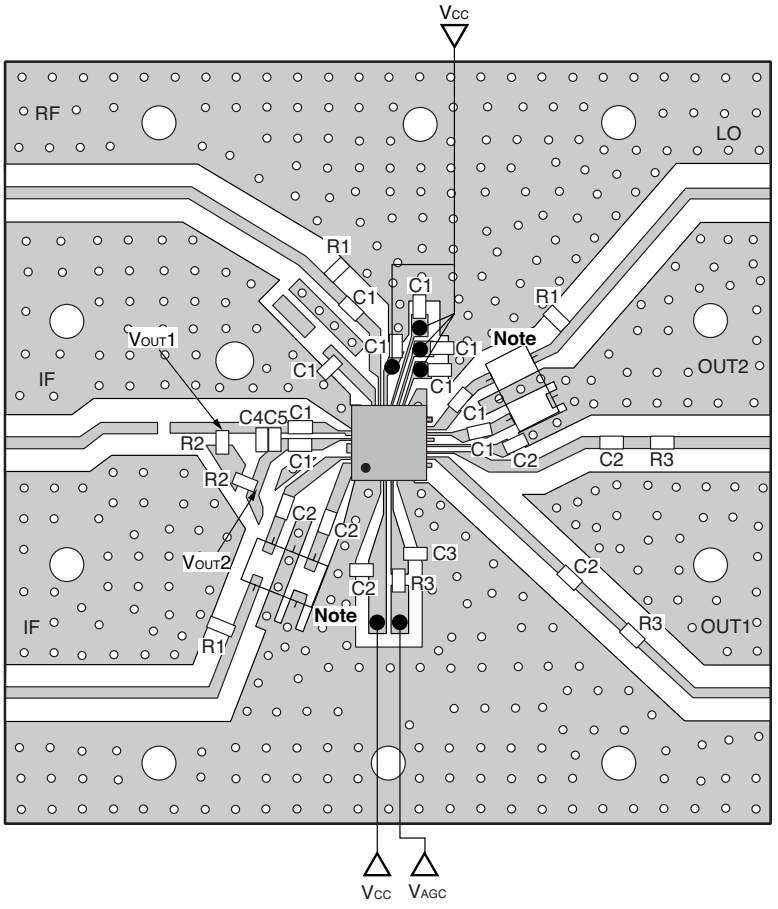
MEASUREMENT CIRCUIT 5

IF Block



Note Balun Transformer : TOKO 617DB-1674 B4F (Double balanced type)

ILLUSTRATION OF THE EVALUATION BOARD



Note Balun Transformer : TOKO 617DB-1674 B4F (Double balanced type)

Remarks

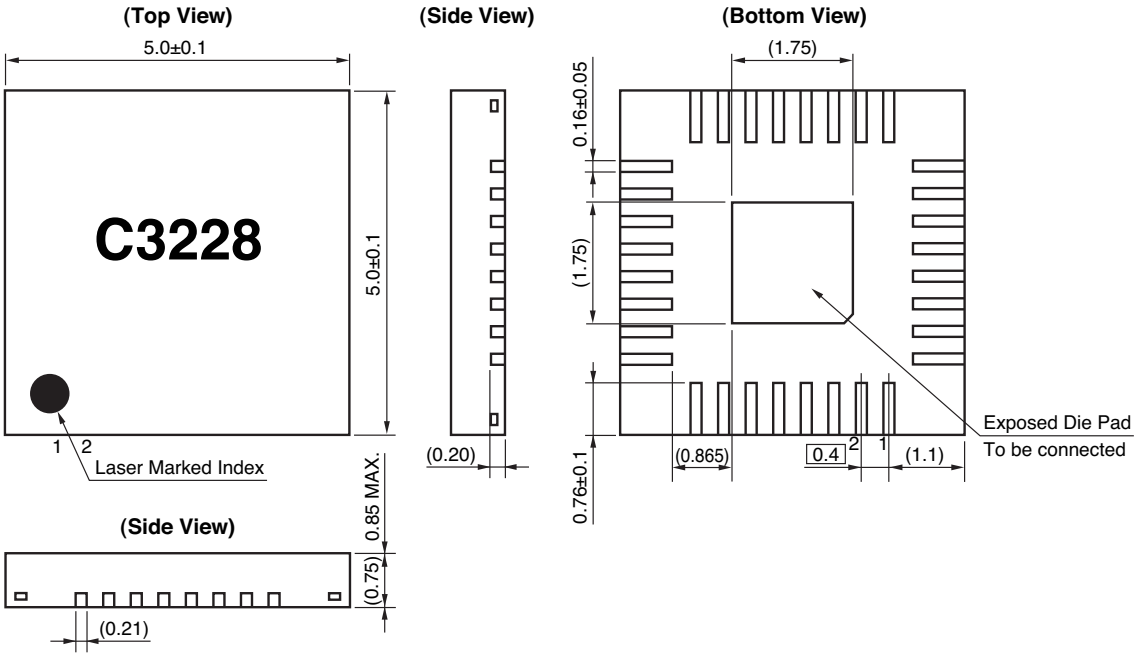
1. Back side: GND pattern
2. Solder plated on pattern
3. ○ : Through hole

USING THE NEC EVALUATION BOARD

Symbol	Values	Maker	Part Number	Size
C1	1 nF	Murata	GRM39CH	1608
C2	0.1 μF	Murata	GRM39B	1608
C3	100 pF	Murata	GRM39CH	1608
C4	10 pF	Murata	GRM36B	1005
C5	6 pF	Murata	GRM36B	1005
R1	51 Ω	Susumu	RR0816 510SSM	1608
R2	200 Ω	Susumu	RR0816 201SSM	1608
R3	1 000 Ω	Susumu	RR0816 102SSM	1608

PACKAGE DIMENSIONS

32-PIN PLASTIC QFN (UNIT: mm)



NOTES ON CORRECT USE

(1) Observe precautions for handling because of electro-static sensitive devices.

(2) Form a ground pattern as widely as possible to minimize ground impedance (to prevent undesired oscillation). All the ground terminals must be connected together with wide ground pattern to decrease impedance difference.

(3) The bypass capacitor should be attached to V_{CC} line.

RECOMMENDED SOLDERING CONDITIONS

This product should be soldered and mounted under the following recommended conditions. For soldering methods and conditions other than those recommended below, contact your nearby sales office.

Soldering Method	Soldering Conditions		Condition Symbol
Infrared Reflow	Peak temperature (package surface temperature) Time at peak temperature Time at temperature of 220°C or higher Preheating time at 120 to 180°C Maximum number of reflow processes Maximum chlorine content of rosin flux (% mass)	: 260°C or below : 10 seconds or less : 60 seconds or less : 120±30 seconds : 3 times : 0.2%(Wt.) or below	IR260
Wave Soldering	Peak temperature (molten solder temperature) Time at peak temperature Preheating temperature (package surface temperature) Maximum number of flow processes Maximum chlorine content of rosin flux (% mass)	: 260°C or below : 10 seconds or less : 120°C or below : 1 time : 0.2%(Wt.) or below	WS260
Partial Heating	Peak temperature (terminal temperature) Soldering time (per side of device) Maximum chlorine content of rosin flux (% mass)	: 350°C or below : 3 seconds or less : 0.2%(Wt.) or below	HS350

Caution Do not use different soldering methods together (except for partial heating).

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Subject: Compliance with EU Directives

CEL certifies, to its knowledge, that semiconductor and laser products detailed below are compliant with the requirements of European Union (EU) Directive 2002/95/EC Restriction on Use of Hazardous Substances in electrical and electronic equipment (RoHS) and the requirements of EU Directive 2003/11/EC Restriction on Penta and Octa BDE.

CEL Pb-free products have the same base part number with a suffix added. The suffix –A indicates that the device is Pb-free. The –AZ suffix is used to designate devices containing Pb which are exempted from the requirement of RoHS directive (*). In all cases the devices have Pb-free terminals. All devices with these suffixes meet the requirements of the RoHS directive.

This status is based on CEL's understanding of the EU Directives and knowledge of the materials that go into its products as of the date of disclosure of this information.

Restricted Substance per RoHS	Concentration Limit per RoHS (values are not yet fixed)	Concentration contained in CEL devices	
Lead (Pb)	< 1000 PPM	-A	-AZ
		Not Detected	(*)
Mercury	< 1000 PPM	Not Detected	
Cadmium	< 100 PPM	Not Detected	
Hexavalent Chromium	< 1000 PPM	Not Detected	
PBB	< 1000 PPM	Not Detected	
PBDE	< 1000 PPM	Not Detected	

If you should have any additional questions regarding our devices and compliance to environmental standards, please do not hesitate to contact your local representative.