

DATA SHEET



BIPOLAR ANALOG INTEGRATED CIRCUIT

μ PC3228T5S

LOW DISTORTION DOWN-CONVERTER + AGC AMPLIFIER + VIDEO AMPLIFIER

DESCRIPTION

The μ PC3228T5S 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 : $I_{CC} = 85 \text{ mA TYP. @ } V_{CC} = 5 \text{ V}$
- AGC AMPLIFIER + MIXER + DRIVER BLOCK : $f_{RF(BW)} = 20 \text{ to } 800 \text{ MHz}$
: $CG = 28 \text{ dB TYP.}$
: $GCR = 70 \text{ dB TYP.}$
: $IM_3 = 47 \text{ dBc MIN./57 dBc TYP. @ Single Ended-OUT} = 0.5 \text{ V}_{p-p}/\text{tone}$
- VIDEO AMPLIFIER BLOCK : $G_V = 59 \text{ dB TYP.}$
: $f_{IF(BW)} = 20 \text{ to } 100 \text{ MHz}$
: $IM_3 = 45 \text{ dBc MIN./55 dBc TYP. @ Output} = 110 \text{ dBu/tone, Differential-out}$
- 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
μ PC3228T5S-E2	μ PC3228T5S-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

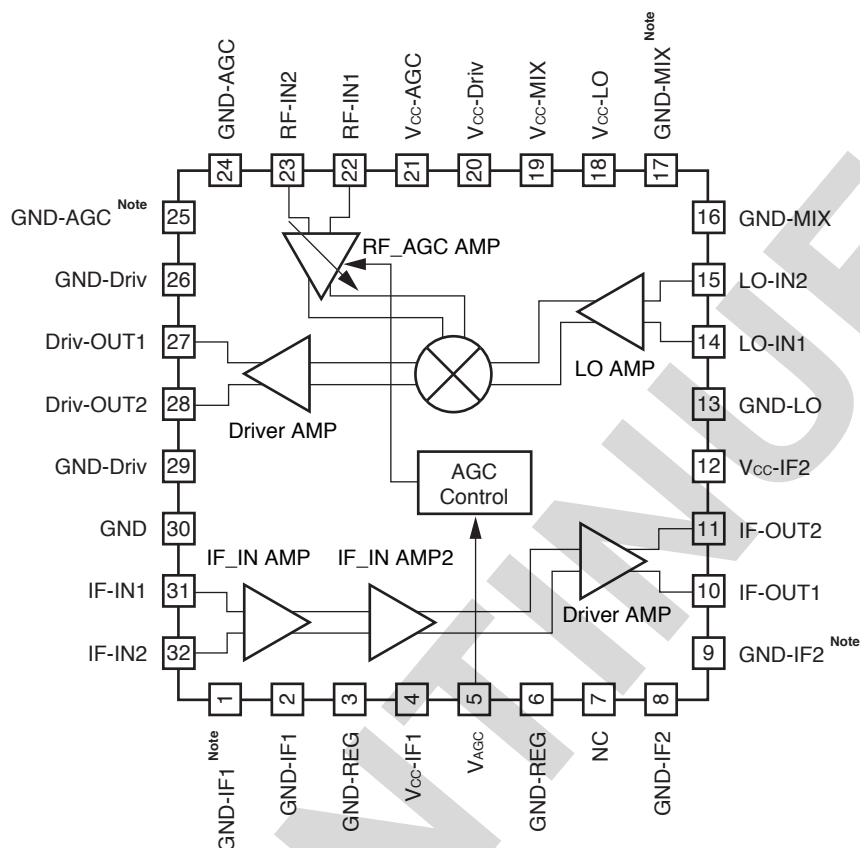
Remark To order evaluation samples, contact your nearby sales office.
Part number for sample order: μ PC3228T5S-A

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

The information in this document is subject to change without notice. Before using this document, please confirm that this is the latest version.

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}	$T_A = +25^{\circ}\text{C}$	6.0	V
Power Dissipation	P_D	$T_A = +80^{\circ}\text{C}$ Note	800	mW
Operating Ambient Temperature	T_A	Note	-20 to +80	$^{\circ}\text{C}$
Storage Temperature	T_{stg}		-55 to +150	$^{\circ}\text{C}$

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

RECOMMENDED OPERATING RANGE ($T_A = +25^{\circ}\text{C}$, 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	$^{\circ}\text{C}$
Gain Control Voltage Range	V_{AGC}		0	–	3.3	V
RF Operating Frequency Range	$f_{RF} \text{ (BW)}$		20	–	800	MHz
IF Operating Frequency Range	$f_{IF} \text{ (BW)}$		20	–	100	MHz

ELECTRICAL CHARACTERISTICS ($T_A = +25^\circ\text{C}$, $V_{CC} = 5\text{ V}$, 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: $f_{RF} = 80\text{ MHz}$, $f_{LO} = 130\text{ MHz}$, $P_{LO} = -10\text{ dBm}$, $Z_S = 50\ \Omega$, $Z_L = 400\ \Omega/16\text{ pF}$)						
RF Input Frequency Range	f_{RF}	$f_c = -3\text{ dB}$ Note 1	20	–	800	MHz
RF Gain Control Range	GCR1	$V_{AGC} = 0\text{ to }2.5\text{ V}$ Note 1	62	70	–	dB
Mixer Conversion Gain	CG	$V_{AGC} = 2.5\text{ V}$ Differential-IN: $V_{in} = +18\text{ dBmV}$ Note 1	25	28	31	dB
3rd Order Intermodulation Distortion	IM31	$f_1 = 44\text{ MHz}$, $f_2 = 45\text{ MHz}$, $V_{in} = +30\text{ dBmV/tone}$, Single Ended-OUT = $0.5\text{ V}_{p-p}/\text{tone}$ Note 1	47	57	–	dBc
Noise Figure	NF1	$V_{AGC} = 2.5\text{ V}$, $f = 50\text{ MHz}$, Differential-Output Note 2	–	8.3	–	dB
IF Characteristics (IF Amplifier Block + Driver Amplifier: $f_{IF} = 50\text{ MHz}$, $Z_S = 50\ \Omega$, $Z_L = 2\ 100\ \Omega$)						
IF Input Frequency Range	f_{IF}	$f_c = -3\text{ dB}$ Note 5	20	–	100	MHz
IF Amplifier Gain	Gv	$V_{in} = -7\text{ dBmV}$, Differential-IN/OUT Note 5	56	59	62	dB
3rd Order Intermodulation Distortion	IM32	$f_1 = 49.5\text{ MHz}$, $f_2 = 50.5\text{ MHz}$, $V_{out} = 110\text{ dBu/tone}$, 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	$V_{AGC} = 0\text{ V}$, $f = 50\text{ MHz}$, Single Ended-Output Note 2	–	3.0	–	dB
Total Block (RF AGC Amplifier + Mixer + Driver Amplifier + SAW Filter + IF Amplifier + Driver Amplifier), SAW Filter : EPCOS X6889M ($f_{IF} = 49\text{ MHz}$, $P_{LO} = -10\text{ dBm}$, $f_{RF} = 70\text{ to }130\text{ MHz}$, $Z_S = 50\ \Omega$, $Z_L = 1\ 050\ \Omega$)						
LO-RF Leakage	LO _{RF}	$V_{AGC} = 2.5\text{ V}$, 22-pin $75\ \Omega$ Termination $f_{LO} = 110\text{ to }180\text{ MHz}$ Note 3	–	–54	–44	dBmV
LO-IF Leakage	LO _{IF}	$V_{AGC} = 2.5\text{ V}$, $V_{out} = 0.7\text{ V}_{p-p}$ Single Ended-Output $f_{RF} = 130\text{ MHz}$, $f_{LO} = 179\text{ MHz}$ Note 4	–	–40	–25	dBc

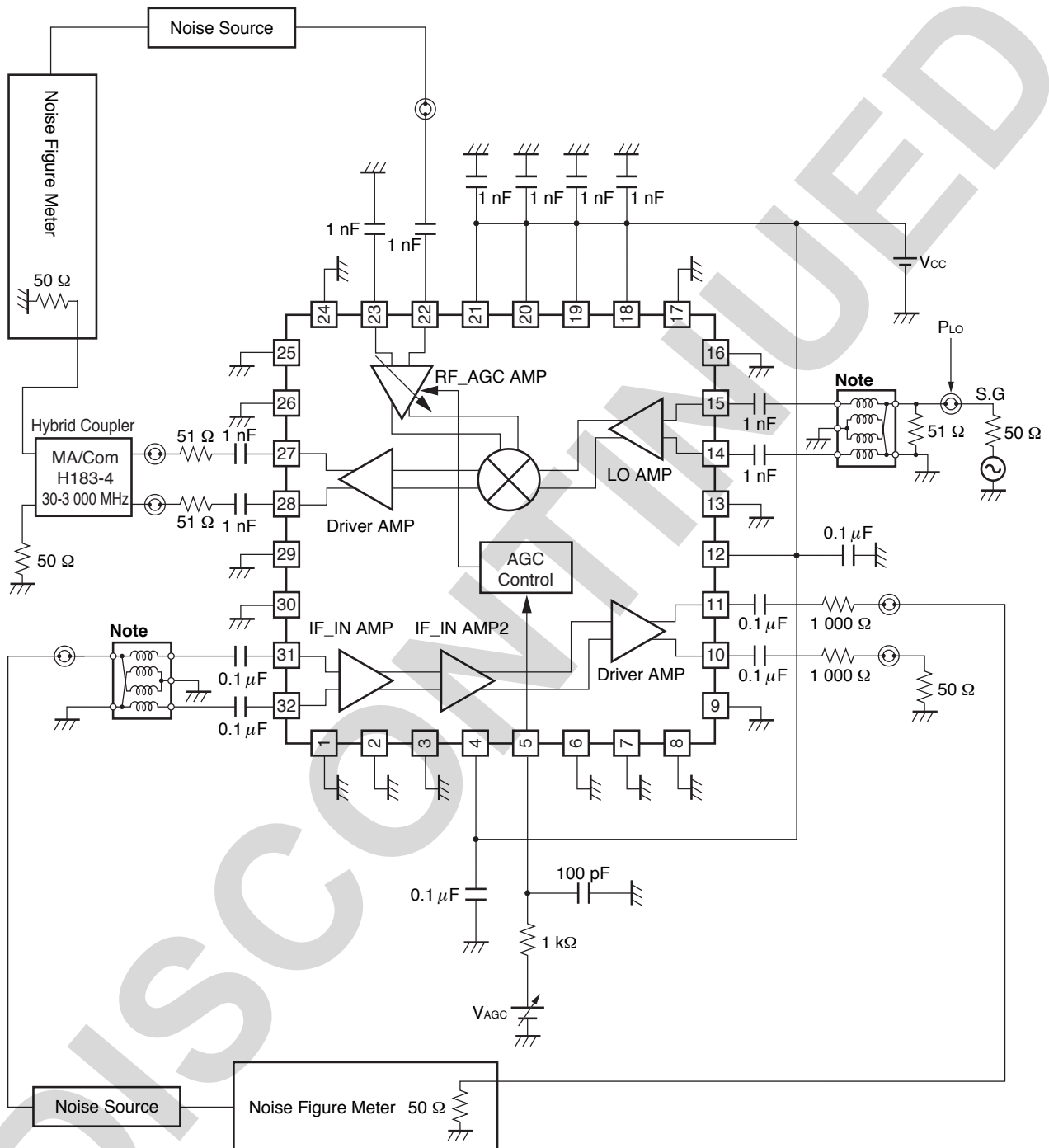
Notes 1. By measurement circuit 1**2.** By measurement circuit 2**3.** By measurement circuit 3**4.** By measurement circuit 4**5.** By measurement circuit 5

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

MEASUREMENT CIRCUIT 2

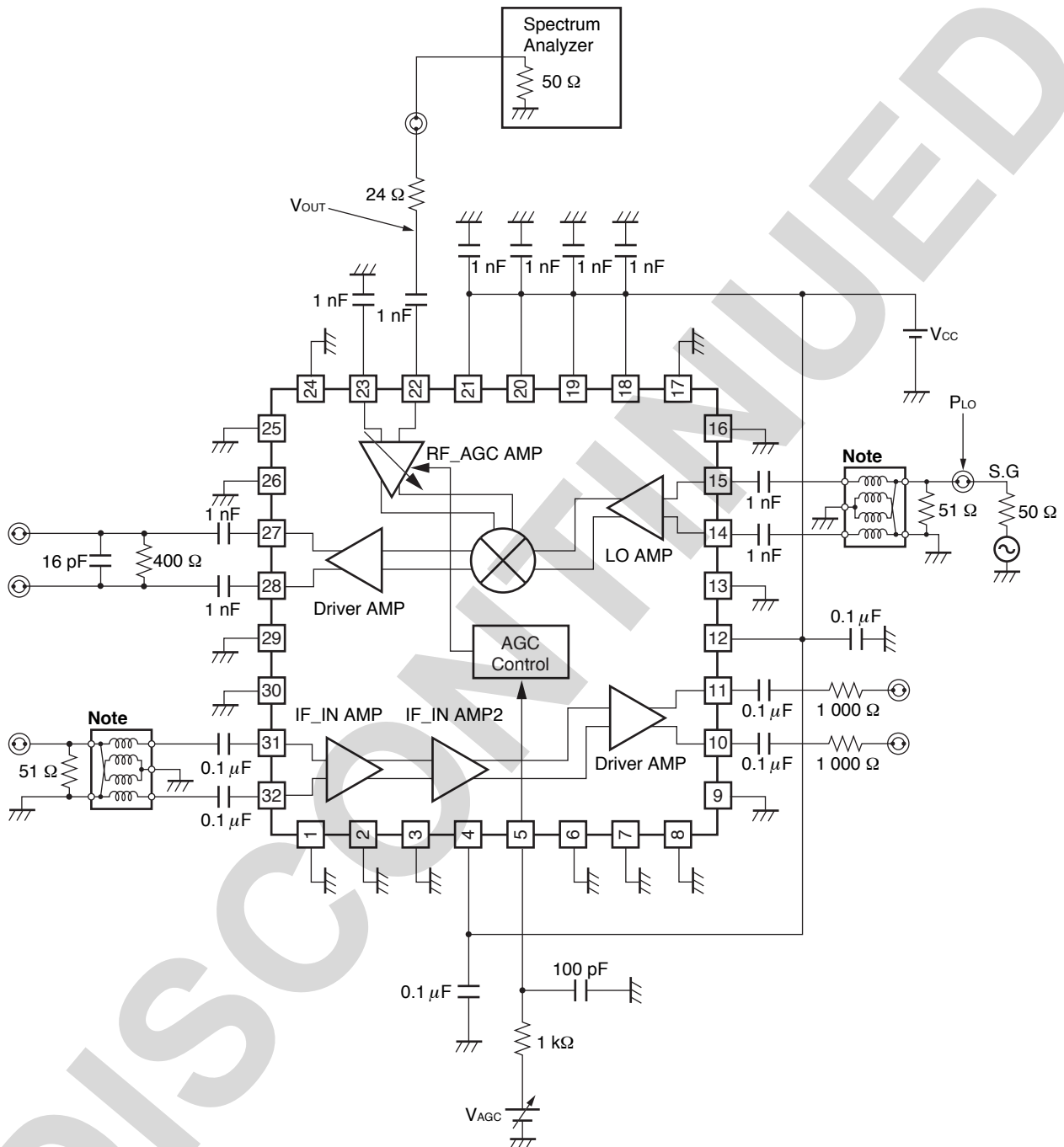
Noise Figure



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

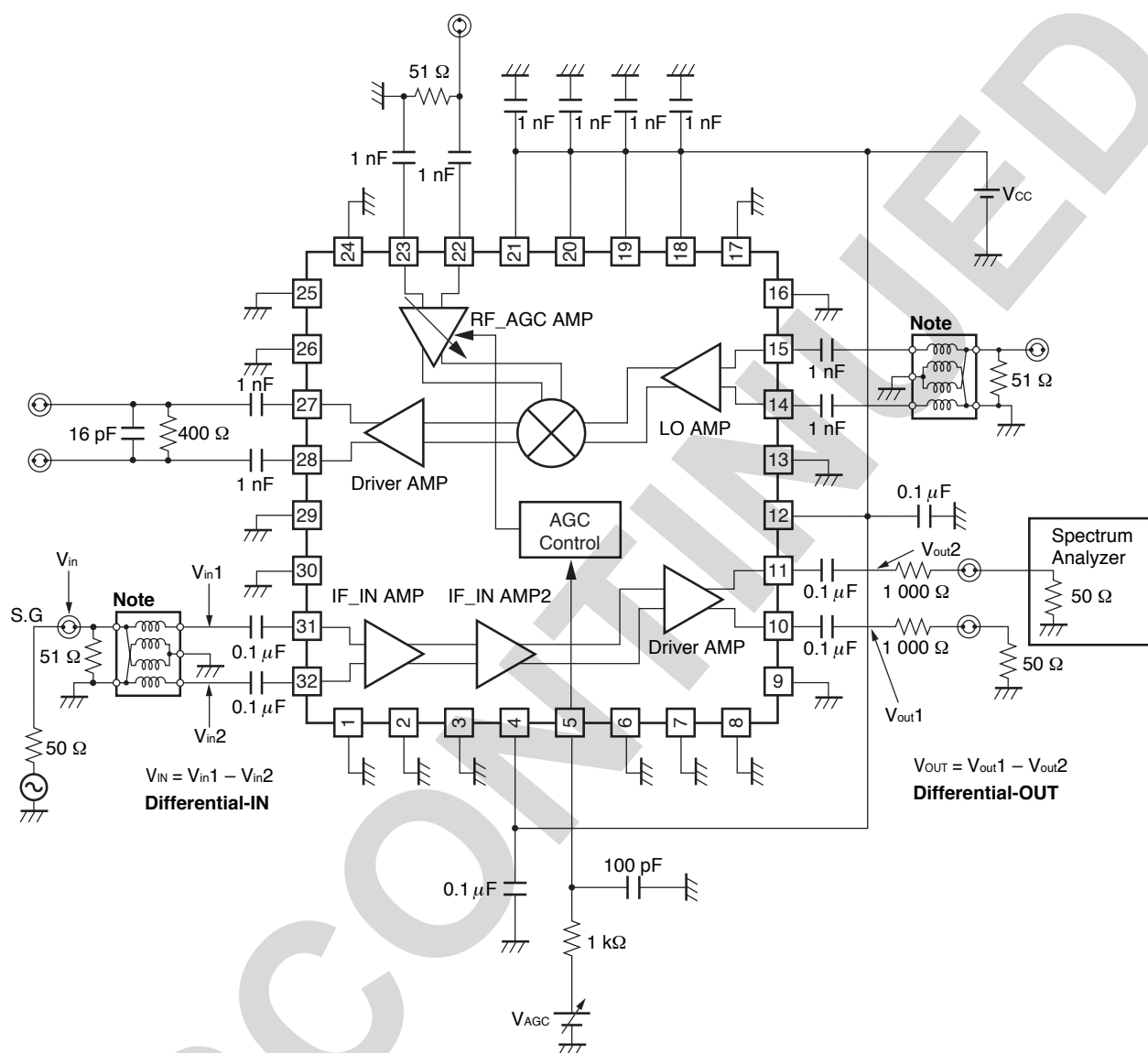
MEASUREMENT CIRCUIT 3

Lo-RF Leakage



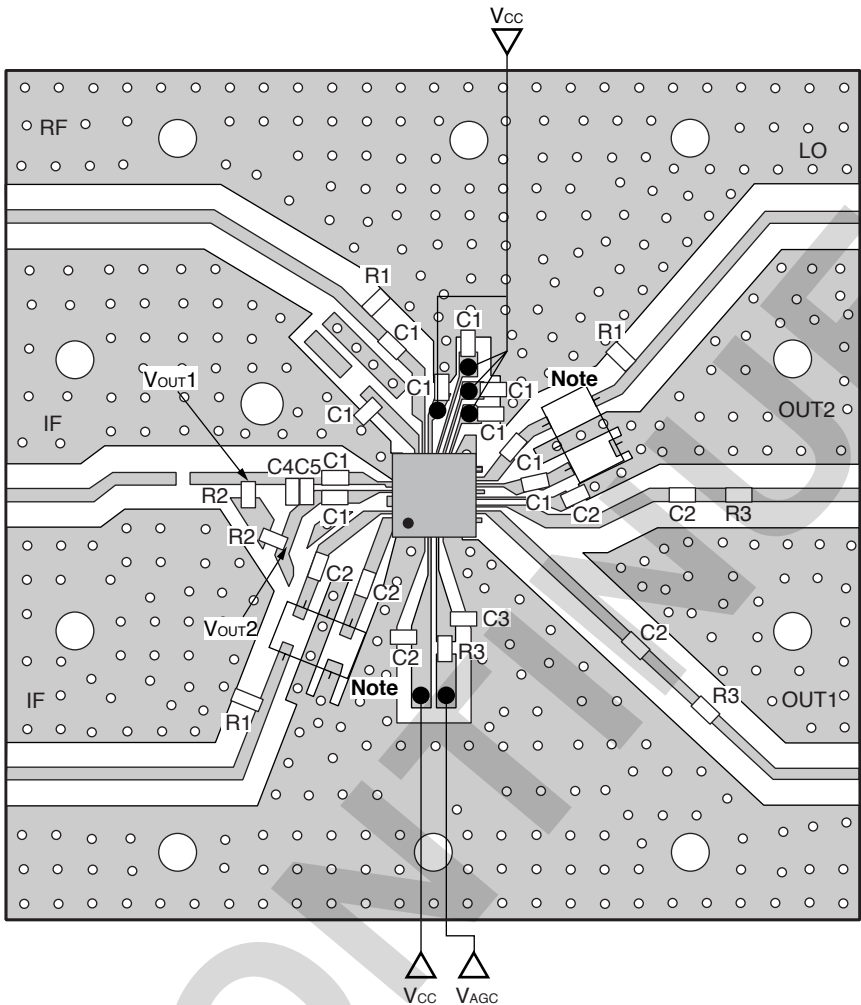
Note Balun Transformer : TOKO 617DB-1674 B4F (Double balanced type)

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

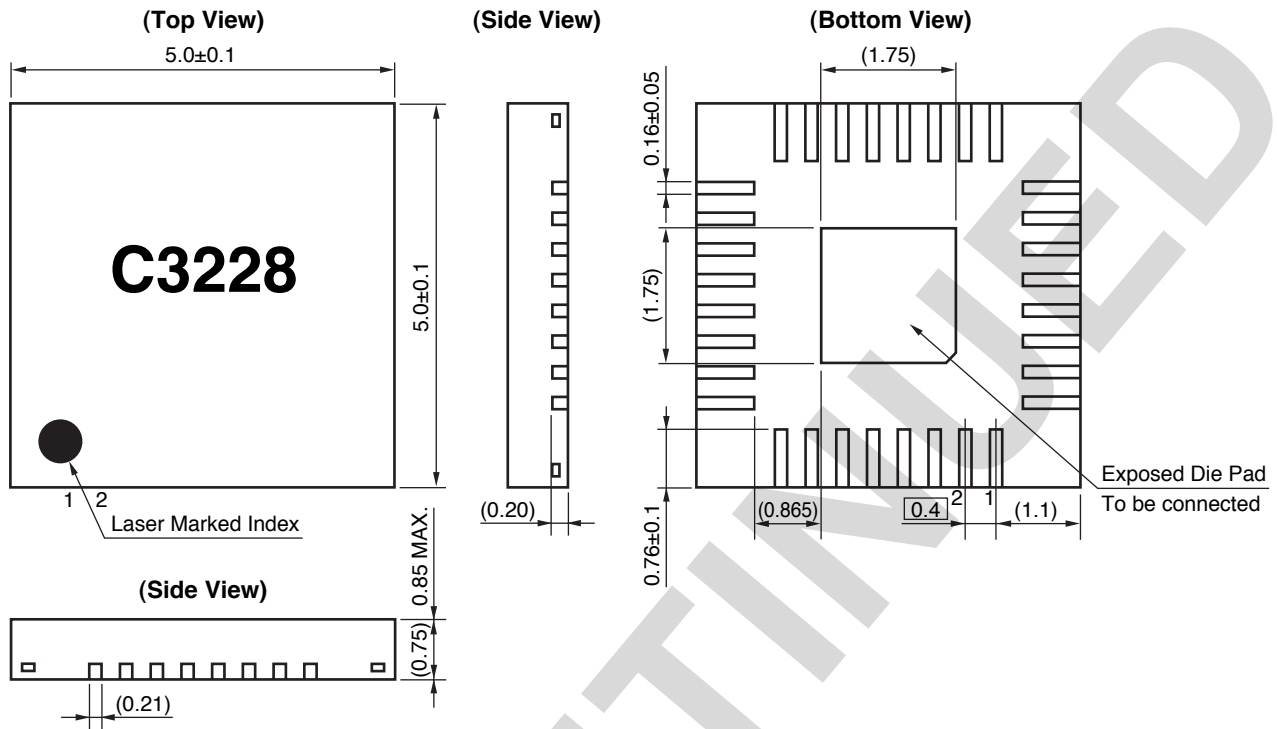
- 1. Back side: GND pattern
- 2. Solder plated on pattern
- 3. o O : Through hole

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

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