



# BIPOLAR ANALOG INTEGRATED CIRCUIT $\mu PC2794GS$

# FREQUENCY DOWN CONVERTER FOR VHF TO UHF BAND TV/VCR TUNER

# DESCRIPTION

The  $\mu$ PC2794GS is a Silicon monolithic IC designed for TV/VCR tuner applications. This IC consists of a double balanced mixer (DBM), local oscillator, preamplifier for precscaler operation, IF amplifier, regulator, UHF/VHF switching circuit, and so on. This one-chip IC covers a wide frequency band from VHF to UHF bands. This IC is packaged in 20-pin SOP (Small Outline Package) suitable for surface mounting.

## **FEATURES**

- VHF to UHF bands operation.
- Low distortion CM: VHF (@free 470 MHz) 96 dB $\mu$ 
  - UHF (@frf = 890 MHz) 92 dB $\mu$
- Supply voltage : 9 V
- Packaged in 20-pin SOP suitable for surface mounting

# **ORDERING INFORMATION**

Part Number	Package	Package Style
μPC2794GS-E1	20-pin plastic SOP (300 mil)	Embossed tape 24 mm wide. 2.5 k/REEL. Pin 1 indicates pull-out direction of tape

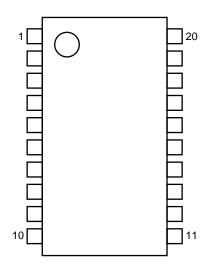
For evaluation sample order, please contact your local NEC office. (Part number for sample order: µPC2794GS)

Caution electro-static sensitive device

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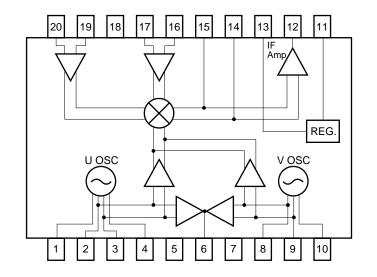
Document No. P11888EJ3V0DS00 (3rd edition) Date Published October 1999 N CP(K) Printed in Japan The mark \* shows major revised points.

# PIN CONFIGURATION (Top View)



2.	UHF OSC Base UHF OSC Collector	(Tr. 2) (Tr. 1)
•••	OSC OUTPUT	
7.	GND	
8.	VHF OSC Base	(Tr. 1)
9.	VHF OSC Base	(Tr. 2)
10.	VHF OSC Collector	(Tr. 1)
11.	REG	
12.	IF OUTPUT	
13.	Vcc	
14.	MIX OUTPUT	
15.	MIX OUTPUT	
16.	VHF RF INPUT	
17.	VHF RF INPUT	
18.	GND	
19.	UHF RF INPUT	
20.	UHF RF INPUT	

# **INTERNAL BLOCK DIAGRAM**



# PIN EXPLANATION

Pin No.	Symbol	Pin Voltage TYP. above: VHF mode below: UHF mode	Function and Explanation	Equivalent Circuit
1	UOSC collector (Tr. 1)	6.90 6.25	Collector pin of UHF oscillator. Assemble LC resonator with 2 pin through capacitor $\simeq$ 1 pF to oscillate with active feedback loop.	
2	UOSC base (Tr. 2)	6.00 3.90	Base pin of UHF oscillator with balance amplifier. Connected to LC resonator through feedback capacitor $\simeq$ 300 pF.	
3	UOSC base (Tr. 1)	6.00	Base pin of UHF oscillator with balance amplifier. Connected to LC resonator	
4	UOSC collector (Tr. 2)	6.90	through feedback capacitor $\geq$ 300 pF. Collector pin of UHF oscillator with balance amplifier. Assemble LC resonator with 3 pin through capacitor $\simeq$ 1 pF to oscillate with	
		6.25	active feedback loop. Double balanced oscillator with transistor 1 and transistor 2.	
5	UB	9.0	Switching pin for VHF or UHF operation. VHF operation = open	
6	OSC output	5.40	UHF operation = 9.0 V UHF and VHF oscillator output pin. In case of F/S tuner application, connected PLL symthesizer IC's input pin.	REG
		5.40		G T T T T T T T T T T T T T
7	GND	0.0	GND pin of VHF and UHF oscillator.	
8	VOSC	3.50	Base pin of VHF oscillator.	
	base (Tr. 1)	5.90	Grounded through capacitor ~ 10 pF.	8 10 9 REG
9	VOSC base	3.50	Base pin of VHF oscillator. Assemble LC resonator with	
	(Tr. 2)	5.90	10 pin to oscillate with active feedback loop.	
10	VOSC collector	6.20	Collector pin of VHF oscillator. Connected to LC resonator	
	(Tr. 1)	6.90	through feedback capacitor $\simeq$ 3 pF.	

Pin No.	Symbol	Pin Voltage TYP. above: VHF mode below: UHF mode	Function and Explanation	Equivalent Circuit		
11	REG	6.90	Monitor pin of regulator output			
		6.90	voltage.			
12	IF output	2.60	IF output pin of VHF-UHF band functions.			
		2.60				
13	Vcc	9.0	Power supply pin for VHF-			
		9.0	UHF band functions.			
14	MIX	7.10	VHF and UHF MIX output pins.	VHF and UHF MIX output pins.	VHF and UHF MIX output pins.	
	output1	7.00	These pins should be			
15	15 MIX	MIX 7.10 adjust in	equipped with tank circuit to adjust intermediate frequency.			
	output2	7.00	adjust intermediate frequency.			
16	VRF input (bypass)	2.75	Bypass pin for VHF MIX input. Grounded through capacitor.	from VHF OSC		
		2.80				
17	VRF input	2.75	VRF signal input pin from antenna.			
		2.80				
18	GND	0.0	GND pin of MIX, IF amplifier and regulator.			
		0.0				
19	URF input (bypass)	_	Bypass pin for UHF MIX input. Grounded through capacitor.	from UHF OSC		
		2.65				
20	URF input	-	URF signal input pin from antenna.			
		2.65	1			

## ABSOLUTE MAXIMUM RATINGS (T<sub>A</sub> = 25 °C unless otherwise specified)

Parameter	Symbol	Condition	Rating	Unit
Supply Voltage 1	Vcc		11.0	V
Supply Voltage 2	UB		11.0	V
Power dissipation	PD	$T_{A} = 80 \ ^{\circ}C^{*1}$	700	mW
Operating ambient temperature	TA		-40 to +80	°C
Storage temperature	Tstg		-60 to +150	°C

\*1 Mounted on  $50\times50\times1.6$  mm double copper epoxy glass board.

# **RECOMMENDED OPERATING RANGE**

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Supply voltage 1	Vcc	8.0	9.0	10.0	V
Supply voltage 2	UB	8.0	9.0	10.0	V
Operating ambient temperature	TA	-20	+25	+80	°C

## ELECTRICAL CHARACTERISTICS (TA = 25 °C, Vcc = 9 V, fif = 45 MHz, $P_{osc}$ = -10 dBm)

Parameter	Symbol	Test Conditions		MIN.	TYP.	MAX.	Unit
Circuit Current 1	lcc1	@VHF, no input signal	*1	36.0	48.0	56.0	mA
Circuit Current 2	Icc2	@UHF, no input signal	*1	37.0	50.0	60.0	mA
Conversion Gain 1	CG1	frf = 55 MHz, Prf = -30 dBm	*2	19.5	23.0	26.5	dB
Conversion Gain 2	CG2	frf = 200 MHz, Prf = -30 dBm	*2	19.5	23.0	26.5	dB
Conversion Gain 3	CG3	frf = 470 MHz, Prf = −30 dBm	*2	20.5	24.0	27.5	dB
Conversion Gain 4	CG4	frf = 470 MHz, Prf = −30 dBm	*2	28.5	32.0	35.5	dB
Conversion Gain 5	CG5	frf = 890 MHz, Prf = -30 dBm	*2	28.5	32.0	35.5	dB
Noise Figure 1	NF1	frf = 55 MHz	*3	_	11.0	14.0	dB
Noise Figure 2	NF2	frf = 200 MHz	*3	_	11.0	14.0	dB
Noise Figure 3	NF3	frf = 470 MHz	*3	_	11.0	14.0	dB
Noise Figure 4	NF4	frf = 470 MHz	*3	_	9.0	12.0	dB
Noise Figure 5	NF5	frf = 890 MHz	*3	_	10.0	13.0	dB
Maximum Output Power 1	Po (sat)1	frf = 55 MHz, Prf = 0 dBm	*2	10.0	13.0	_	dBm
Maximum Output Power 2	Po (sat)2	frf = 200 MHz, Prf = 0 dBm	*2	10.0	13.0	_	dBm
Maximum Output Power 3	Po (sat)3	frf = 470 MHz, Prf = 0 dBm	*2	10.0	13.0	_	dBm
Maximum Output Power 4	Po (sat)4	frf = 470 MHz, Prf = 0 dBm	*2	10.0	13.0	_	dBm
Maximum Output Power 5	Po (sat)5	frf = 890 MHz, Prf = 0 dBm	*2	10.0	13.0	_	dBm

\*1 By measurement circuit 1

\*2 By measurement circuit 2

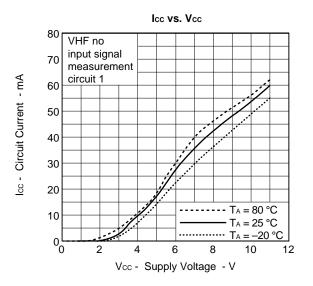
\*3 By measurement circuit 3

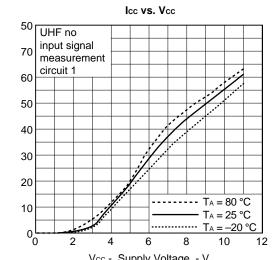
# STANDARD CHARACTERISTICS (Reference Values) (T<sub>A</sub> = 25 $^{\circ}$ C, Vcc = 9 V)

Parameter	Symbol	Test Conditions		Value for Reference	Unit
1 % cross-modulation distortion 1	CM1	$\label{eq:fdes} \begin{array}{l} f_{des} = 55 \mbox{ MHz, fundes} = f_{des} + 6 \mbox{ MHz,} \\ P_{des} = -30 \mbox{ dBm, fir} = 45 \mbox{ MHz,} \\ P_{osc} = -10 \mbox{ dBm, AM 100 \mbox{ kHz, } 30 \mbox{ \%} \\ modulation, \mbox{ DES/CM} = 46 \mbox{ dBc} \end{array}$	*1	100	dΒμ
1 % cross-modulation distortion 2	CM2	$\label{eq:fdes} \begin{array}{l} f_{des} = 200 \mbox{ MHz}, \mbox{ fundes} = f_{des} + 6 \mbox{ MHz}, \\ P_{des} = -30 \mbox{ dBm}, \mbox{ fir} = 45 \mbox{ MHz}, \\ P_{osc} = -10 \mbox{ dBm}, \mbox{ AM} \mbox{ 100 \mbox{ kHz}}, \mbox{ 30 \mbox{ \%}} \\ modulation, \mbox{ DES/CM} = 46 \mbox{ dBc} \end{array}$	*1	100	dΒμ
1 % cross-modulation distortion 3	CM3	$\label{eq:fdes} \begin{array}{l} f_{des} = 470 \mbox{ MHz}, \mbox{ fundes} = f_{des} + 6 \mbox{ MHz}, \\ P_{des} = -30 \mbox{ dBm}, \mbox{ fiF} = 45 \mbox{ MHz}, \\ P_{osc} = -10 \mbox{ dBm}, \mbox{ AM} \mbox{ 100 \mbox{ kHz}}, \mbox{ 30 \mbox{ \%}} \\ modulation, \mbox{ DES/CM} = 46 \mbox{ dBc} \end{array}$	*1	96	dΒμ
1 % cross-modulation distortion 4	CM4	$\label{eq:fdes} \begin{array}{l} f_{des} = 470 \mbox{ MHz, } f_{undes} = f_{des} + 6 \mbox{ MHz, } \\ P_{des} = -30 \mbox{ dBm, } f_{IF} = 45 \mbox{ MHz, } \\ P_{osc} = -10 \mbox{ dBm, } AM \mbox{ 100 } \mbox{ kHz, } 30 \mbox{ \% } \\ modulation, \mbox{ DES/CM} = 46 \mbox{ dBc} \end{array}$	*1	94	dΒμ
1 % cross-modulation distortion 5	CM5	$\label{eq:fdes} \begin{array}{l} f_{des} = 890 \mbox{ MHz, } f_{undes} = f_{des} + 6 \mbox{ MHz, } \\ P_{des} = -30 \mbox{ dBm, } f_{IF} = 45 \mbox{ MHz, } \\ P_{osc} = -10 \mbox{ dBm, } AM \mbox{ 100 } \mbox{ kHz, } 30 \mbox{ \% } \\ modulation, \mbox{ DES/CM} = 46 \mbox{ dBc} \end{array}$	*1	92	dΒμ

\*1 By measurement circuit 4

#### **TYPICAL CHARACTERISTICS**

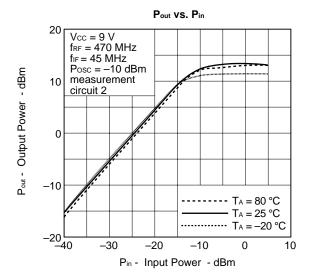


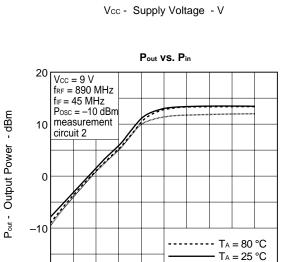


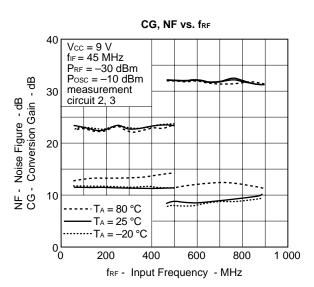
lcc - Circuit Current - mA

\_20 └\_\_ \_40

-30







CM vs. frf

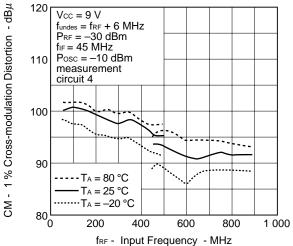
Pin - Input Power - dBm

-10

-20

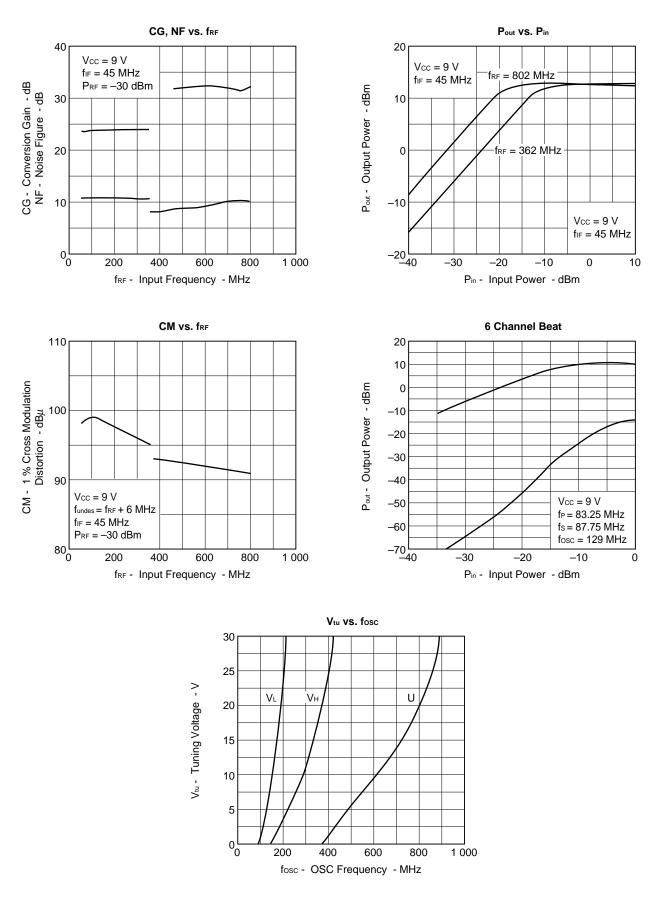
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Data Sheet P11888EJ3V0DS00

#### STANDARD CHARACTERISTICS (by application circuit example)

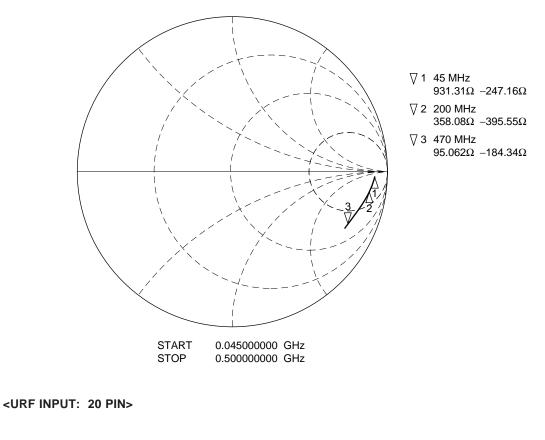


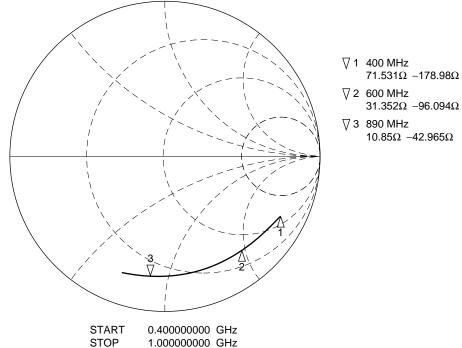
#### Data Sheet P11888EJ3V0DS00

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#### **INPUT IMPEDANCE (by measurement circuit 5)**

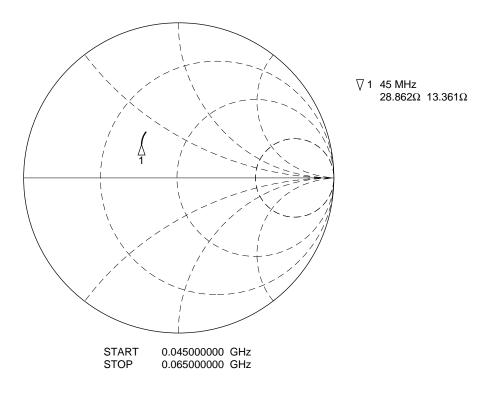
# <VRF INPUT: 17 PIN>



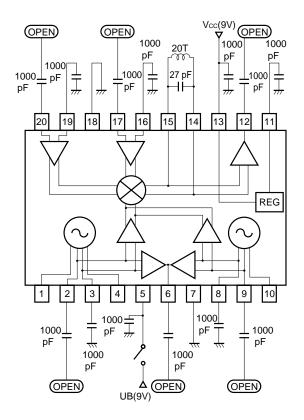


**OUTPUT IMPEDANCE (by measurement circuit 5)** 

# <IF OUTPUT: 12 PIN>

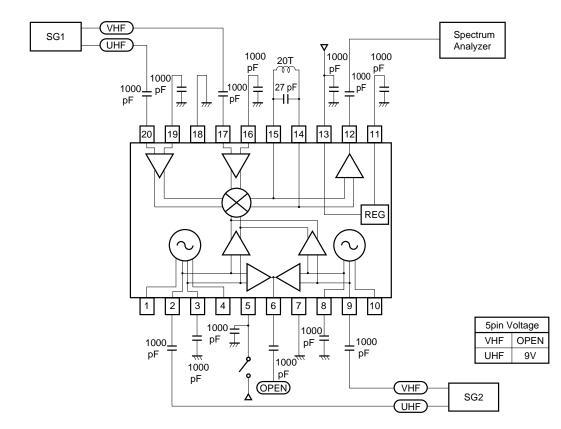


# **MEASUREMENT CIRCUIT 1**



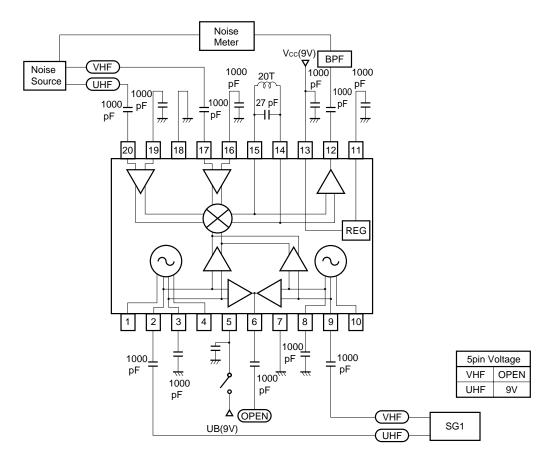
5pin Voltage					
VHF OPEN					
UHF	9V				

**MEASUREMENT CIRCUIT 2** 

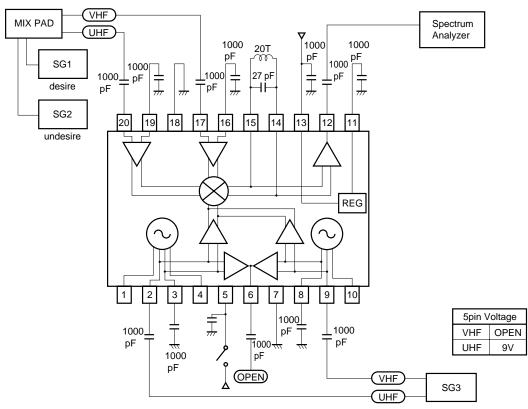


Data Sheet P11888EJ3V0DS00

# **MEASUREMENT CIRCUIT 3**

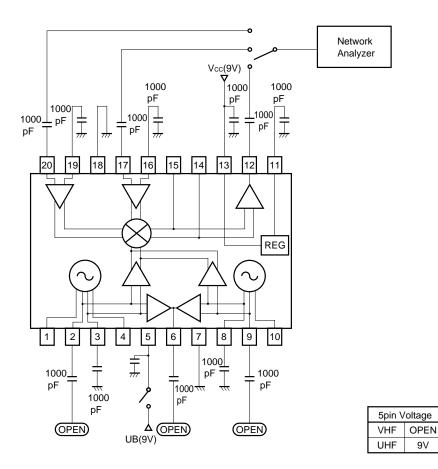


# **MEASUREMENT CIRCUIT 4**

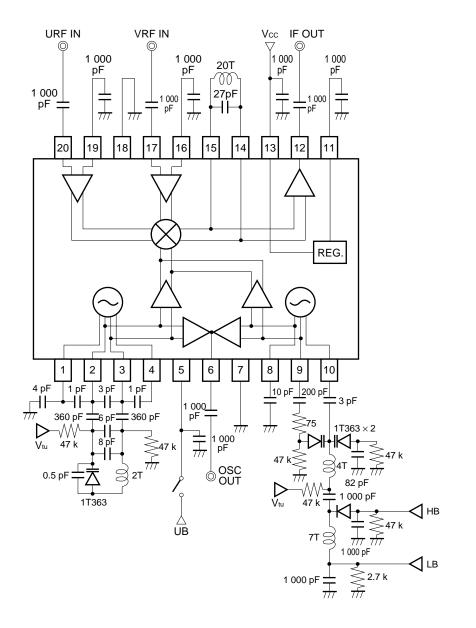


9V

# **MEASUREMENT CIRCUIT 5**



#### **APPLICATION CIRCUIT EXAMPLE**



The application circuits and their parameters are for reference only and are not intended for use in actual design-ins.

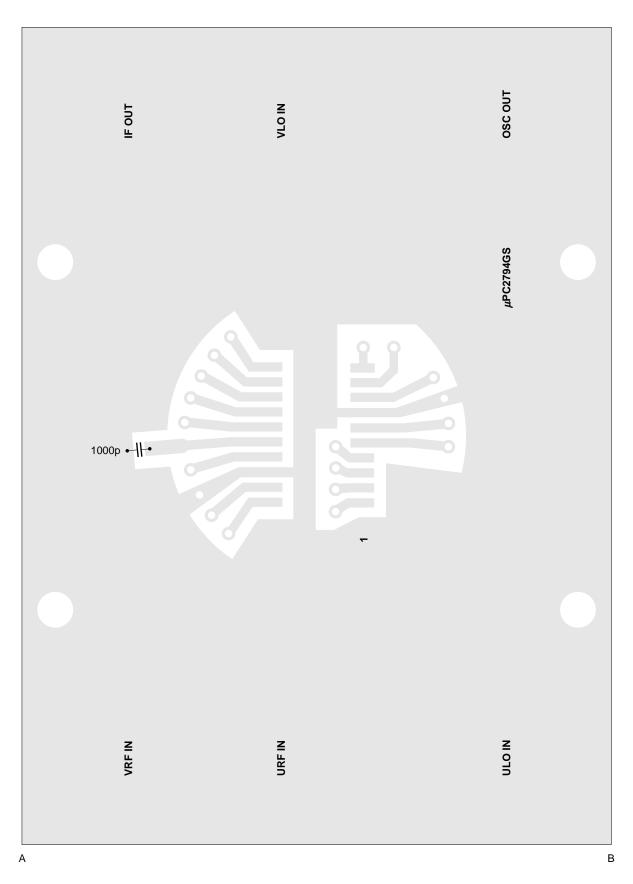
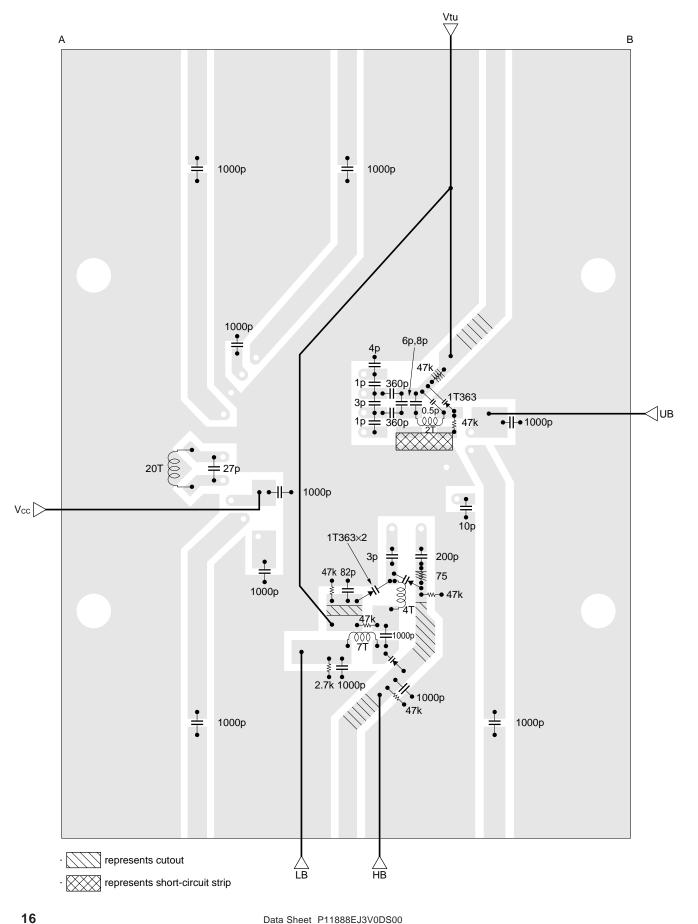


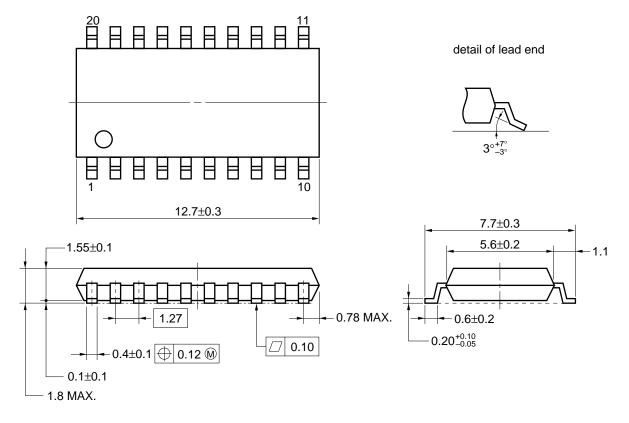
ILLUSTRATION OF THE EVALUATION BOARD FOR APPLICATION CIRCUIT EXAMPLE (Surface)



# ILLUSTRATION OF THE EVALUATION BOARD FOR APPLICATION CIRCUIT EXAMPLE (Back side)

# PACKAGE DIMENSIONS

\* 20 PIN PLASTIC SOP (300 mil) (UNIT: mm)



NOTE Each lead centerline is located within 0.12 mm of its true position (T.P.) at maximum material condition.

# NOTE 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 undesires oscillation).
- (3) Keep the track length of the ground pins as short as possible.
- (4) A low pass filter must be attached to Vcc line.
- (5) A matching circuit must be externally attached to output port.

# **RECOMMENDED SOLDERING CONDITIONS**

The following conditions (see table below) must be met when soldering this product.

Please consult with our sales officers in case other soldering process is used or in case soldering is done under different conditions.

For details of recommended soldering conditions for surface mounting, refer to information document SEMICONDUCTOR DEVICE MOUNTING TECHNOLOGY MANUAL (C10535E).

#### μ**PC2794GS**

Soldering Process	Soldering Conditions	Symbol
Infrared ray reflow	Peak package's surface temperature: 235 °C or below, Reflow time: 30 seconds or below (210 °C or higher), Number of reflow process: 3, Exposure limit <sup>*1</sup> : None	IR35-00-3
VPS	Peak package's surface temperature: 215 °C or below, Reflow time: 40 seconds or below (200 °C or higher), Number of reflow process: 3, Exposure limit <sup>*1</sup> : None	VP15-00-3
Partial heating method	Terminal temperature: 300 °C or below, Flow time: 3 seconds or below, Exposure limit <sup>*1</sup> : None	

\*1 Exposure limit before soldering after dry-pack package is opened. Storage conditions: 25 °C and relative humidity at 65 % or less.

Caution Do not apply more than single process at once, except for "Partial heating method".

[MEMO]

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  - Special: Transportation equipment (automobiles, trains, ships, etc.), traffic control systems, anti-disaster systems, anti-crime systems, safety equipment and medical equipment (not specifically designed for life support)
  - Specific: Aircraft, aerospace equipment, submersible repeaters, nuclear reactor control systems, life support systems or medical equipment for life support, etc.

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