To our customers,

Old Company Name in Catalogs and Other Documents

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Renesas Electronics website: http://www.renesas.com

April 1st, 2010
Renesas Electronics Corporation

Issued by: Renesas Electronics Corporation (http://www.renesas.com)

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RENESAS

DATA SHEET

BIPOLAR ANALOG INTEGRATED CIRCUITS

μPC8190T5E, μPC8191T5E

RX/TX-IF Si MMIC FOR W-CDMA

Phase-out/Discontinued

DESCRIPTION

The μPC8190T5E and μPC8191T5E are silicon monolithic integrated circuits designed as receiver (RX) and transmitter (TX) IF section for W-CDMA. The μPC8190T5E is an RX-IF IC including IF-AGC amplifier and demodulator. The μPC8191T5E is a TX-IF IC including IF-AGC amplifier and quadrature modulator. These two ICs are suitable for kit-use for W-CDMA IF section since RX and TX-IF frequency can be constituted from one local oscillator. Both T5E suffix means LGA package that is physically smaller than conventional K suffix QFN package.

The ICs are manufactured using our new ultra high speed silicon bipolar process.

FEATURES

- RX-IF: 380 MHz, TX-IF: 570 MHz
- Low power consumption
- Built-in power-saving function
- Small size: 20-pin plastic LGA (CSP type) package (3 × 3 × 0.6 mm)

APPLICATION

- W-CDMA

ORDERING INFORMATION

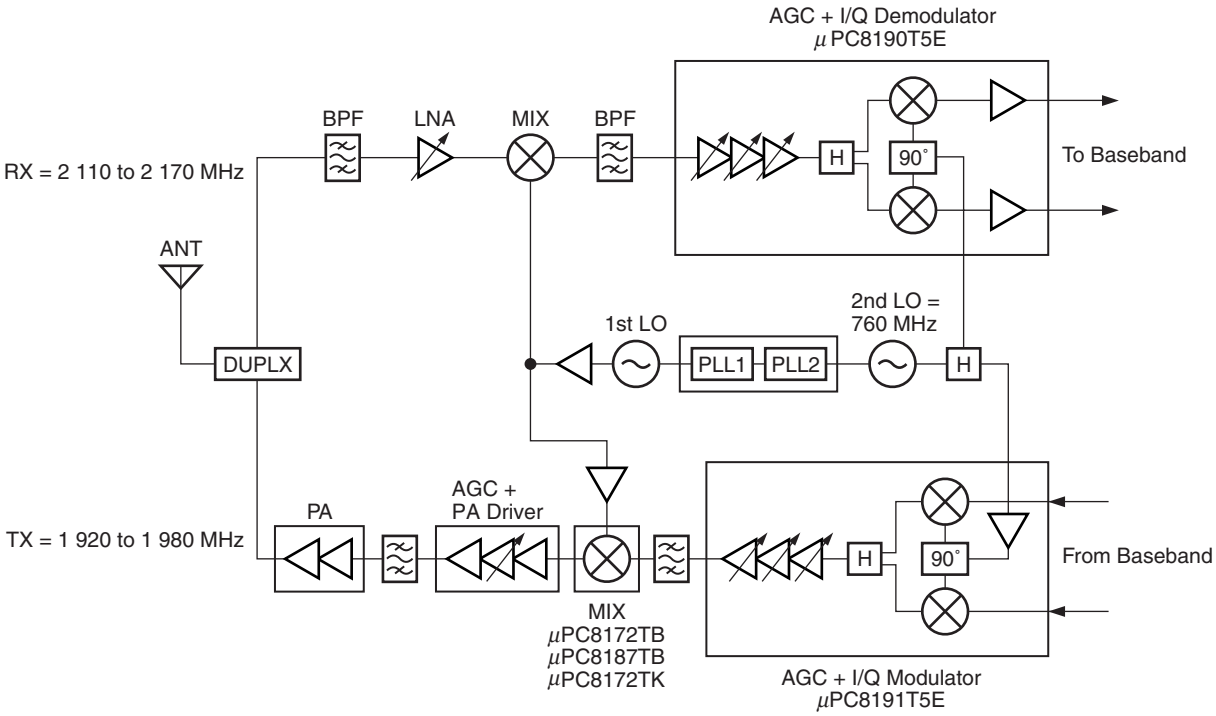
Part Number	Order Number	Package	Marking	Supplying Form
μPC8190T5E-E1	μPC8190T5E-E1-A	20-pin plastic LGA (CSP type) (size 3 × 3 × 0.6 mm) (Pb-Free)	8190	• Embossed tape 8mm wide • Pin 1 indicates pull-out direction of tape • Qty 3kpcs/reel
μPC8191T5E-E1	μPC8191T5E-E1-A		8191	

Remark To order evaluation samples, contact your nearby sales office.
Part number for sample order: μPC8190T5E, μPC8191T5E

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

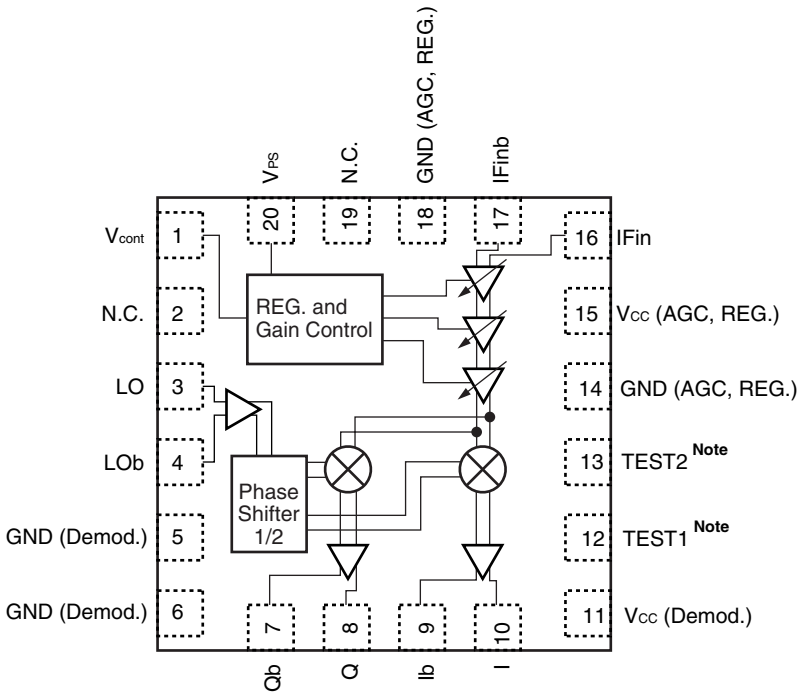
Document No. PU10453EJ01V0DS (1st edition)
Date Published February 2005 CP(K)
Printed in Japan

APPLICATION EXAMPLE



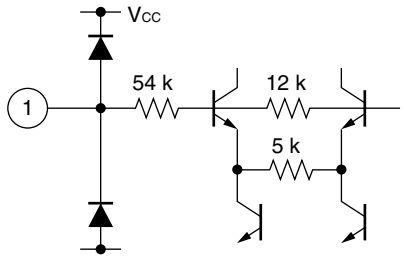
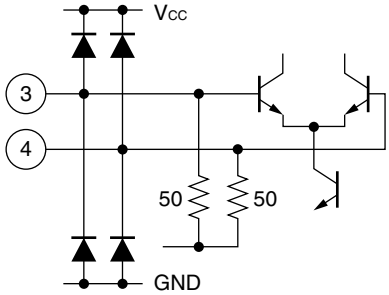
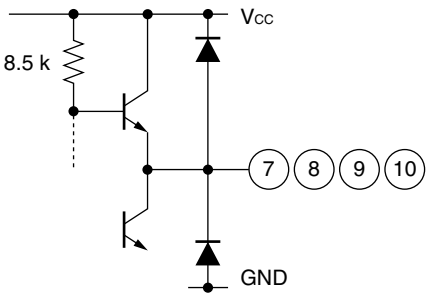
INTERNAL BLOCK DIAGRAM AND PIN CONFIGURATION – μPC8190T5E (RX) –

(Top View)



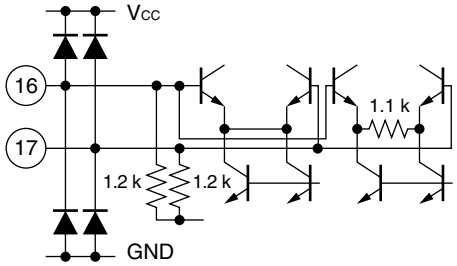
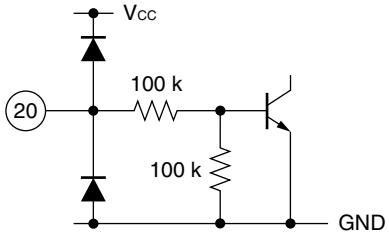
Note In actual use, Pins TEST1 and TEST2 should be grounded.

PIN EXPLANATIONS – μPC8190T5E (RX) –

Pin No.	Pin Name	Applied Voltage (V)	Pin Voltage (TYP.) (V) Note	Functions and Applications	Internal Equivalent Circuits
1	V_{cont}	0 to 3.0	–	Gain control pin of AGC amplifier. Variable gains are available in accordance with applied voltage.	
2 19	N.C.	–	–	Non connection. This pin is not connected to internal circuit. This pin should be opened or grounded.	———
3	LO	–	–	Local signal input pin of I/Q demodulator. Input frequency is 760 MHz.	
4	LOb	–	–	Bypass pin of local signal input for I/Q demodulator. In the case of single local input, this pin must be decoupled with capacitor ex. 100 to 1 000 pF.	
5 6	GND (Demod.)	0	–	Ground pin of I/Q demodulator. This pin should be grounded with minimum inductance. Form the ground pattern as widely as possible to minimize ground impeadance.	———
7	Qb	–	–	I/Q/Ib/Qb signal output pins. Each pin is an emitter follower. Each of Ib and Qb is differential output of I and Q. Recommendable load impedance is 10 to 20 kΩ.	
8	Q	–	–		
9	Ib	–	–		
10	I	–	–		

Note Pin voltage is measured at V_{CC} = 3.0 V

– μPC8190T5E (RX) –

Pin No.	Pin Name	Applied Voltage (V)	Pin Voltage (TYP.) (V) Note	Functions and Applications	Internal Equivalent Circuits
11	V_{CC} (Demod.)	2.7 to 3.3	–	Supply voltage pin of I/Q demodulator (phase shifter + I/Q Mixer).	———
12	TEST 1	0	–	TEST pin. In actual use, this pin should be grounded.	———
13	TEST 2	0	–		
14 18	GND (AGC, REG.)	0	–	Ground pin of AGC amplifier and internal regulator. This pin should be grounded with minimum inductance. Form the ground pattern as widely as possible to minimize ground impedance.	———
15	V_{CC} (AGC, REG.)	2.7 to 3.3	–	Supply voltage pin of AGC amplifier and internal regulator.	———
16	IFin	–	–	IF signal input pin. This pin is input of AGC amplifier. Balance input between 16, 17 pin. Input frequency is 380 MHz.	
17	IFinb	–	–	IF signal input pin. In the case of signal local input, this pin must be decoupled with capacitor.	
20	V_{PS}	H: 2.2 to V_{CC} L: 0 to 0.5	–	Power saving pin. This pin modulator can control Active/Sleep state with bias as follows. V_{PS} (V) / State: 0 to 0.5 – Sleep Mode 2.2 to 3 – Active Mode	

Note Pin voltage is measured at V_{CC} = 3.0 V

ABSOLUTE MAXIMUM RATINGS – μPC8190T5E (RX) –

Parameter	Symbol	Ratings	Unit
Supply Voltage	V_{CC}	4.0	V
Applied Voltage	V_{PS}, V_{cont}	–0.3 to V_{CC} + 0.3	V
Operating Ambient Temperature	T_A	–40 to +85	°C
Storage Temperature	T_{stg}	–55 to +125	°C

RECOMMENDED OPERATING RANGE – μPC8190T5E (RX) –

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Supply Voltage	V_{CC}	2.7	3.0	3.3	V
Operating Ambient Temperature	T_A	–25	+25	+85	°C
IF Frequency	f_{IF}	–	380	–	MHz
Local Frequency	f_{LO}	–	760	–	MHz
Local Input Level	P_{LO}	–18	–15	–12	dBm
I/Q Output Frequency	$f_{I/Q}$	–	–	10	MHz

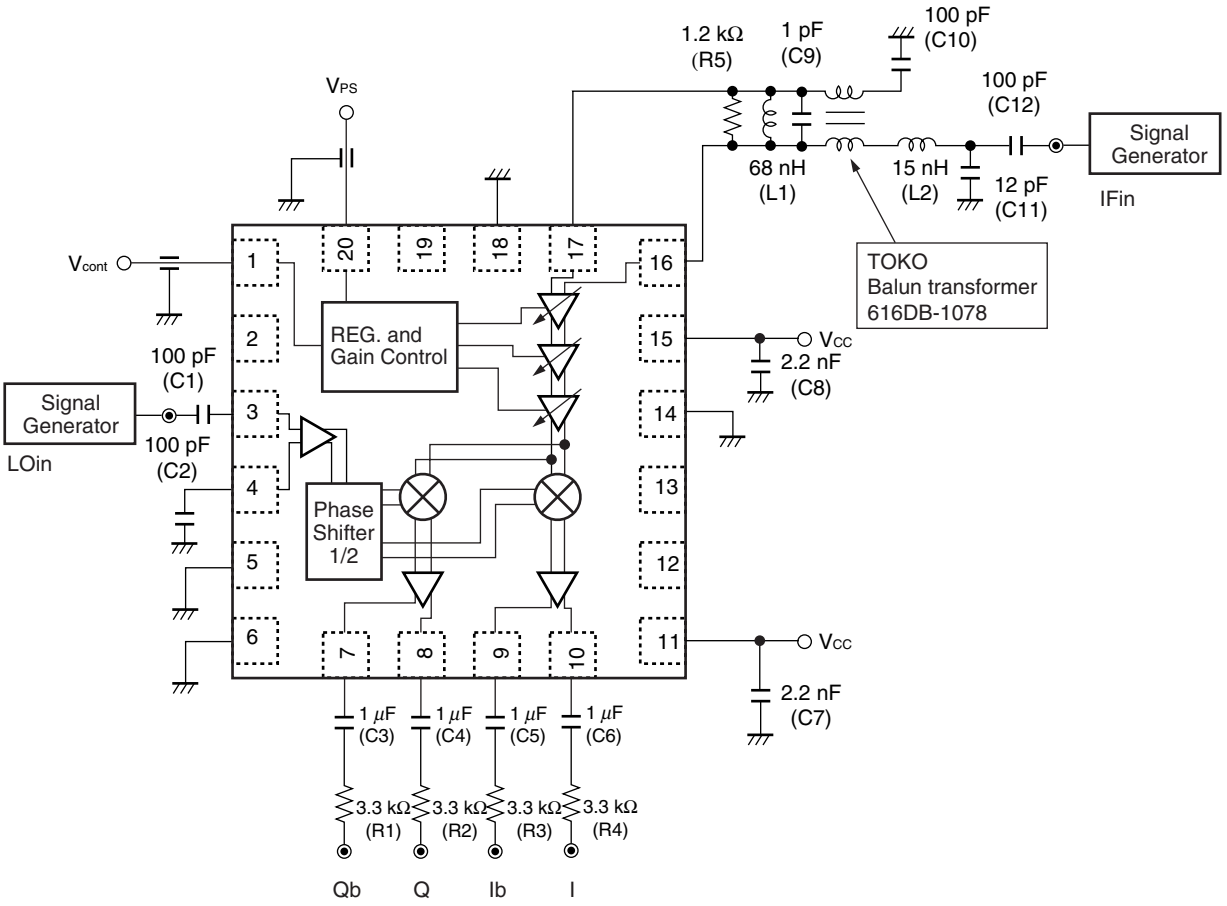
ELECTRICAL CHARACTERISTICS – μPC8190T5E (RX) – (Unless otherwise specified, V_{CC} = 3.0 V, T_A = +25°C, f_{IF} = 382.5 MHz, f_{LO} = 760 MHz, P_{LO} = –15 dBm, $f_{I/Q}$ = 2.5 MHz)

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Circuit Current	I_{CC}	No input signal	–	9.0	12	mA
		At power-saving mode	–	–	1	μA
Voltage Gain 1	V_G1	V_{cont} = 2.5 V	68	77	–	dB
Voltage Gain 2	V_G2	V_{cont} = 0.5 V	–	–20	–15	dB
Input 3rd Order Intercept Point 1	$IIP_3$1	V_G = +65 dB (R_S= 600 Ω balanced), P_{IFin} = –70 dBm	–60	–55	–	dBm
Input 3rd Order Intercept Point 2	$IIP_3$2	V_G = –10 dB (R_S= 600 Ω balanced), P_{IFin} = –10 dBm	0	3	–	dBm
Local Leakage	LOL	Leakage to I/Q port when local = 380 MHz and output = 30 mV_{P-P} balanced	–	–	–20	dBc
I/Q Bandwidth	$f_{I/Q\ (B/W)}$	3 dB down	10	–	–	MHz
I/Q Maximum Output Swing	$V_{O\ (sat)}$	Balanced output	1	–	–	V_{P-P}
I/Q Gain Balance	AE	$f_{I/Q}$ = 2.5 MHz	–	–	Δ0.5	dB
I/Q Phase Error	PE	$f_{I/Q}$ = 2.5 MHz	–	–	±4	deg.
Gain Accuracy	Gacc	V_{cont} = 1 to 2 V	–	Δ4.6	Δ6	dB/V
Rise Time from Power-saving Mode	t_{PS}	Until I/Q becomes 90%	–	–	20	μs
Rising Voltage from Power-saving Mode	$V_{PS\ on}$		2.2	–	–	V
Falling Voltage from Power-saving Mode	$V_{PS\ off}$		–	–	0.5	V
Gain Flatness	Flat	f_{IF} ± 2.5 MHz	–	–	Δ0.5	dB

STANDARD CHARACTERISTICS FOR REFERENCE – μPC8190T5E (RX) – (Unless otherwise specified, V_{CC} = 3.0 V, T_A = +25°C, f_{IF} = 382.5 MHz, f_{LO} = 760 MHz, P_{LO} = –15 dBm, $f_{I/Q}$ = 2.5 MHz)

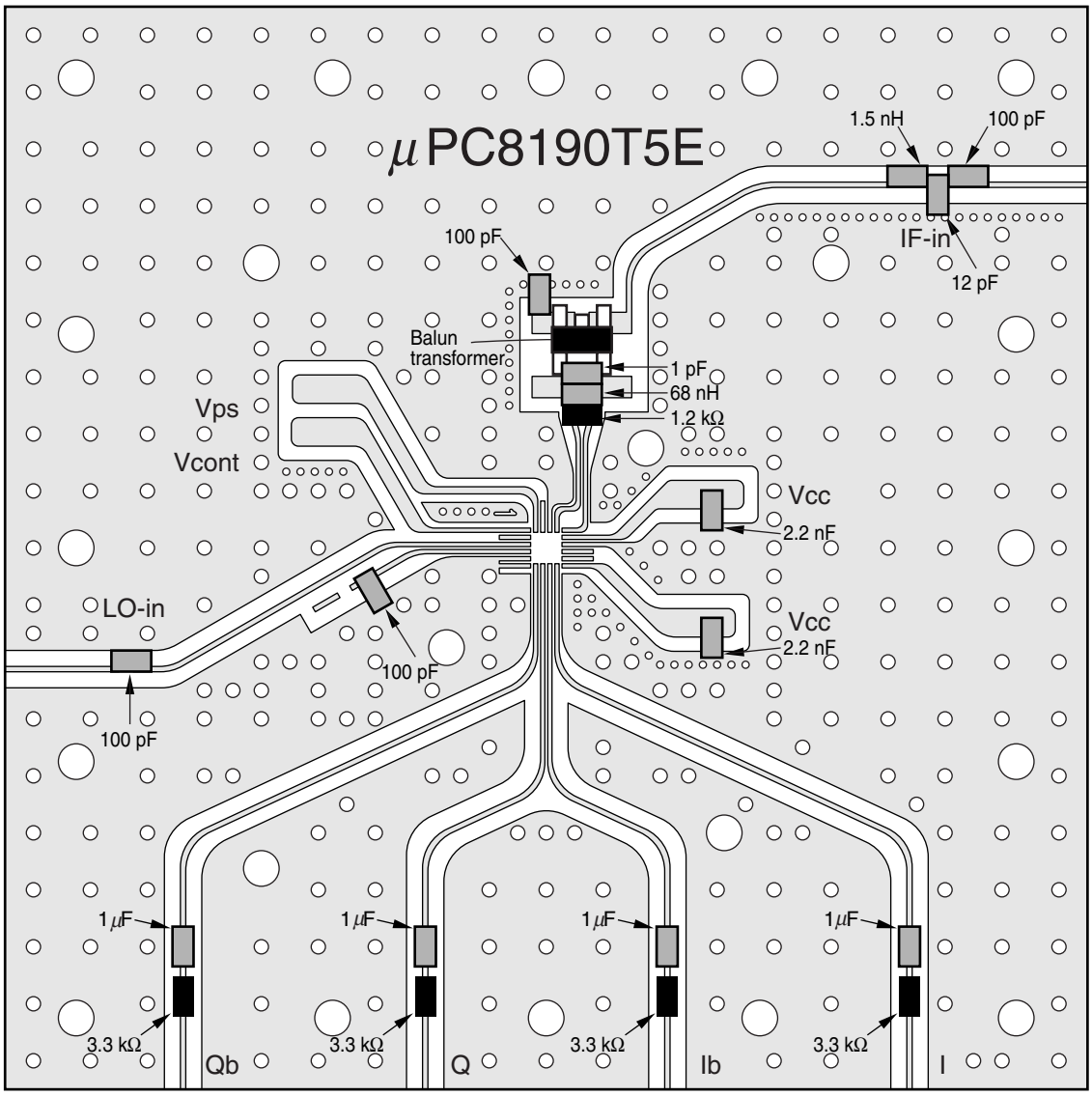
Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Noise Figure	NF	V_G = +65 dB	–	9.5	–	dB
Error Vector Magnitude (Vector Error)	EVM	IF = 380 MHz, 3.84 Mbps QPSK modulation, gain is adujsted	–	3	–	%rms
Gain 1 dB Compression Input Power	$P_{in\ (1\ dB)}$	V_G = +50 dB	–	–45	–	dBm

MEASUREMENT CIRCUIT – μPC8190T5E (RX) –



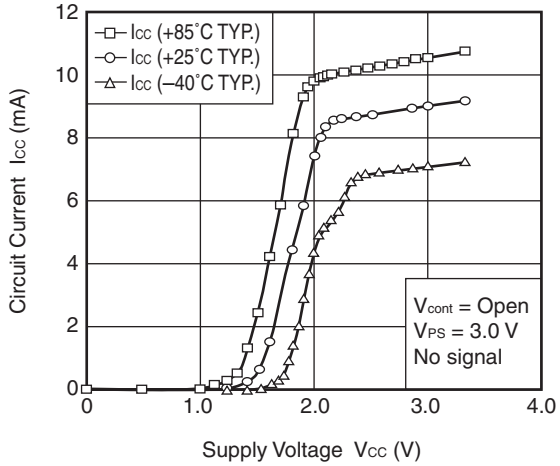
Remark ◉ : AC connector
○ : DC terminal
⏚ : Feed through capacitor

ILLUSTRATION OF THE TEST CIRCUIT ASSEMBLED ON EVALUATION BOARD – μPC8190T5E (RX) –

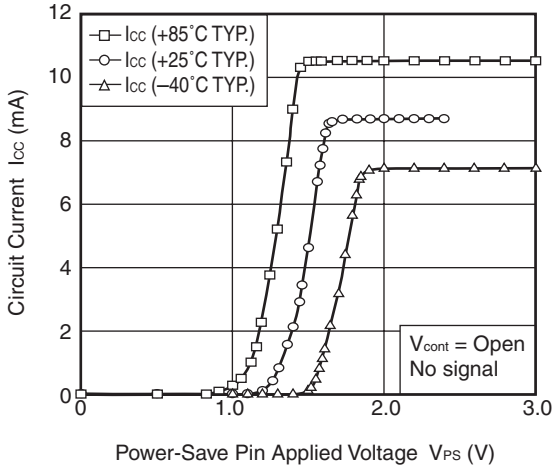


TYPICAL CHARACTERISTICS – μPC8190T5E (RX) – (V_{CC} = 3.0 V, T_A = +25°C, f_{IF} = 382.5 MHz, f_{LO} = 760 MHz, P_{LO} = –15 dBm, $f_{I/Q}$ = 2.5 MHz, unless otherwise specified)

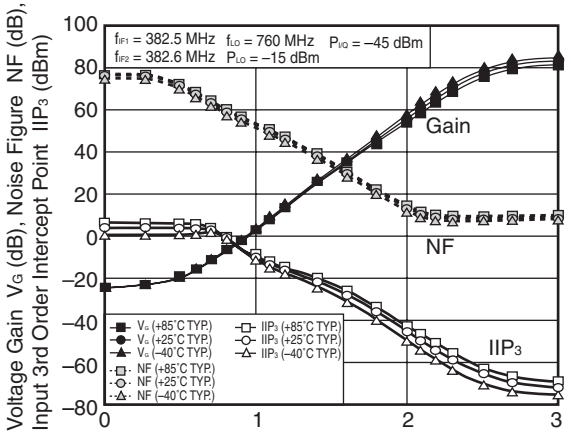
CIRCUIT CURRENT vs. SUPPLY VOLTAGE



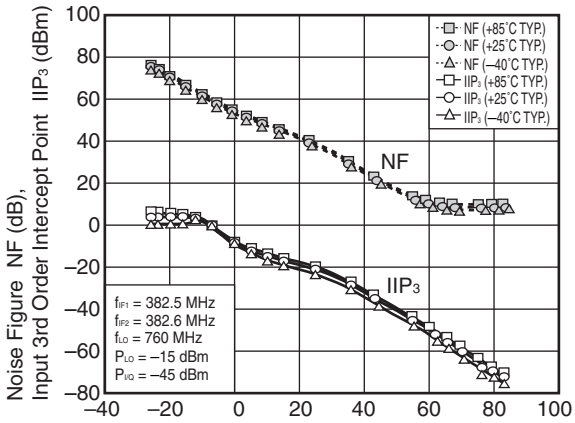
CIRCUIT CURRENT vs. POWER-SAVE PIN APPLIED VOLTAGE



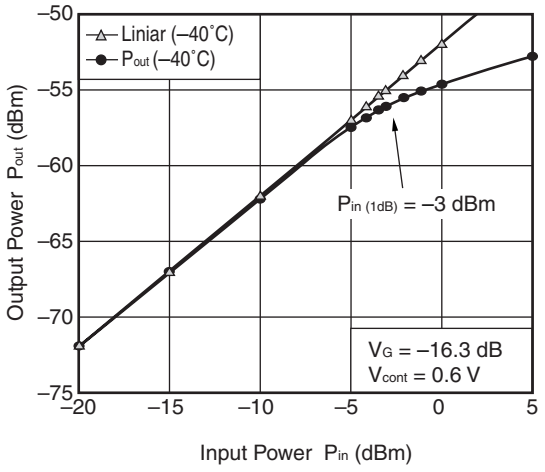
VOLTAGE GAIN, NOISE FIGURE, INPUT 3RD ORDER INTERCEPT POINT vs. CONTROL VOLTAGE



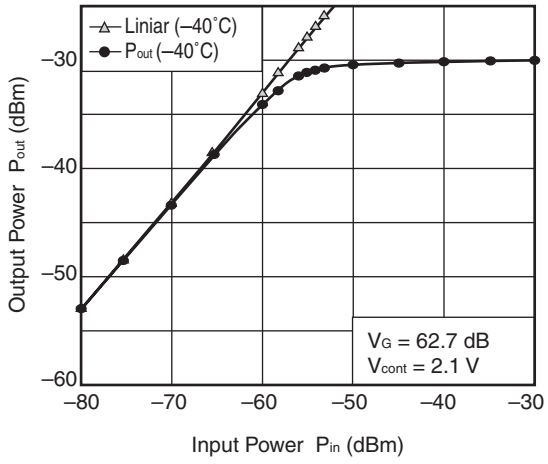
NOISE FIGURE, INPUT 3RD ORDER INTERCEPT POINT vs. VOLTAGE GAIN



OUTPUT POWER vs. INPUT POWER AT MINIMUM VOLTAGE GAIN (T_A = –40°C)



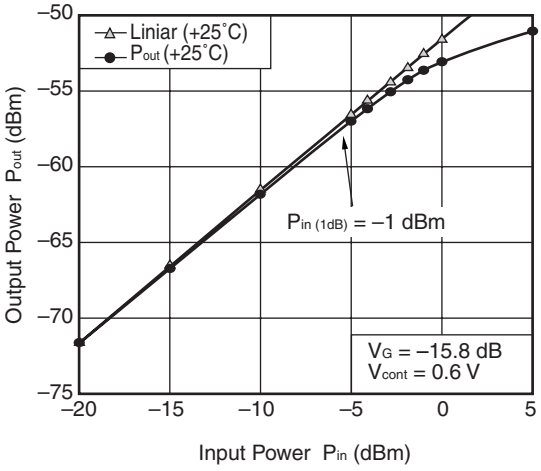
OUTPUT POWER vs. INPUT POWER AT MAXIMUM VOLTAGE GAIN (T_A = –40°C)



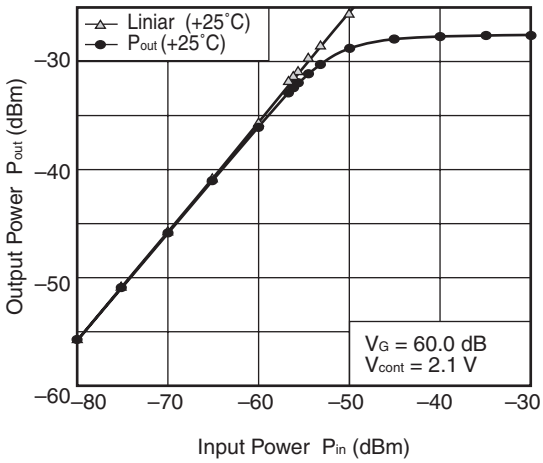
Remark The graphs indicate nominal characteristics.

– μPC8190T5E (RX) –

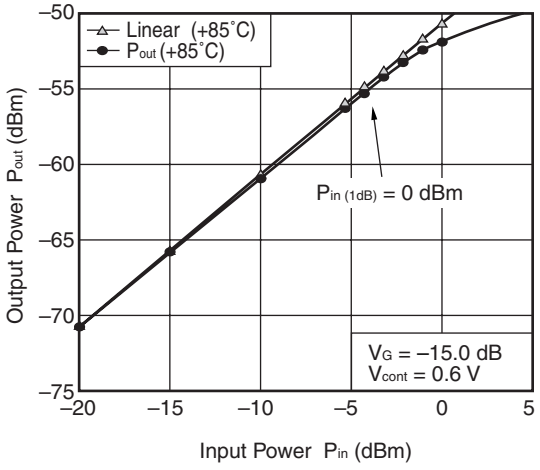
OUTPUT POWER vs. INPUT POWER AT MINIMUM VOLTAGE GAIN (T_A = +25˚C)



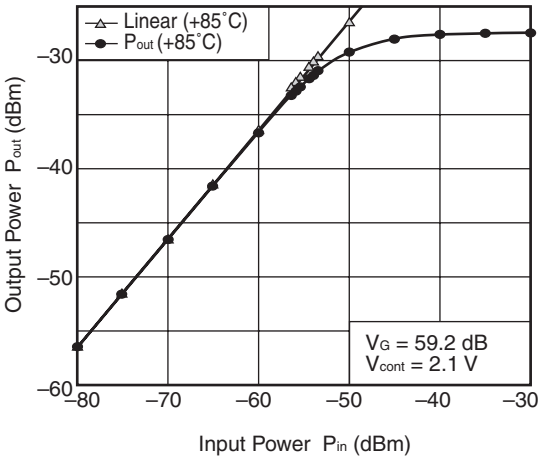
OUTPUT POWER vs. INPUT POWER AT MAXIMUM VOLTAGE GAIN (T_A = +25˚C)



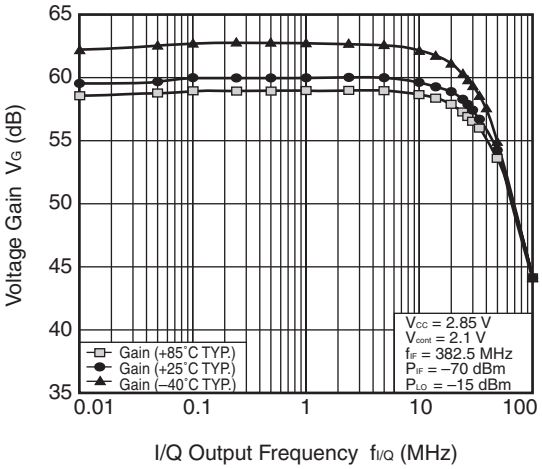
OUTPUT POWER vs. INPUT POWER AT MINIMUM VOLTAGE GAIN (T_A = +85˚C)



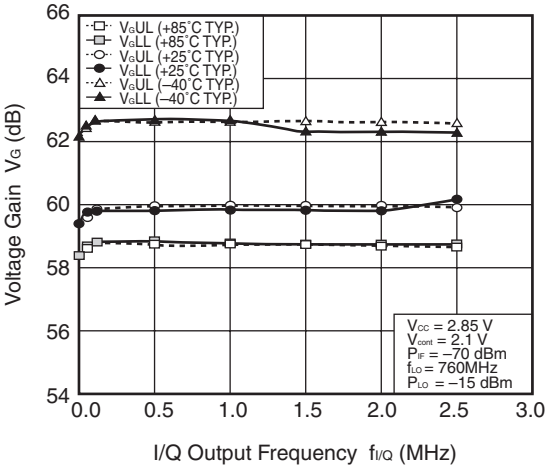
OUTPUT POWER vs. INPUT POWER AT MAXIMUM VOLTAGE GAIN (T_A = +85˚C)



VOLTAGE GAIN vs. I/Q OUTPUT FREQUENCY



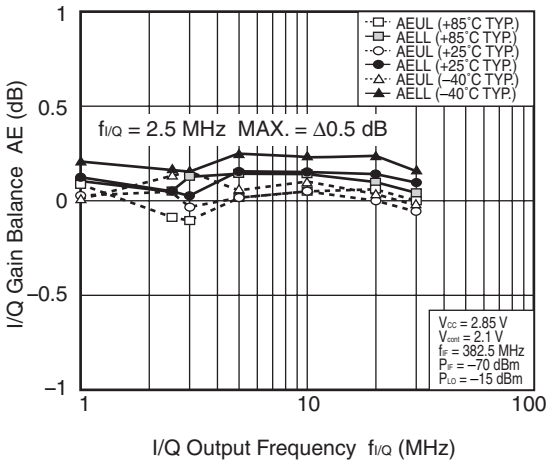
VOLTAGE GAIN vs. I/Q OUTPUT FREQUENCY



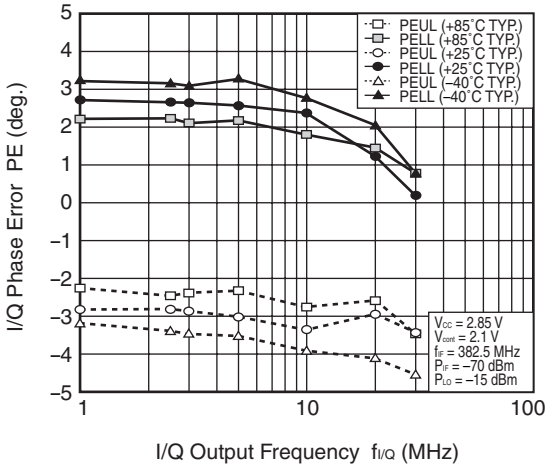
Remark The graphs indicate nominal characteristics.

– μPC8190T5E (RX) –

I/Q GAIN BALANCE vs.
I/Q OUTPUT FREQUENCY



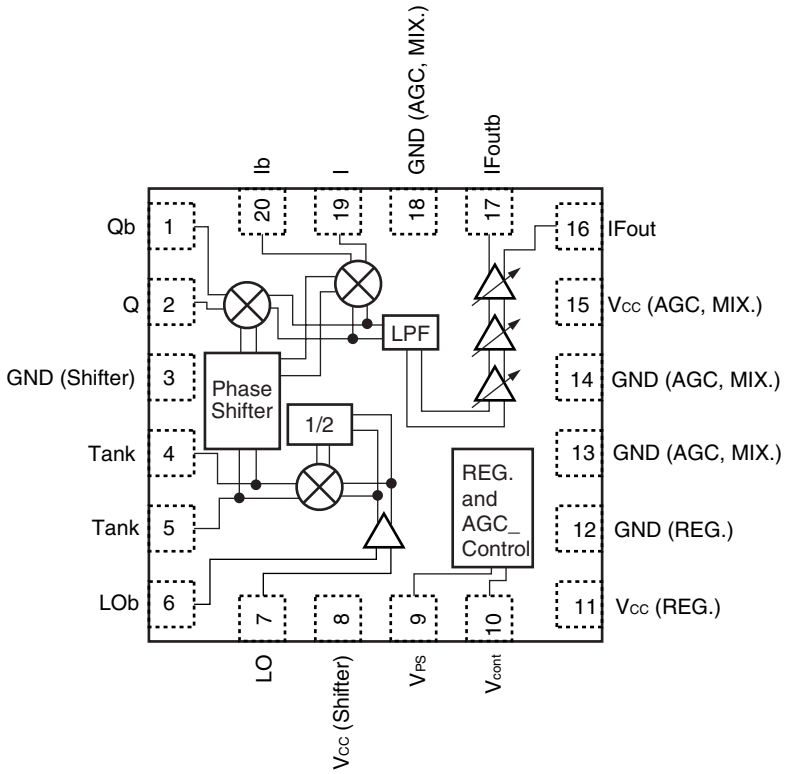
I/Q PHASE ERROR vs.
I/Q OUTPUT FREQUENCY



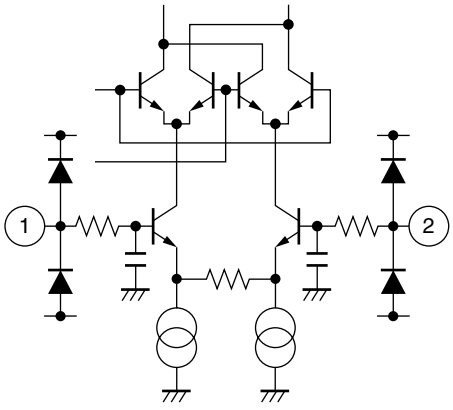
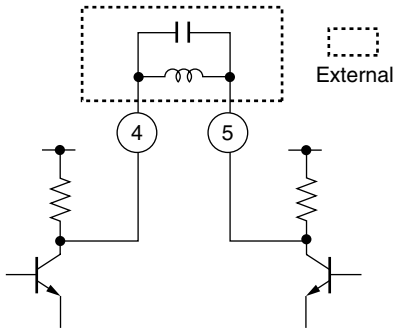
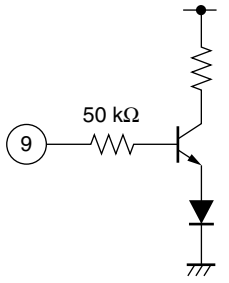
Remark The graphs indicate nominal characteristics.

INTERNAL BLOCK DIAGRAM AND PIN CONFIGURATION – μPC8191T5E (TX) –

(Top View)

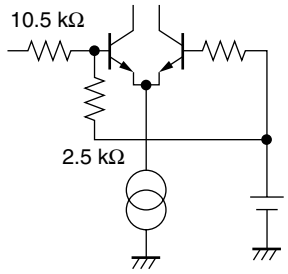
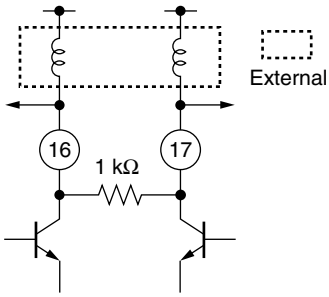
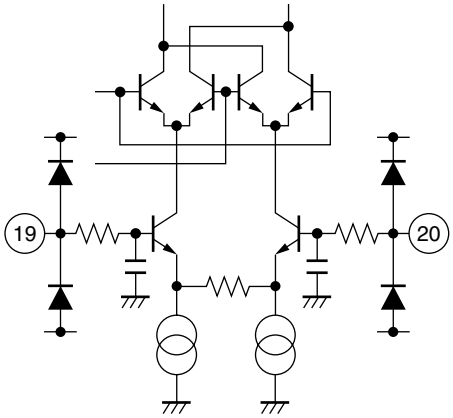


PIN EXPLANATIONS – μPC8191T5E (TX) –

Pin No.	Pin Name	Applied Voltage (V)	Pin Voltage (TYP.) (V) Note	Functions and Applications	Internal Equivalent Circuits
1	Qb	V_{CC}/2	–	Q signal input pin. Apply bias voltage externally. Maximum balance input voltage is 1 000 mV_{P-P} (balance).	
2	Q	V_{CC}/2	–		
3	GND (Shifter)	0	–	Ground pin of I/Q modulator. This pin should be grounded with minimum inductance. Form the ground pattern as widely as possible to minimize ground impedance.	———
4 5	Tank	0	2.65	External inductor and capcitor can supress harmonics spurious of LO frequency. LC value should be determined according to LO input frequency and suppression level.	
6	LOb	0	2.02	Bypass pin of local signal input for I/Q modulator. In the case of single local input, this pin must be decoupled with capacitor ex. 1 000 pF.	———
7	LO	0	2.02	Local signal input of I/Q modulator. The DC cut capacitor ex. 1 000 pF must be attaced to this pin.	———
8	V_{CC} (Shifter)	2.7 to 3.3	–	Supply voltage pin of I/Q modulator.	———
9	V_{PS}	0 to 3.0	–	Power saving pin of I/Q modulator + AGC amplifier. This pin modulator can control Active/Sleep state with bias as follows. V_{PS} (V) / State: 0 to 0.5 – Sleep Mode 2.2 to 3 – Active Mode	

Note Pin voltage is measured at V_{CC} = 3.0 V

– μPC8191T5E (TX) –

Pin No.	Pin Name	Applied Voltage (V)	Pin Voltage (TYP.) (V) Note	Functions and Applications	Internal Equivalent Circuits
10	V_{cont}	0 to 3.0	–	Gain control pin of AGC amplifier. Variable gains are available in accordance with applied voltage between 0 to 3.0 V.	
11	V_{CC} (REG.)	2.7 to 3.3	–	Supply voltage pin of internal regulator.	———
12	GND (REG.)	0	–	Ground pin internal regulator. This pin should be grounded with minimum inductance. Form the ground pattern as widely as possible to minimize ground impedance.	———
13 14 18	GND (AGC, MIX)	0	–	Ground pin of AGC amplifier + I/Q Mixer. This pin should be grounded with minimum inductance. Form the ground pattern as widely as possible to minimize ground impedance.	———
15	V_{CC} (AGC, MIX)	2.7 to 3.3	–	Supply voltage pin of AGC amplifier + I/Q Mixer.	———
16	IFout	2.7 to 3.3	–	IF output pin. The inductor must be attached between V_{CC} and output pin due to open collector. Output frequency is 570 MHz which is 3/4 of local signal frequency 760 MHz.	
17	IFoutb	2.7 to 3.3	–	Balance output of IFout pin. The inductor must be attached between V_{CC} and output pin due to open collector.	
19	I	V_{CC}/2	–	I signal input pin. Apply bias voltage externally. Maximum balance input voltage is 1 000 mV_{P-P} (balance).	
20	Ib	V_{CC}/2	–		

Note Pin voltage is measured at V_{CC} = 3.0 V

ABSOLUTE MAXIMUM RATINGS – μPC8191T5E (TX) –

Parameter	Symbol	Ratings	Unit
Supply Voltage	V_{CC}	4.0	V
Applied Voltage	V_{PS}, V_{cont}	–0.3 to V_{CC} + 0.3	V
Operating Ambient Temperature	T_A	–40 to +85	°C
Storage Temperature	T_{stg}	–55 to +125	°C

RECOMMENDED OPERATING RANGE – μPC8191T5E (TX) –

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Supply Voltage	V_{CC}		2.7	3.0	3.3	V
Operating Ambient Temperature	T_A		–25	+25	+85	°C
IF Frequency	f_{IF}		–	570	–	MHz
Local Frequency	f_{LO}		–	760	–	MHz
Local Input Level	P_{LO}		–18	–15	–12	dBm
IF Output Impedance	Z_{IF}	Balance output internal resistance	–	1	–	kΩ
I/Q Maximum Input Voltage	$VI_{/Q}$	Balance input	–	0.4	1	V_{P-P}

ELECTRICAL CHARACTERISTICS – μPC8191T5E (TX) –

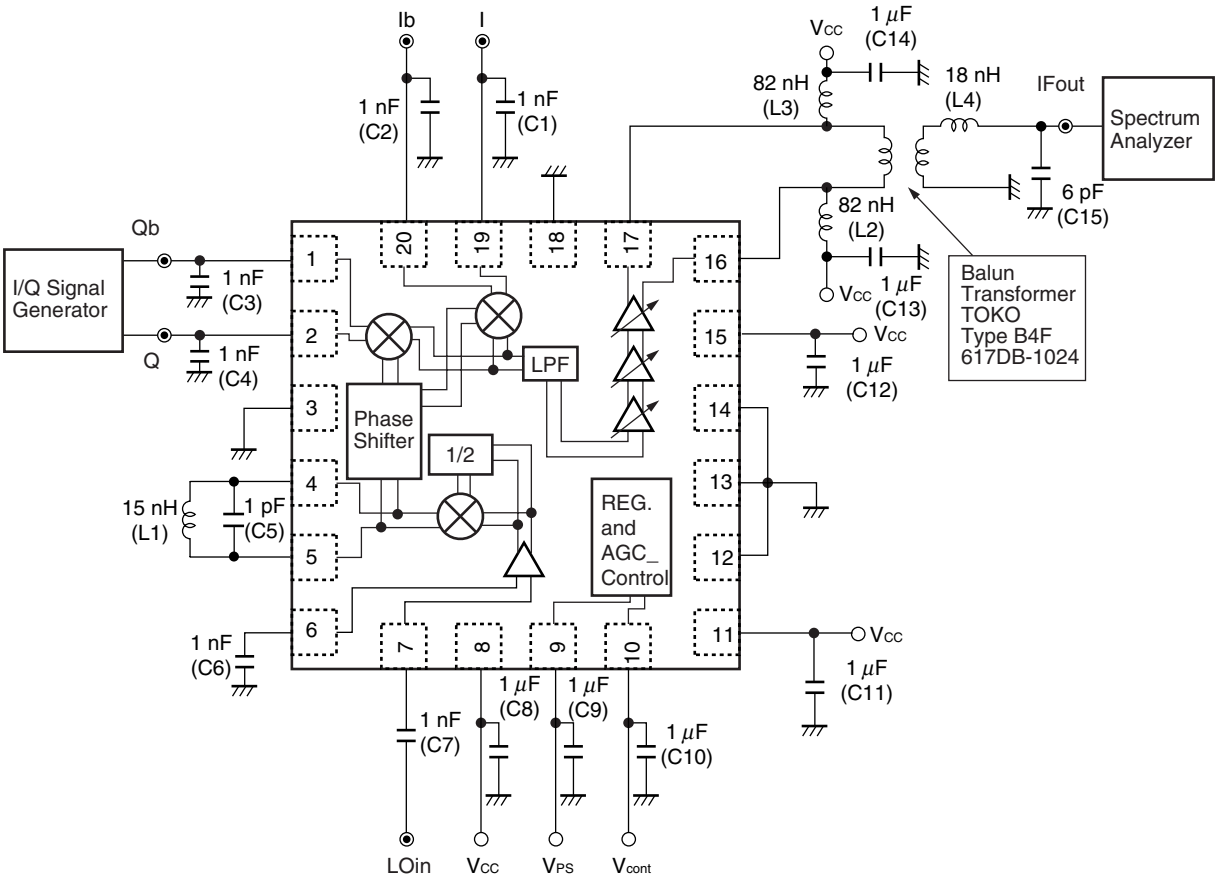
(Unless otherwise specified, V_{CC} = 3.0 V, T_A = +25°C, f_{IF} = 570 MHz, f_{LO} = 760 MHz, P_{LO} = –15 dBm, $f_{I/Q}$ = 10 kHz, 400 mV_{P-P} balanced sine-wave)

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Circuit Current	I_{CC}	No input signal	–	30.7	38	mA
		At power-saving mode	–	0	1	μA
Output Power 1	$P_{out}1$	V_{cont} = 2.3 V, I/Q = 400mV_{P-P} balanced	–17	–13	–	dBm
Output Power 2	$P_{out}2$	V_{cont} = 0.3 V, I/Q = 400mV_{P-P} balanced	–	–93	–88	dBm
Local Leakage	LOL		–	–	–30	dBc
Image Rejection	ImR		–	–	–30	dBc
Output Harmonics 1	Hm1	Leakage when IF output = 190 MHz	–	–	–20	dBc
Output Harmonics 2	Hm2	Leakage when IF output = 380 MHz	–	–	–30	dBc
Rise Time from Power-saving Mode	t_{PS}		–	–	10	μs
Rising Voltage from Power-saving Mode	$V_{PS\ on}$		–	–	2.2	V
Falling Voltage from Power-saving Mode	$V_{PS\ off}$		0.5	–	–	V

STANDARD CHARACTERISTICS FOR REFERENCE – μPC8191T5E (TX) –
(Unless otherwise specified, V_{CC} = 3.0 V, T_A = +25°C, f_{IF} = 570 MHz, f_{LO} = 760 MHz, P_{LO} = –15 dBm, $f_{I/Q}$ = 10 kHz, 400 mV_{P-P} balanced sine-wave)

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Output Noise Level 1	NFL1	P_{out} = –25 dBm, f_{IF} ± 20 MHz	–	–148	–	dBm/Hz
Output Noise Level 2	NFL2	P_{out} = –65 dBm, f_{IF} ± 20 MHz	–	–162	–	dBm/Hz
Error Vector Magnitude (Vector Error)	EVM		–	3	–	%rms
Adjacent Channel Power	ACPR	f_{IF} ± 5 MHz	–	–55	–	dBc

MEASUREMENT CIRCUIT – μPC8191T5E (TX) –

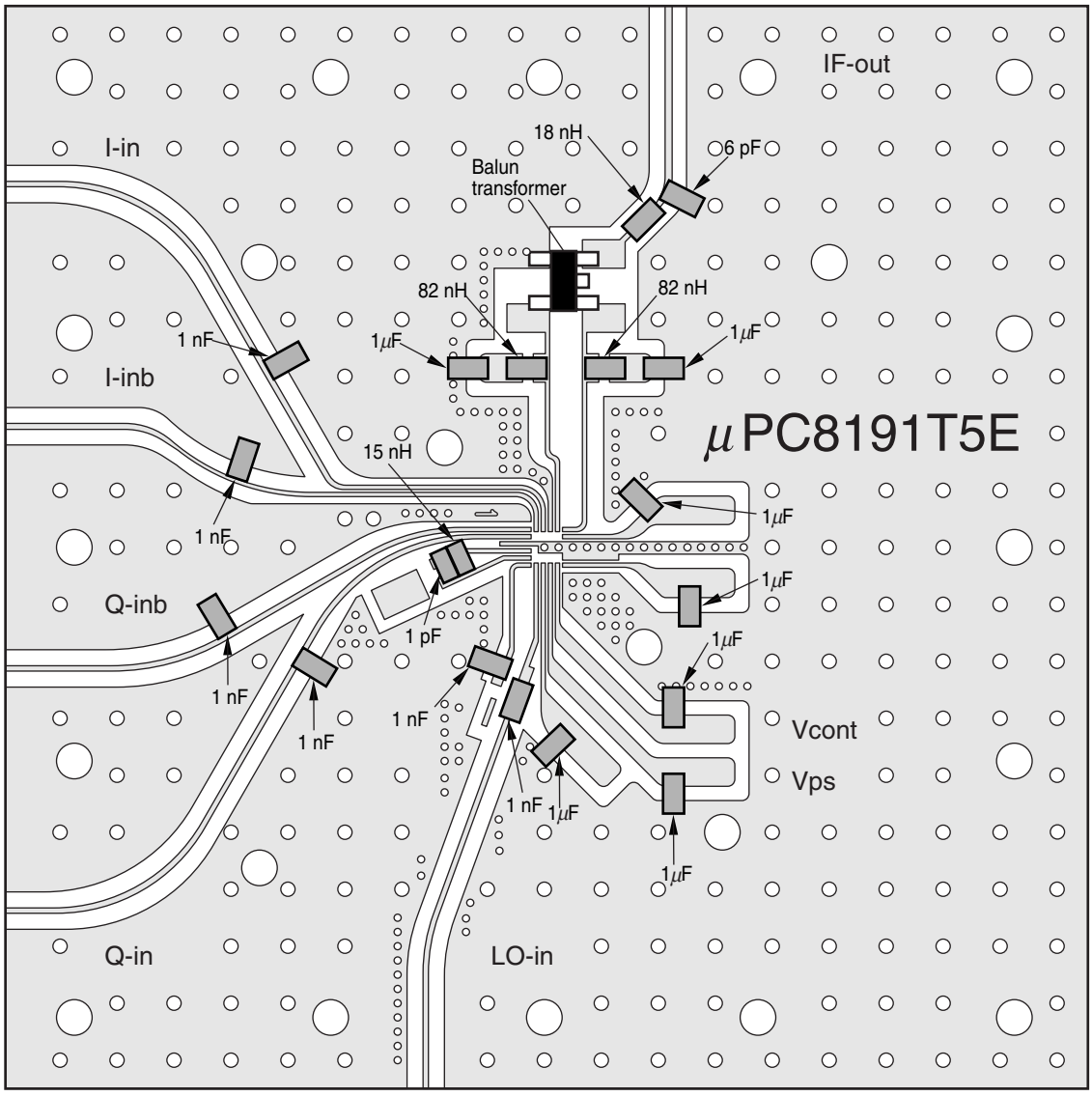


Remarks 1. ◉ : AC connector

○ : DC terminal

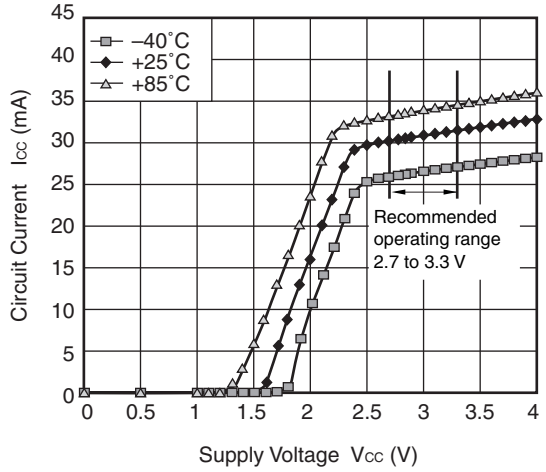
2. In the case of ACPR, output noise level, EVM measurement, 1 nF capacitors of I, Ib, Q, Qb are removed.

ILLUSTRATION OF THE TEST CIRCUIT ASSEMBLED ON EVALUATION BOARD – μPC8191T5E (TX) –

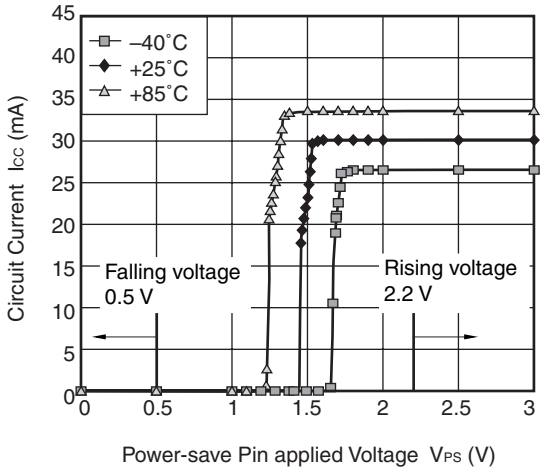


TYPICAL CHARACTERISTICS – μPC8191T5E (TX) – (V_{CC} = 3.0 V, T_A = +25°C, f_{IF} = 570 MHz, f_{LO} = 760 MHz, P_{LO} = –15 dBm, $f_{I/Q}$ = 10 kHz, 400 mV_{P-P} balanced sin-wave, unless otherwise specified)

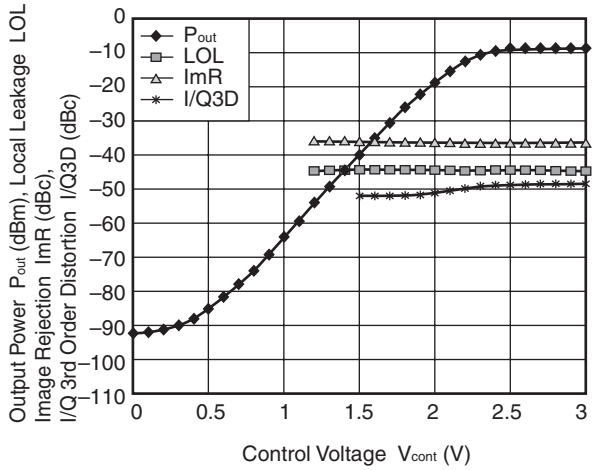
CIRCUIT CURRENT vs. SUPPLY VOLTAGE



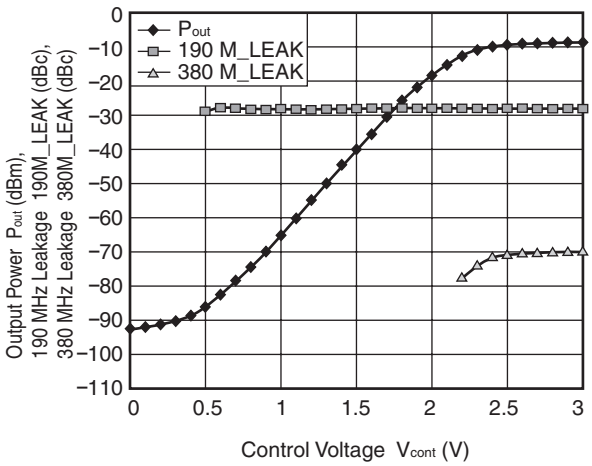
CIRCUIT CURRENT vs. POWER-SAVE PIN APPLIED VOLTAGE



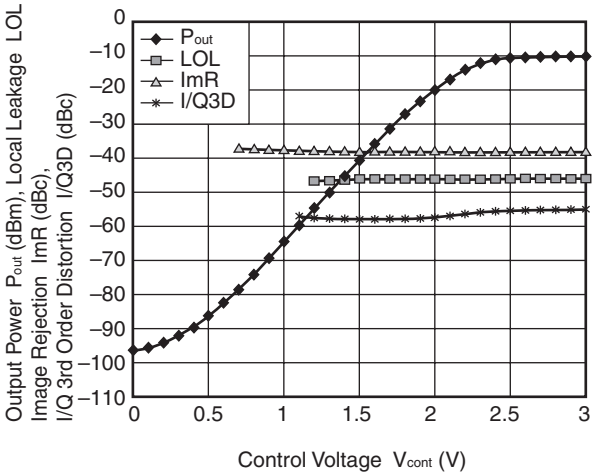
OUTPUT POWER, LOCAL LEAKAGE, IMAGE REJECTION, I/Q 3RD ORDER DISTORTION vs. CONTROL VOLTAGE (T_A = –40˚C)



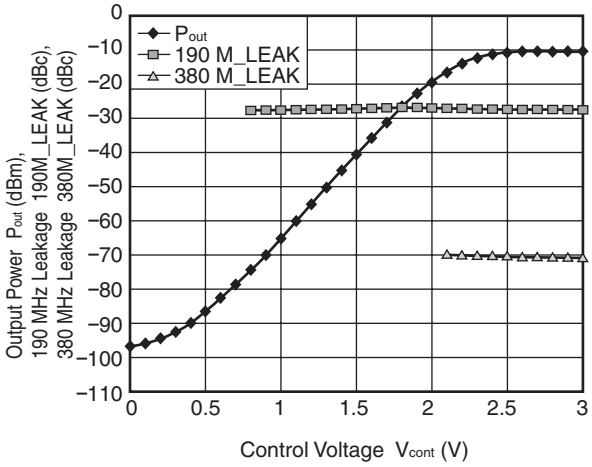
OUTPUT POWER, 190 MHz LEAKAGE, 380 MHz LEAKAGE vs. CONTROL VOLTAGE (T_A = –40˚C)



OUTPUT POWER, LOCAL LEAKAGE, IMAGE REJECTION, I/Q 3RD ORDER DISTORTION vs. CONTROL VOLTAGE (T_A = +25˚C)



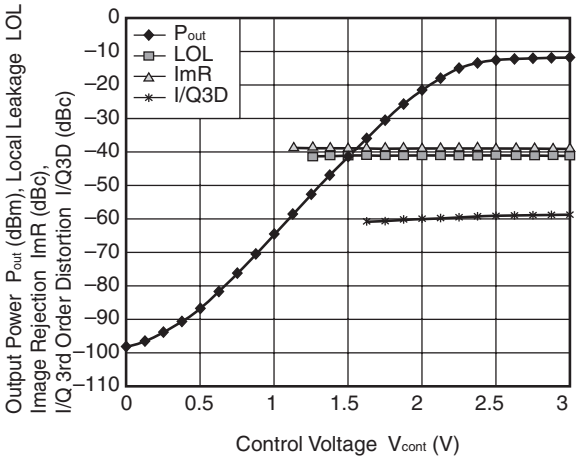
OUTPUT POWER, 190 MHz LEAKAGE, 380 MHz LEAKAGE vs. CONTROL VOLTAGE (T_A = +25˚C)



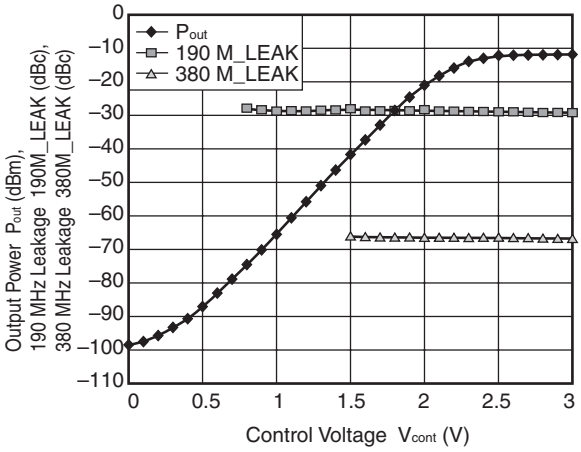
Remark The graphs indicate nominal characteristics.

– μPC8191T5E (TX) –

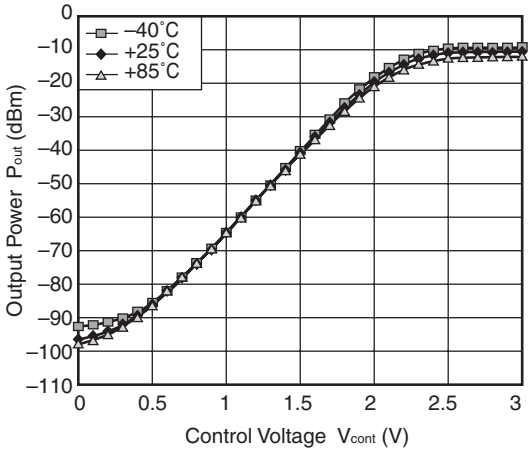
OUTPUT POWER, LOCAL LEAKAGE, IMAGE REJECTION, I/Q 3RD ORDER DISTORTION vs. CONTROL VOLTAGE (T_A = +85˚C)



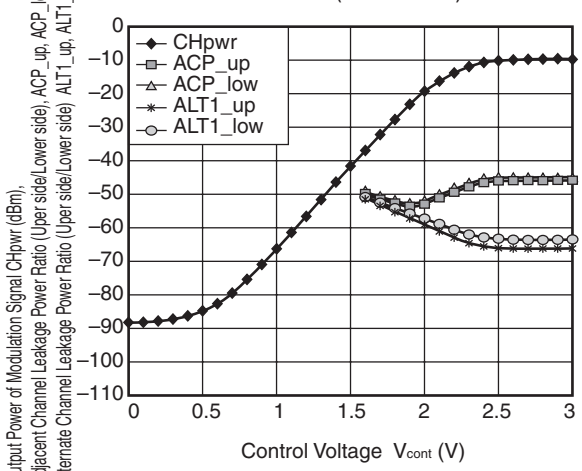
OUTPUT POWER, 190 MHz LEAKAGE, 380 MHz LEAKAGE vs. CONTROL VOLTAGE (T_A = +85˚C)



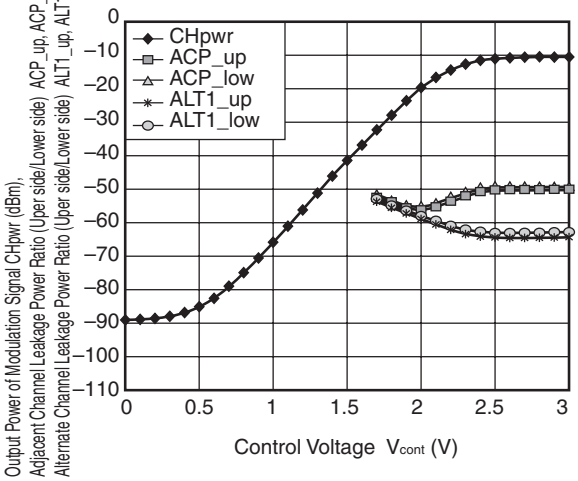
OUTPUT POWER vs. CONTROL VOLTAGE DEPENDENT ON TEMPERATURE



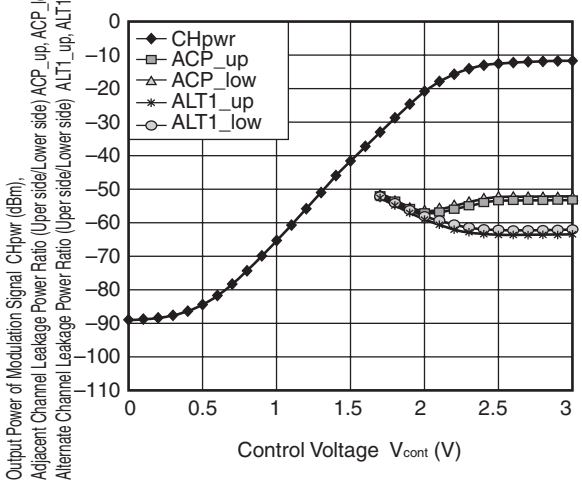
OUTPUT POWER OF MODULATION SIGNAL, ACP_up, ACP_Low, ALT1_Low, ALT1_up vs. CONTROL VOLTAGE (T_A = –40˚C)



OUTPUT POWER OF MODULATION SIGNAL, ACP_up, ACP_Low, ALT1_Low, ALT1_up vs. CONTROL VOLTAGE (T_A = +25˚C)



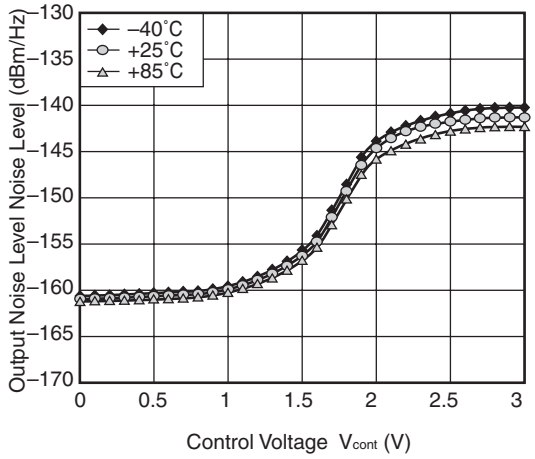
OUTPUT POWER OF MODULATION SIGNAL, ACP_up, ACP_Low, ALT1_Low, ALT1_up vs. CONTROL VOLTAGE (T_A = +85˚C)



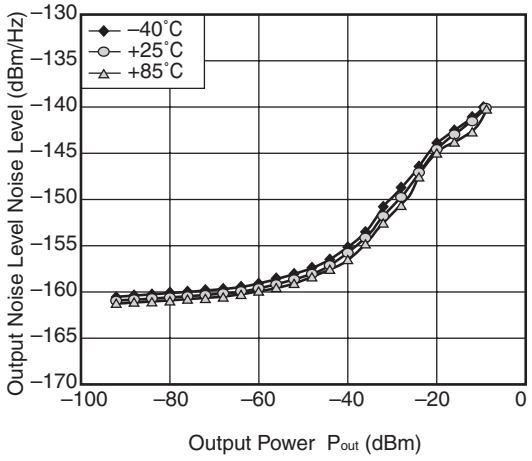
Remark The graphs indicate nominal characteristics.

– μPC8191T5E (TX) –

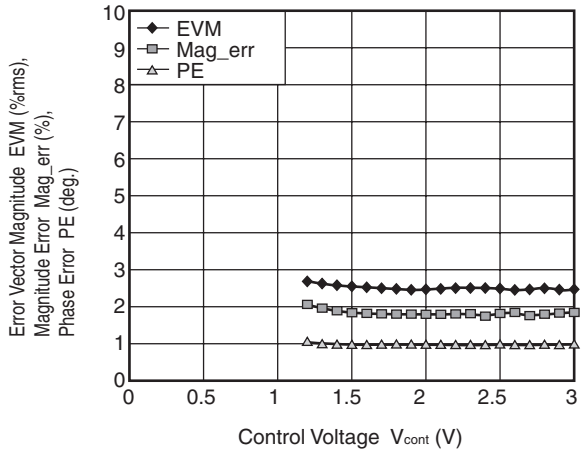
OUTPUT NOISE LEVEL vs. CONTROL VOLTAGE



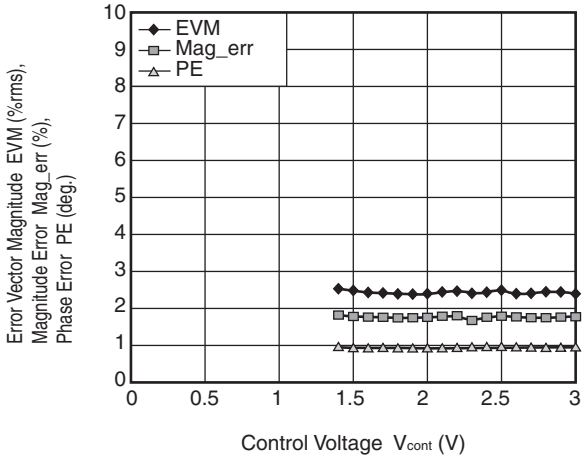
OUTPUT NOISE LEVEL vs. CONTROL VOLTAGE



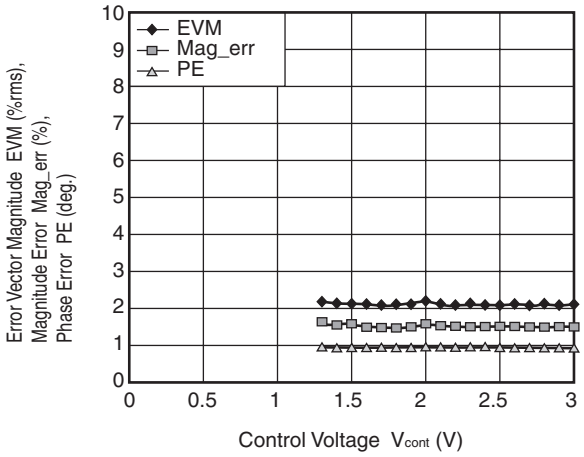
ERROR VECTOR MAGNITUDE, MAGNITUDE ERROR, PHASE ERROR vs. CONTROL VOLTAGE (T_A = –40˚C)



ERROR VECTOR MAGNITUDE, MAGNITUDE ERROR, PHASE ERROR vs. CONTROL VOLTAGE (T_A = +25˚C)



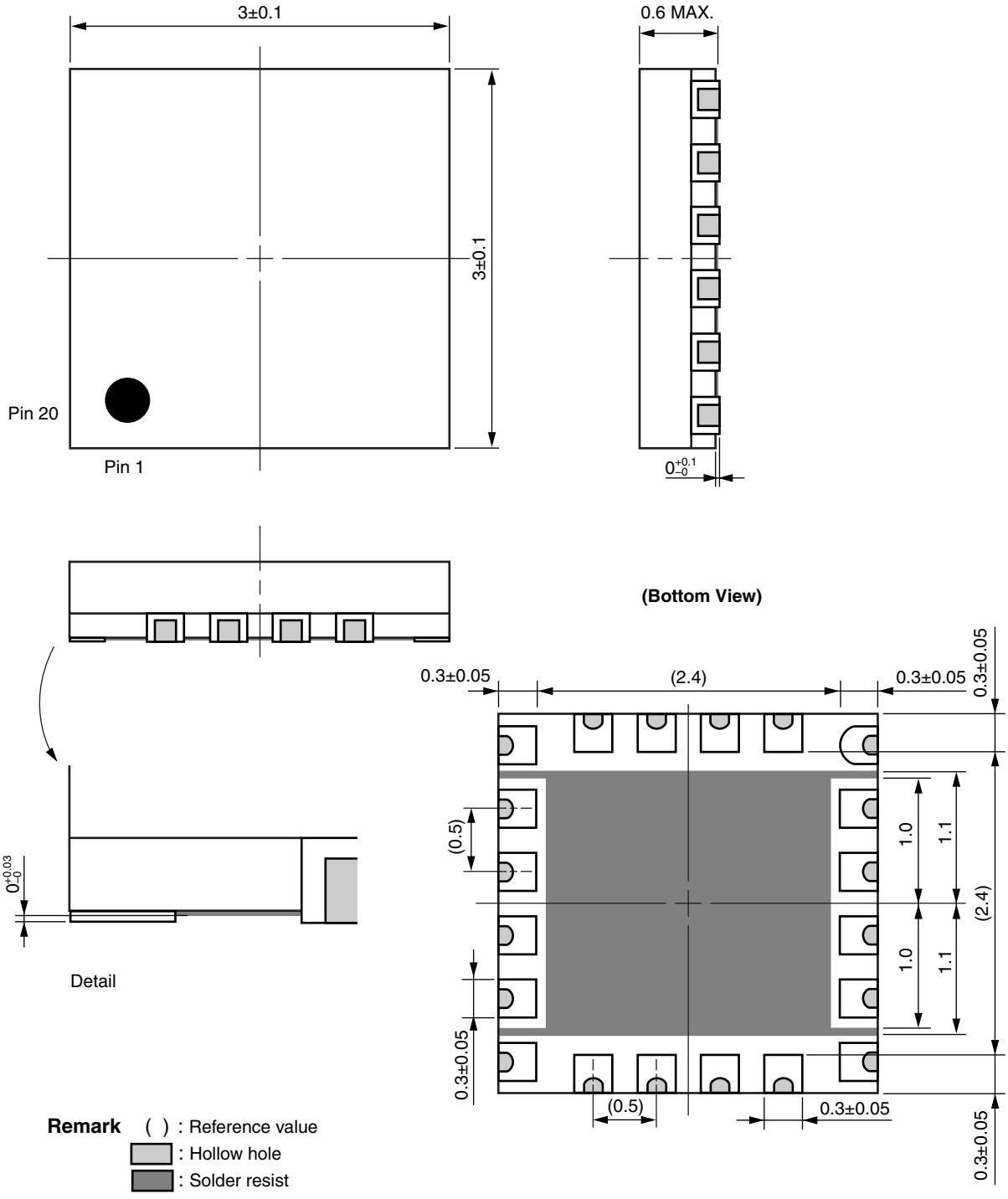
ERROR VECTOR MAGNITUDE, MAGNITUDE ERROR, PHASE ERROR vs. CONTROL VOLTAGE (T_A = +85˚C)



Remark The graphs indicate nominal characteristics.

PACKAGE DIMENSIONS

20-PIN PLASTIC LGA (CSP Type) (UNIT: mm)



Remark ( ) : Reference value
: Hollow hole
: Solder resist

NOTE ON CORRECT USE

(1) Observe precautions for handling because this IC is an electrostatic sensitive device.
(2) Form a ground pattern as widely as possible to minimize its impedance (to prevent undesired oscillation).
(3) Keep the track length of the ground terminals as short as possible.
(4) Connect a bypass capacitor to the V_{CC} terminal.

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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M8E 00.4-0110

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