AN6227FHN

Single chip, transmission and reception IC for PDC

■ Overview

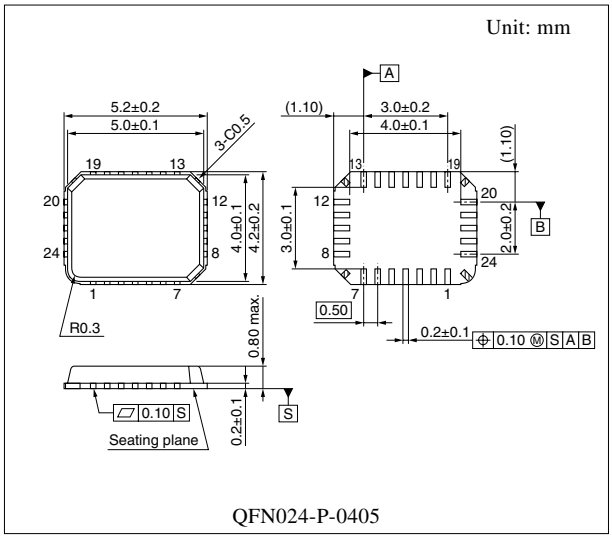
The AN6227FHN is a transmission and reception IC incorporating reception sleep function for a 1.5 GHz cellular telephone.

■ Features

- Reception sleep function built-in
- Ultra mini-type 4 mm × 5 mm leadless package
- Current consumption: At reception: 25 mA
  At transmission: 3.2 mA

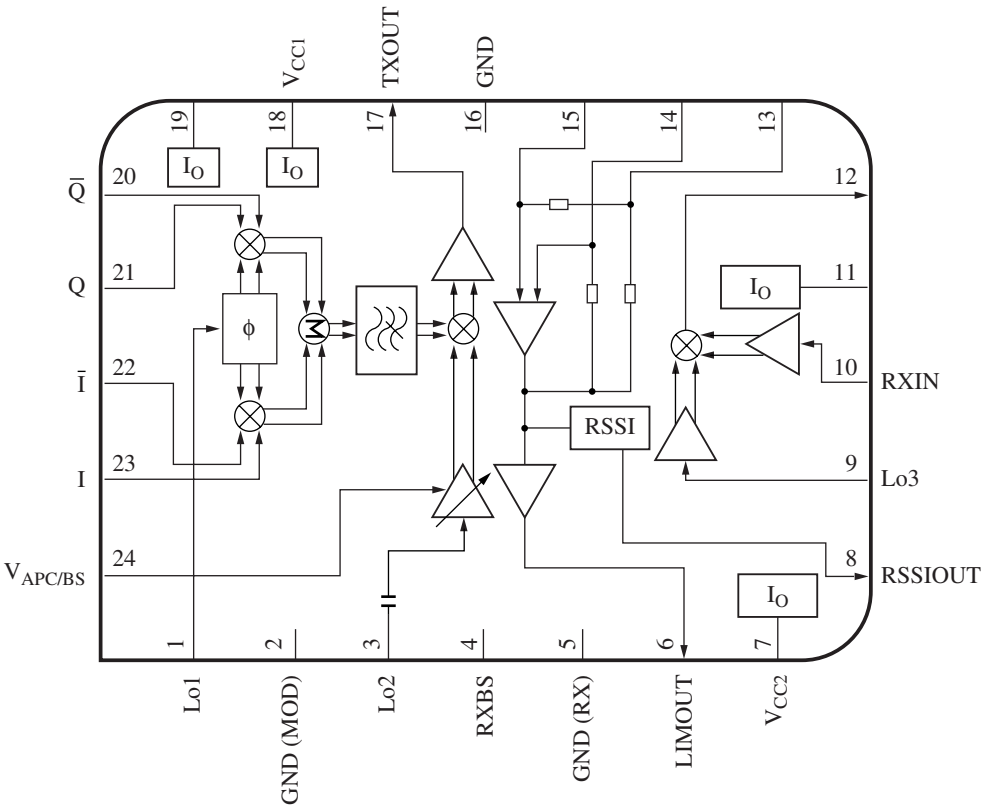
■ Applications

- Cellular telephone (1.5 GHz PDC)



QFN024-P-0405

■ Block Diagram



■ Pin Descriptions

Pin No.	Symbol	Description	Pin No.	Symbol	Description
1	TXLO1	TX local 1 input	13	LMDEC1	Limiter decouple 1
2	GNDMOD	TX modulator GND	14	LMDEC2	Limiter decouple 2
3	TXLO2	TX local 2	15	LMIN	Limiter input
4	RXBS	RXBS	16	GNDOUT	TX output GND
5	GNDRX	RX GND	17	TXOUT	TX output
6	LMOUT	Limiter output	18	VCCOUT	TX output V_{CC}
7	VCCLIM	V_{CC} limiter	19	VCCMOD	TX modulator V_{CC}
8	RSOUT	RSSI output	20	$\overline{Q}$-IN	$\overline{Q}$ input
9	RXLOIN	RX local input	21	Q-IN	Q input
10	RXMXIN	RX mixer input	22	$\overline{I}$-IN	$\overline{I}$ input
11	VCCMIX	Mixer V_{CC}	23	I-IN	I input
12	MXOUT	Mixer output	24	APC/BS	APC/BS

■ Absolute Maximum Ratings

Parameter	Symbol	Rating	Unit
Supply voltage	V_{CC}	4.2	V
Supply current	I_{CC}	60	mA
Power dissipation *2	P_D	125	mW
Operating ambient temperature *1	T_{opr}	−30 to +80	°C
Storage temperature *1	T_{stg}	−55 to +125	°C

Note) ∗1: Except for the operating ambient temperature and storage temperature, all ratings are for T_a = 25°C.

∗2: P_D is the value at T_a = 80°C without a heatsink. Use this device within the range of allowable power dissipation referring to "■ Technical Data • P_D — T_a curves of QFN024-P-0405".

■ Recommended Operating Range

Parameter	Symbol	Range	Unit
Supply voltage	V_{CC}	2.6 to 4.0	V

■ Electrical Characteristics at T_a = 25°C

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Current consumption (transimisson) *1	I_{CCTX}	Lo1 = 178 MHz, −25 dBm Lo2 = 1619 MHz, −18 dBm V_{APC} = 2.3 V	—	25	33	mA
Sleep current *1	I_{SLTX}	No signal, $V_{APC/BS} \leq 0.3$ V	—	0	10	µA

■ Electrical Characteristics at T_a = 25°C (continued)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output level 1 *1	P_{O1}	Lo1 = 178 MHz, −25 dBm Lo2 = 1 607 MHz, −18 dBm V_{APC} = 2.3 V	−16	−13	—	dBm
Output level 2 *1	P_{O2}	Lo1 = 178 MHz, −25 dBm Lo2 = 1 631 MHz, −18 dBm V_{APC} = 2.3 V	−16	−13	—	dBm
Minimum output level *1	P_{min}	Lo1 = 178 MHz, −25 dBm Lo2 = 1 619 MHz, −18 dBm V_{APC} = 1.0 V	—	−50	−40	dBm
Current consumption (reception) *2	I_{CCRX}	No signal	—	3.2	4.5	mA
Reception sleep current *2	I_{RXSLP}	No signal, RXBS ≤ 0.3 V	—	—	10	µA
Mixer conversion gain *2	G_{MX}	V_{MI} = 60 dBµ, SW1 = b (refer to "■ Application Circuit Example"), Excludes the filter loss of −7 dB	20	23	26	dB
Mixer maximum output amplitude *2	V_{MX}	V_{MI} = 105 dBµ, SW1 = b (refer to "■ Application Circuit Example"), Excludes the filter loss of −7 dB	100	106	—	dBµ
Limiter voltage gain *2	G_{LM}	V_{LI} = 15 dBµ	80	85	90	dB
Limiter maximum output amplitude *2	V_{LM}	V_{LI} = 80 dBµ, 450 kHz component	0.90	1.25	1.60	V[p-p]
RSSI output voltage 1 *2	$V_{S(1)}$	V_{LI} = 0 dBµ	0	0.23	0.6	V
RSSI output voltage 2 *2	$V_{S(2)}$	V_{LI} = 115 dBµ	2.31	2.6	2.91	V
RSSI reference output slope *3	D_S	$V_S (V_{IS}) = V_{S(1)} + 0.12$ V $D_S = V_S (V_{IS} + 75$ dBµ$) - V(V_{IS})$	1.39	1.8	2.19	V
RSSI output slope variation 1 *3	$\Delta D_{S(1)}$	$\Delta D_{S(1)} = 5 \{V_S (V_{IS} + 15$ dBµ$) - V_S (V_{IS})\} / D_S$	0.75	1	1.25	—
RSSI output slope variation 2 *3	$\Delta D_{S(2)}$	$\Delta D_{S(2)} = 5 \{V_S (V_{IS} + 30$ dBµ$) - V_S (V_{IS} + 15$ dBµ$)\} / D_S$	0.75	1	1.25	—
RSSI output slope variation 3 *3	$\Delta D_{S(3)}$	$\Delta D_{S(3)} = 5 \{V_S (V_{IS} + 45$ dBµ$) - V_S (V_{IS} + 30$ dBµ$)\} / D_S$	0.75	1	1.25	—
RSSI output slope variation 4 *3	$\Delta D_{S(4)}$	$\Delta D_{S(4)} = 5 \{V_S (V_{IS} + 60$ dBµ$) - V_S (V_{IS} + 45$ dBµ$)\} / D_S$	0.75	1	1.25	—
RSSI output slope variation 5 *3	$\Delta D_{S(5)}$	$\Delta D_{S(5)} = 5 \{V_S (V_{IS} + 75$ dBµ$) - V_S (V_{IS} + 60$ dBµ$)\} / D_S$	0.75	1	1.25	—

Note) ∗1: V_{CC1} = 3.0 V, IQ signal amplitude: 0.18 V[p-p] (both phases), DC bias: 1.6 V, (π/4 QPSK-modulated [0000] continuous wave input.

Output frequency of P_{O1}: 1429.0025 MHz, output frequency of P_{O2}: 1453.0025 Hz, output frequency of P_{min}: 1441.0025 MHz.

Output level is measured with a spectrum analyzer.

Setting of a spectrum analyzer: SPAN = 20 kHz, RBW = 300 Hz, VBW = 30 Hz, ST = 5 s

(When inputting π/4 QPSK-modulated [0000] continuous wave as IQ signal, the frequency for P_{O1}, P_{O2} and P_{min} becomes Lo frequency plus IQ signal frequency, which leads to the above value.)

Lo input level is a setting value of signal source (output impedance 50 Ω) described in the "■ Application Circuit Example".

■ Electrical Characteristics at T_a = 25°C (continued)

Note) (continued)

∗2: Unless otherwise specified: V_{CC2} = 3.0 V, RXBS = 2.5 V to 3.0 V, SW1 = a (Refer to "■ Application Circuit Example").
V_{LO3} = 90 dBμ: f = 129.55 MHz, V_{MI}: f = 130 MHz, V_{LI}: f = 450 kHz
(Input level of pin 15 is excluded the loss of the matching circuit and filter.)
V_{MX} and V_{LM} are measured in high impedance.
Lo input level is a setting value of signal source (output impedance 50 Ω) described in the "■ Application Circuit Example".

∗3: V_{IS} is the input level V_{L1} at which the RSSI output voltage becomes $V_{S(1)}$ + 0.12 V.

• Design reference data

Unless otherwise specified, V_{CC1} = 3.0 V.
Lo input level is a setting value of signal source (output impedance 50 Ω) described in the "■ Application Circuit Example".

Note) The characteristics listed below are theoretical values based on the IC design and are not guaranteed.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Carrier leak suppression ∗1 (fLo2-fLo1)	CL	Lo1 = 178 MHz, −25 dBm Lo2 = 1619 MHz, −18dBm V_{APC} = 2.3 V	—	−35	−25	dBc
Image leak suppression ∗1	IL	Lo1 = 178 MHz, −25 dBm Lo2 = 1619 MHz, −18 dBm V_{APC} = 2.3 V	—	−35	−30	dBc
Proximity spurious suppression ∗1	DU	Lo1 = 178 MHz, −25 dBm Lo2 = 1619 MHz, −18 dBm V_{APC} = 2.3 V	—	−70	−65	dBc
Base band distortion suppression ∗1	BD	Lo1 = 178 MHz, −25 dBm Lo2 = 1619 MHz, −18 dBm V_{APC} = 2.3 V	—	−40	−30	dBc
Adjacent channel leak power suppression (30 kHz detuning) ∗2	BL1	Lo1 = 178 MHz, −25 dBm Lo2 = 1619 MHz, −18 dBm V_{APC} = 2.3 V	—	−45	−38	dBc
Adjacent channel leak power suppression (50 kHz detuning) ∗2	BL2	Lo1 = 178 MHz, −25 dBm Lo2 = 1619 MHz, −18 dBm V_{APC} = 2.3 V	—	−70	−60	dBc
Adjacent channel leak power suppression (100 kHz detuning) ∗2	BL3	Lo1 = 178 MHz, −25 dBm Lo2 = 1619 MHz, −18 dBm V_{APC} = 2.3 V	—	—	−65	dBc
APC variable width ∗1	L_{APC}	Lo1 = 178 MHz, −25 dBm Lo2 = 1619 MHz, −18 dBm V_{APC} = 1.0 V to 2.3 V	30	37	45	dB
APC output level control sensitivity ∗1	S_{APC}	Lo1 = 178 MHz, −25 dBm Lo2 = 1619 MHz, −18 dBm V_{APC} = 1.0 V/1.6 V	37	46	55	dB/V
In-band output level deviation ∗1	ΔP	Lo1 = 178 MHz, −25 dBm Lo2 = 1607 MHz to 1631 MHz, −18 dBm, V_{APC} = 2.3 V	−1.5	—	+1.5	dB

■ Electrical Characteristics at T_a = 25°C (continued)

• Design reference data (continued)

Unless otherwise specified, V_{CC1} = 3.0 V.

Lo input level is a setting value of signal source (output impedance 50 Ω) described in the "■ Application Circuit Example".

Note) The characteristics listed below are theoretical values based on the IC design and are not guaranteed.

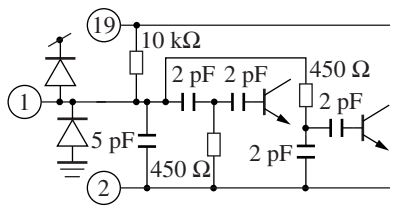
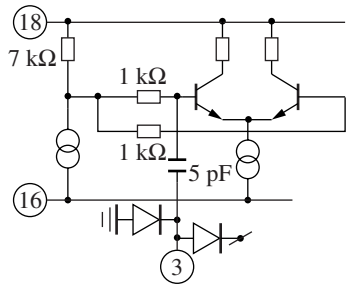
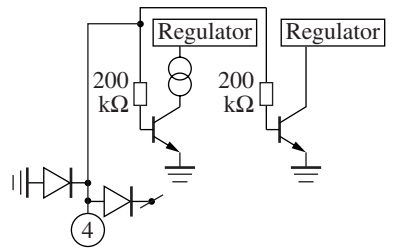
Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Modulation precision *3	EVM	Lo1 = 178 MHz, −25 dBm Lo2 = 1619 MHz, −18 dBm V_{APC} = 2.3 V	—	2.0	3.5	%[rms]

Note) *1: IQ signal amplitude: 0.18 V[p-p] (both phases), DC bias: 1.6 V, π/4 QPSK-modulated [0000] continuous wave input.
Measure the suppression amount for output with a spectrum analyzer.
Setting of a spectrum analyzer: SPAN = 20 kHz, RBW = 300 Hz, VBW = 30 Hz, ST = 5 s

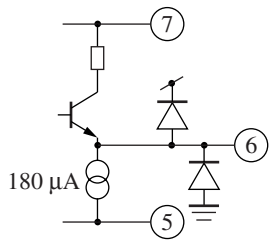
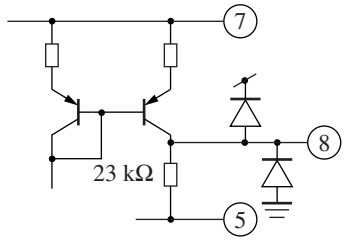
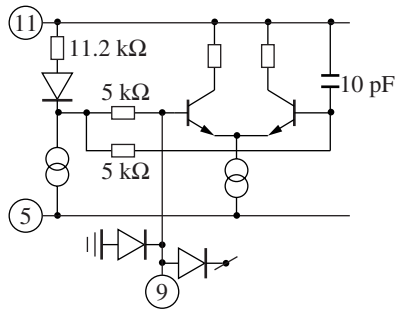
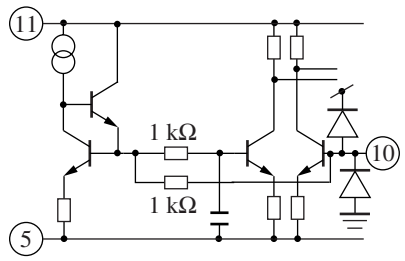
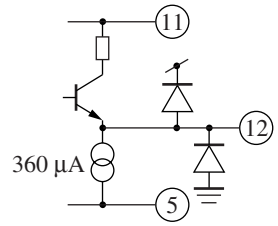
*2: IQ signal amplitude: 0.18 V[p-p] (both phases), DC bias: 1.6 V, π/4 QPSK-modulated [PN9] continuous wave input.
To be measured by a spectrum analyzer. (By using a leak power measurement function for an adjacent channel.)
Setting of a spectrum analyzer: SPAN = 250 kHz, RBW = 1 kHz, VBW = 1 kHz, ST = 2 s

*3: IQ signal amplitude: 0.18 V[p-p] (both phases), DC bias: 1.6 V, π/4 QPSK-modulated [PN9] continuous wave input.
The output level be measured by a spectrum analyzer. (By using a modulation precision measurement function.)

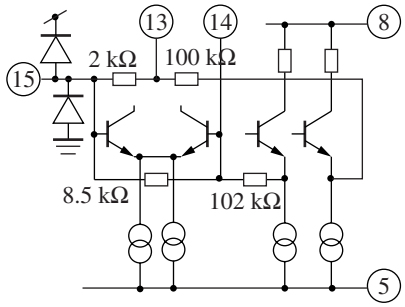
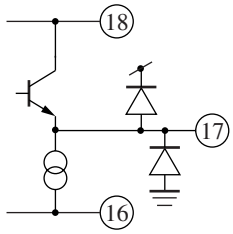
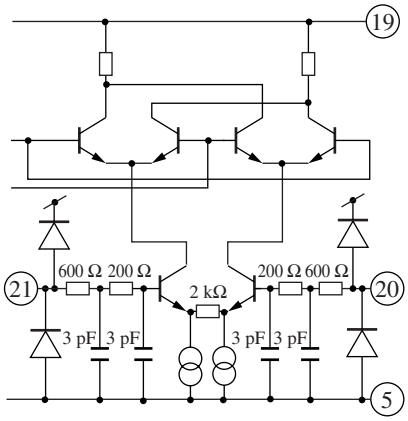
■ Terminal Equivalent Circuits

Pin No.	Equivalent circuit	Description	I/O
1		TXLO1: Input pin of quadrature modulator.	I
2		GNDMOD: GND pin of phase shifter and modulator. Make impedance low by widening the GND pattern.	—
3		TXLO2: Local input pin for up mixer.	I
4		RXBS: On/off control pin for reception block. RXBS (V) / Reception block 0 to 0.3 / Off 2.5 to 3 / On	I

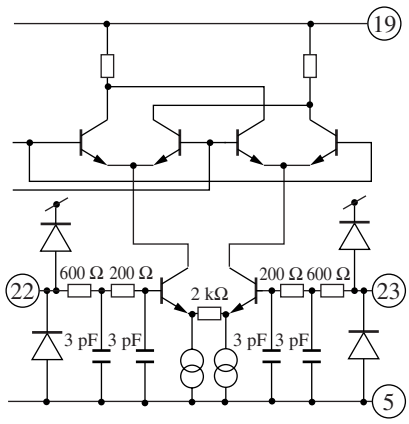
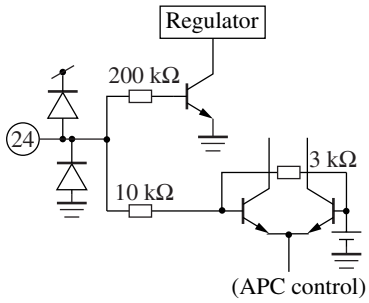
■ Terminal Equivalent Circuits (continued)

Pin No.	Equivalent circuit	Description	I/O
5		GNDRX: GND pin of reception system. Make impedance low by widening the GND pattern.	—
6		LMOUT: Output pin of limiter amplifier.	O
7		VCCLIM: V_{CC} pin for IF limiter amplifier RSSI.	—
8		RSOUT: RSSI output pin. DC potential corresponding to input signal level of limiter amplifier is outputted.	O
9		RXLOIN: Local input pin for reception down mixer.	I
10		RXMXIN: Input pin to 1st. IF amplifier. Input impedance is 2 kΩ.	I
11		VCCMIX: V_{CC} pin for reception down mixer.	—
12		MXOUT: Reception down-mixer output pin.	O

■ Terminal Equivalent Circuits (continued)

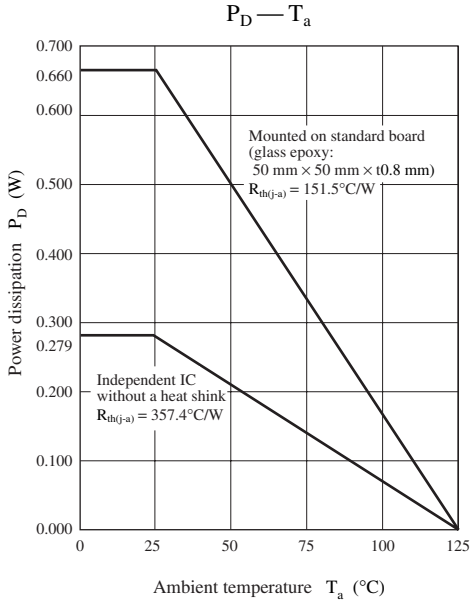
<table>
<tr><th>Pin No.</th><th>Equivalent circuit</th><th>Description</th><th>I/O</th></tr>
<tr><td>13, 14</td><td rowspan="2"> 
</td><td>Pin 13: LMDEC1; Pin 14: LMDEC2:
De-coupling pin for feedback of limiter amplifier.
Connect an external capacitor to GND.</td><td>—</td></tr>
<tr><td>15</td><td>LMIN:
Limiter amplifier input pin.
Input impedance is 2 kΩ.</td><td>I</td></tr>
<tr><td>16</td><td rowspan="3"> 
</td><td>GNDOUT:
GND pin for transmission up-mixer and RF output amplifier.</td><td>—</td></tr>
<tr><td>17</td><td>TXOUT:
RF output pin from output amplifier circuit.</td><td>O</td></tr>
<tr><td>18</td><td>VCCOUT:
V_{CC} pin for transmission up-mixer and RF output amplifier.</td><td>—</td></tr>
<tr><td>19</td><td rowspan="2"> 
</td><td>VCCMOD:
V_{CC} pin for phase shifter and quadrature modulator.</td><td>—</td></tr>
<tr><td>20</td><td>$\overline{Q}$-IN:
$\overline{Q}$ signal input pin.
Relation between DC bias and amplitude is as follows:
<table><tr><th>DC bias (V)</th><th>Amplitude (V[p-p])</th></tr><tr><td>1.6</td><td>0.18</td></tr></table>Input impedance is 100 kΩ or more.</td><td>I</td></tr>
<tr><td>21</td><td>Q-IN:
Q signal input pin.
Relation between DC bias and amplitude is as follows:
<table><tr><th>DC bias (V)</th><th>Amplitude (V[p-p])</th></tr><tr><td>1.6</td><td>0.18</td></tr></table>Input impedance is 100 kΩ or more.</td><td>I</td></tr>
</table>

■ Terminal Equivalent Circuits (continued)

<table>
<tr><th>Pin No.</th><th>Equivalent circuit</th><th>Description</th><th>I/O</th></tr>
<tr><td>22</td><td rowspan="2"> 
</td><td>$\overline{I}$-IN:
$\overline{I}$ signal input pin.
Relation between DC bias and amplitude is as follows:
DC bias (V) | Amplitude (V[p-p])
1.6 | 0.18
Input impedance is 100 kΩ or more.</td><td>I</td></tr>
<tr><td>23</td><td>I-IN:
I signal input pin.
Relation between DC bias and amplitude is as follows:
DC bias (V) | Amplitude (V[p-p])
1.6 | 0.18
Input impedance is 100 kΩ or more.</td><td>I</td></tr>
<tr><td>24</td><td> 
</td><td>APC/BC:
Pin for use both as battery saving of transmission block and as power control of transmitting RF output.
Control with the following conditions:
V_{APC} (V) | Mode
0 to 0.3 | Off
1.0 to V_{CC} | On (APC control)
Input impedance is 5 kΩ or more.</td><td>I</td></tr>
</table>

■ Technical Data

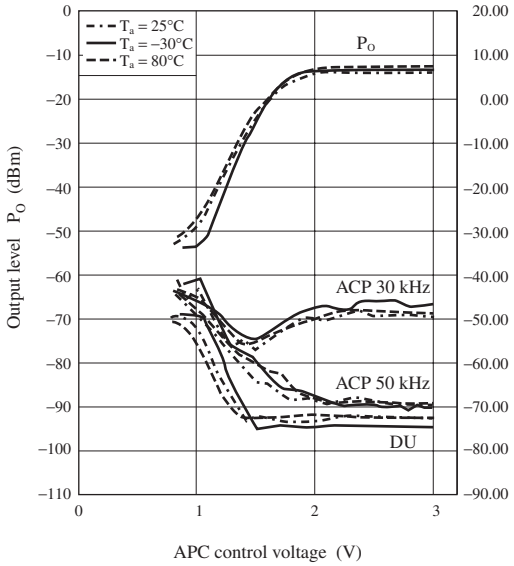
1. P_D — T_a curves of QFN024-P-0405



■ Technical Data (continued)

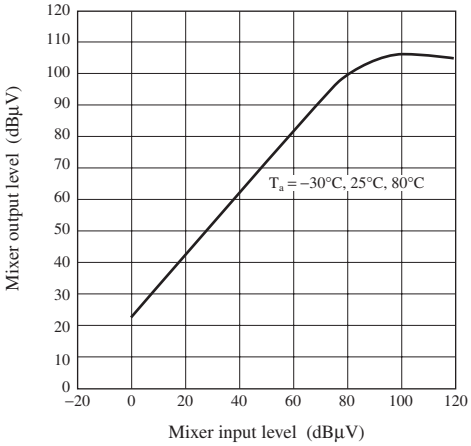
2. Main characteristics

APC control voltage characteristics



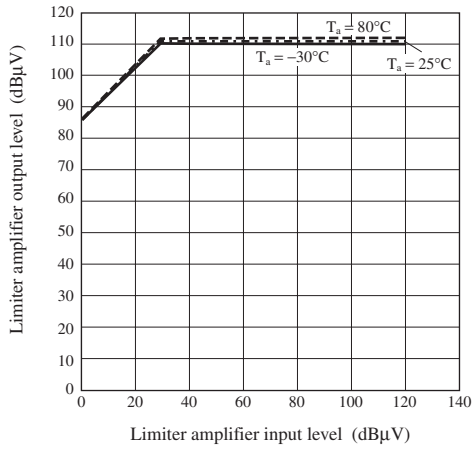
V_{CC} = 3.0 V, T_a = −30°C, 25°C, 80°C,
BS = V_{APC} = V_{AR}
Lo1 : 178 MHz, −25 dBm
Lo2 : 1 619 MHz, −18 dBm
I, Q : 0.18 V[p-p] (both phases) 1.6 V_{DC} ,
π/4, [0000] or using PN9 stages
continuous wave.
Adjacent channel leak power suppression amount: ACP 30 kHz, ACP 50 kHz (dBc)
Proximity spurious suppression amount: DU (dBc)

Mixer characteristic



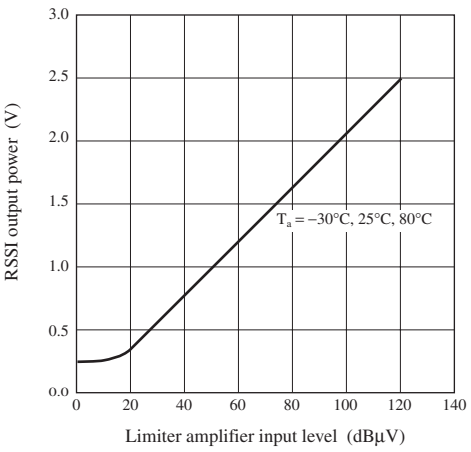
V_{CC} = 3.0 V, T_a = −30°C, 25°C, 80°C
Mixer in: 130 MHz
Mixer out: 450 kHz
Lo3 in: 129.55 MHz, 90 dBμV

Limiter amplifier characteristics



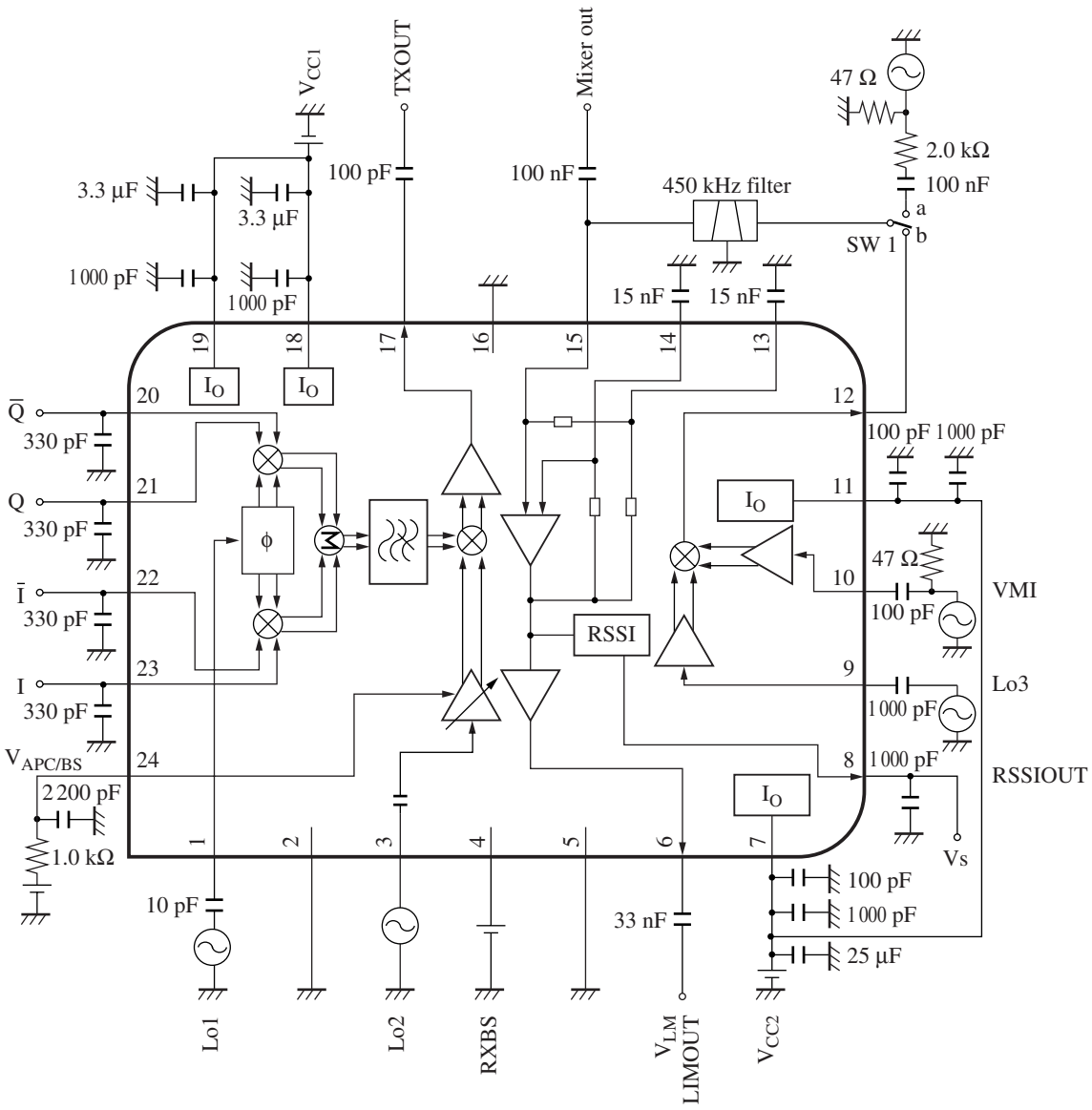
V_{CC} = 3.0 V, T_a = −30°C, 25°C, 80°C,
BS = 2.5 V
Limiter in: 450 MHz, Limiter out: 450 kHz

RSSI characteristic



V_{CC} = 3.0 V, T_a = −30°C, 25°C, 80°C,
BS = 2.5 V
Limiter in: 450 MHz, Limiter out: 450 kHz

■ Application Circuit Example



Request for your special attention and precautions in using the technical information and semiconductors described in this material

(1) An export permit needs to be obtained from the competent authorities of the Japanese Government if any of the products or technologies described in this material and controlled under the "Foreign Exchange and Foreign Trade Law" is to be exported or taken out of Japan.

(2) The technical information described in this material is limited to showing representative characteristics and applied circuit examples of the products. It does not constitute the warranting of industrial property, the granting of relative rights, or the granting of any license.

(3) The products described in this material are intended to be used for standard applications or general electronic equipment (such as office equipment, communications equipment, measuring instruments and household appliances).
Consult our sales staff in advance for information on the following applications:
- Special applications (such as for airplanes, aerospace, automobiles, traffic control equipment, combustion equipment, life support systems and safety devices) in which exceptional quality and reliability are required, or if the failure or malfunction of the products may directly jeopardize life or harm the human body.
- Any applications other than the standard applications intended.

(4) The products and product specifications described in this material are subject to change without notice for reasons of modification and/or improvement. At the final stage of your design, purchasing, or use of the products, therefore, ask for the most up-to-date Product Standards in advance to make sure that the latest specifications satisfy your requirements.

(5) When designing your equipment, comply with the guaranteed values, in particular those of maximum rating, the range of operating power supply voltage and heat radiation characteristics. Otherwise, we will not be liable for any defect which may arise later in your equipment.
Even when the products are used within the guaranteed values, redundant design is recommended, so that such equipment may not violate relevant laws or regulations because of the function of our products.

(6) When using products for which dry packing is required, observe the conditions (including shelf life and after-unpacking standby time) agreed upon when specification sheets are individually exchanged.

(7) No part of this material may be reprinted or reproduced by any means without written permission from our company.

Please read the following notes before using the datasheets

A. These materials are intended as a reference to assist customers with the selection of Panasonic semiconductor products best suited to their applications.
Due to modification or other reasons, any information contained in this material, such as available product types, technical data, and so on, is subject to change without notice.
Customers are advised to contact our semiconductor sales office and obtain the latest information before starting precise technical research and/or purchasing activities.

B. Panasonic is endeavoring to continually improve the quality and reliability of these materials but there is always the possibility that further rectifications will be required in the future. Therefore, Panasonic will not assume any liability for any damages arising from any errors etc. that may appear in this material.

C. These materials are solely intended for a customer's individual use.
Therefore, without the prior written approval of Panasonic, any other use such as reproducing, selling, or distributing this material to a third party, via the Internet or in any other way, is prohibited.

2001 MAR