iT5010
40 Gb/s 6 Vpp Optical Modulator Driver

Description

The iT5010 is an extremely broadband GaAs MMIC traveling wave amplifier that delivers medium output power and moderate gain from 30 kHz to 45 GHz. It can be used as a general-purpose broadband driver in optical communication systems and is well suited for broadband applications requiring a flat gain response, 6 Vpp output voltage, and excellent port matches.

Seven P-HEMT cascode stages provide a flat gain response, making the iT5010 an ideal broadband driver amplifier. The iT5010 incorporates advanced MBE technology, Ti-Pt-Au gate metallization, silicon nitride passivation, and polyimide for scratch protection. Dynamic gain control and low-frequency extension capabilities are designed into the device.

Features

- Frequency range: 30 kHz to 45 GHz
- Gain: 9 dB
- Gain flatness: ±0.5 dB
- P1dB at 20 GHz: 19 dBm
- Psat at 20 GHz: 21 dBm
- Output voltage: 6 Vpp
- Return loss:
  Input: –15 dB
  Output: –10 dB
- Low-frequency operation
- Available in die form

Absolute Maximum Ratings

Symbol	Parameters/conditions	Min.	Max.	Units
Vdd	Power supply voltage		10	V
Vg1	Power supply voltage	-8		V
Vg2	Power supply voltage	-3		V
Rfin	Input power		20	dBm
Tch	Operating channel temperature		150	ºC
Tstg	Storage temperature	-65	150	ºC

Recommended Operating Conditions

Vdd = 7 V, Idd = 150 mA

Symbol	Parameters/conditions	Min.	Typ.	Max.	Units
Ta	Operating temperature range	-40		85	ºC
Vdd	Positive power supply voltage		7		V
Vg2	Positive power supply voltage		3		V
Vg1	Negative power supply voltage		-0.5		V

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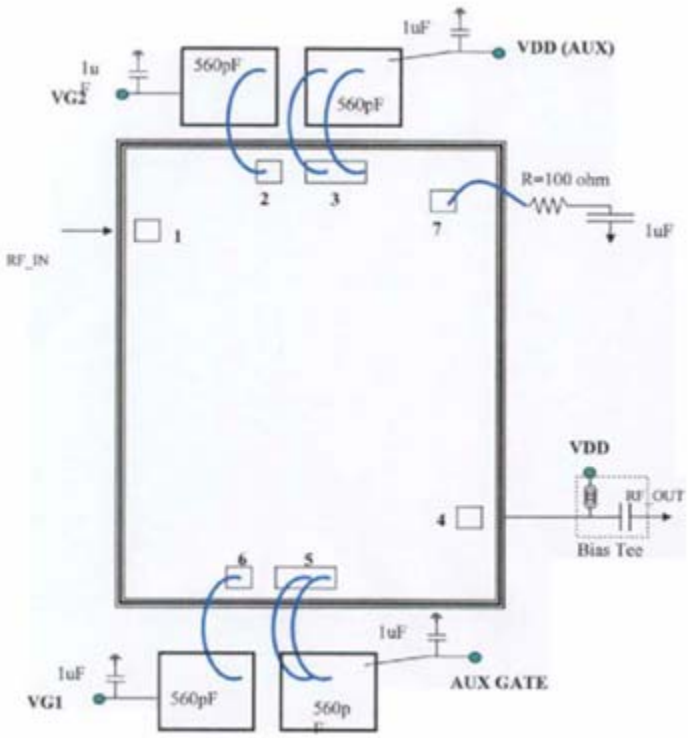
Electrical Characteristics

At ambient temperature

Vdd = 7 V
Idd = 150 mA

Symbol	Parameters/conditions	Min	Typ	Max	Units
$\|S21\|^{(2)}$	Small signal gain		9		dB
D|S21|	Small signal gain flatness		0.5		dB
RI_{in}	Minimum input return loss		-15		dB
RI_{out}	Minimum output return loss		-10		dB
$\|S12\|^{(2)}$	Isolation		-35		dB
P_{-1db}	Output power at 1 dB gain compression (f =20 GHz)		21		dBm
Psat	Saturated output power (f = 20 GHz)		22		dBm
B3dB	3 dB bandwidth		45		GHz
OIP3	Output third-order intercept point		28		dBm
	RF_{in1}=RF_{in2}= 2 dBm, f = 18 GHz, Df = 10 MHz				

Recommended Assembly Diagram



Pinouts:

P1: RF input
P2: VG2
P3: Aux drain
P4: RF output
P5: Aux gate
P6: VG1
P7: Low-frequency tuning

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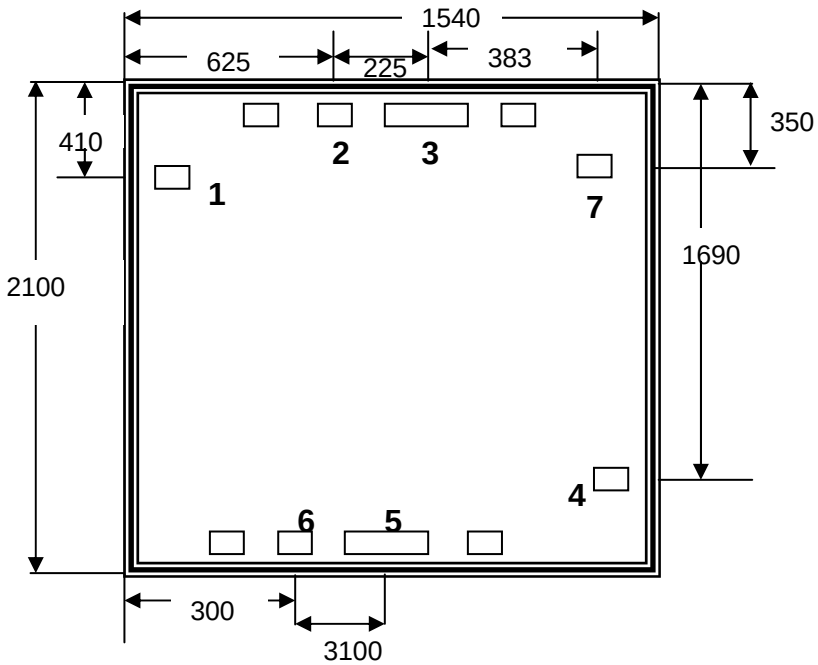
Die Dimensions

1. All dimensions in microns
2. No connection required for unlabeled pads
3. Typical bond pads are 100 x 100 µm and 100 x 250 µm
4. Backside metal is ground
5. Input pad is labeled with the number 1, output pad is labeled with the number 6. VG1 is connected to pad 6, VG2 is connected to pad 2, vdd (AUX) is connected to pad 3.



Biasing and General Operation

The iT5010 is biased with a positive drain supply (V_{dd}) and one negative gate supply (V_{g1}). The recommended bias conditions for the iT5010 are V_{dd}= 7.0 V and I_{dd} = 150 mA. To achieve this drain current level, V_{g1} is typically biased between –0.35 V and –0.45 V. The gate voltage (V_{g1}) MUST be applied prior to the drain voltage (V_{dd}) during power up and removed after the drain voltage is removed during power down. Drain bias V_{dd} can be applied through an external bias tee to the RF output pad. The positive power supply can also be applied to the drain low-frequency extension (3) pad Vdd (AUX). In this case, the bias voltage must consider the voltage drop through the internal resistor of 34 ohms. For example, if the bias voltage at the drain of the top FET in each leg of the distributed amplifier is 7 V, then the external positive supply should be 12.1 V when the device is operating at 150 mA (7 V + 34 ohm x 150 mA = 12.1 V).

The second gate Vg2 can be used to obtain 30 dB typical gain control. For normal operation an external bias of 3.1 V is required (Vdd = 7 V, Vg1 = -0.4 V). In general, Vg2 = Vdd/2 – |Vg1|. When Vdd = 7 V and Vg1 = -0.4 → |Vg1| = 0.4 and the recommended voltage operation is: Vg2 = 7 V/2-0.4 V = 3.1 V. External coupling capacitors are needed on RF_IN (pad 1) and RF_OUT (pad 4) ports. The drain bias pad is connected to RF_OUT pad. RF choke inductance must be large enough to cover the lowest operating frequency. The auxiliary gate pad 5 and drain pad 3 contact pads are provided to extend performance below 5 GHz. Connect these pads via large external capacitors to ground to maintain input and output VSWR at low frequencies. Do not apply bias to these pads. See the bonding diagram for details. The auxiliary gate PAD (5) and drain PAD (3) contact pads are provided to extend performance below 2 GHz. Connect these pads via large external capacitors to ground to maintain input and output VSWR at low frequencies. Do not apply bias to these pads. See the bonding diagram for details.

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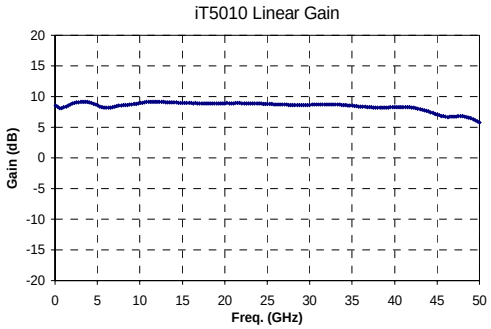
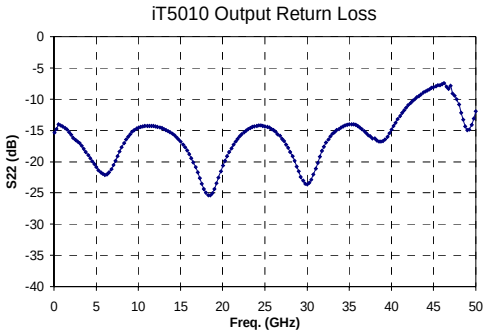
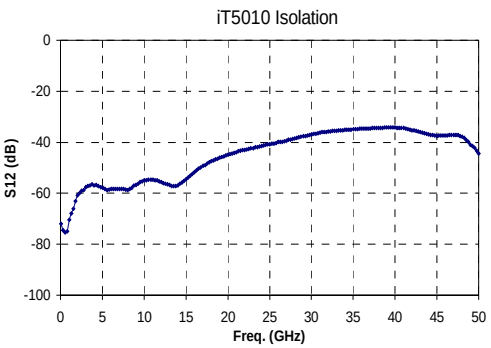
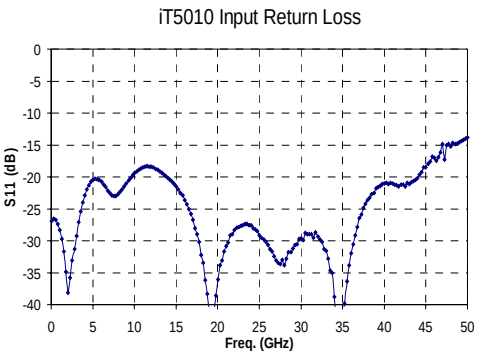
Small Signal Measured Performance
at Vdd=7 V









Optical Modulator Driver Application

The iT5010 amplifier has been designed to drive 43 Gb/s optical modulators, providing an output voltage of 6 Vpp. In order to achieve the best eye diagram performance, the assembly diagram reported in this data sheet is recommended along with the following bias procedure:

1. Disable RF during the initial biasing

2. Set Vg1 to –1 V

3. Set Vdd to 7 V

4. Increase Vg1 in order to bring current close to 150 mA (this should correspond to about Vg1 = -0.4).

5. Apply RF signal at 2 Vpp, small decreasing of current can be observed.

6. Increase input signal to 3 Vpp with output voltage of 6 Vpp (current decrease of about 5%)

7. Adjust Vg1 to center eye crossing.

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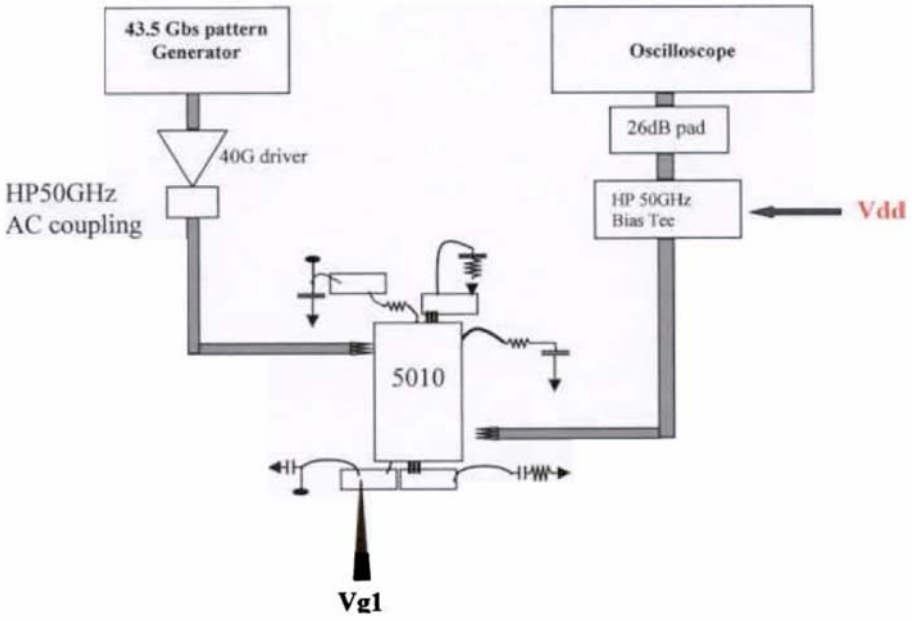
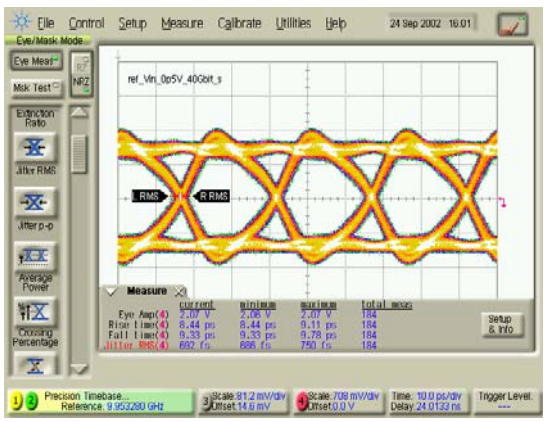
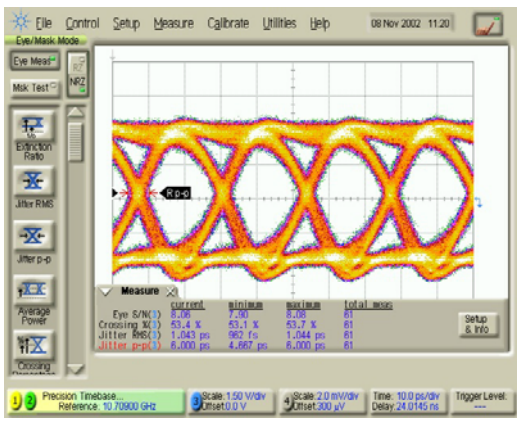
43.5 Gb/s Eye Diagram - Probe Test Set Up



Eye Diagram Measured Performance At 40 Gb/s



INPUT SIGNAL
Bit rate: 40 Gb/s pbrs 2^31
Vin = 2.0 Vpp
Rt/Ft = 9.3 ps, Jitter RMS = 0.7 ps



OUTPUT SIGNAL
Bit rate: 40 Gb/s pbrs 2^31
Vout = 6 Vpp
Rt/F t = 9.7 ps, Jitter RMS = 1.0 ps

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