MINDSPEED
BUILD IT FIRST

MC2010

PIN Pre-amplifier with AGC for 3.3V Fibre-Optics Applications to 1.25Gbs

FEATURES

- Low cost IC. Fabricated in advanced sub-micron pure-CMOS process.
- Receiver sensitivity better than -27dBm @ 1.25Gbs (MC20L10)
- Minimum 830MHz bandwidth and multi-pole roll off allows a wide range of operation up to 1.25Gbs.
- Typical differential transimpedance at low signal levels of 16KΩ (MC20L10) and 8KΩ (MC20S10)
- AGC gives continuous operation to +3dBm
- > 35dB power-supply noise rejection.
- Typical 100mW power comsumption at 3.3V supply.
- Monitor O/P gives linear indication of recieved optical power.
- Available in MSOP (mini-SO) package or in die form.

APPLICATIONS

- ATM/SDH/SONET
- Gigabit Ethernet
- Fibre Channel

DESCRIPTION

The **MC2010** is a low-noise, transimpedance amplifier with AGC, manufactured in an advanced, yet low-cost, sub-micron CMOS process. It is available in two versions:

The **MC20L10** has low noise and wide dynamic range making it well suited for telecommunications, especially OC-24.

The **MC20S10** has lower gain and is designed for use with lower cost, higher capacitance photodiodes (including Si diodes) in datacom applications.

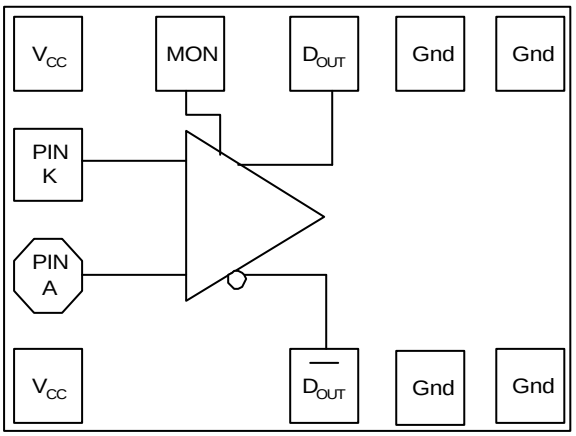
The **MC2010** is available in both die or packaged form. For optimum system performance die should be used, mounted in close proximity with the photodetector.

The **MC2010** is designed to be used with the Microcosm MC2046 postamplifier IC. When combined with a photodiode, the chipset forms a high performance, low cost 3.3V receiver.

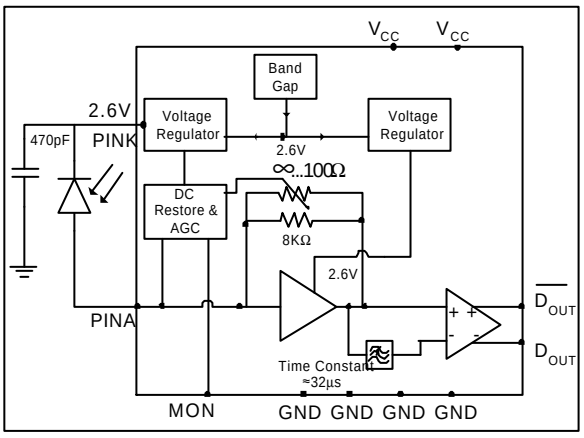
ORDERING INFORMATION

Part	Pin-Package
MC2010SDIEWP	Waffle Pack
MC2010LDIEWP	Waffle Pack
MC2010SWAFER	Expanded whole 8" wafer on a 10" grip ring
MC2010LWAFER	Expanded whole 8" wafer on a 10" grip ring

TOP LEVEL DIAGRAM



BLOCK DIAGRAM



PIN DESCRIPTION

Name	Function	
GND	Ground pin. Connect to the most negative supply. All pins should be used	
D_{OUT}	Non-Inverted Data Output. Differential output with $\overline{D_{OUT}}$	
V_{CC}	Power pin. Connect to most positive supply. Either or both pins may be used.	
PINK	PIN Cathode connection. Connect photodiode between this pin and PINA Connect de-coupling cap between here and GND (470pF typ).	
PINA	PIN Anode connection. Connect photodiode between this pin and PINK.	
$\overline{D_{OUT}}$	Inverted Data Output. Differential output with D_{OUT}	
MON	Optical input power monitor	

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Rating	Units
V_{CC}	Power Supply (V_{CC}-Gnd)	4.5	V
T_A	Operating Ambient (SOIC8)	-40 to +85	°C
T_J	Junction Temperature (die)	+150	°C
T_{STG}	Storage Temperature	-65 to +150	°C

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Rating	Units
V_{CC}	Power supply (V_{CC}-GND)	3.3 $\pm$ 7.5%	V
T_J	Junction Temperature (die)	-40 to +100	°C
T_A	Operating ambient	-40 to +85	°C

DC CHARACTERISTICS

Symbol	Parameter	Min.	Typ.	Max.	Units
V_B	PIN bias voltage (PINK - PINA)	1.5	1.6	1.8	V
V_{CM}	Common mode output voltage	V_{CC}/2-0.1V	V_{CC}/2	V_{CC}/2+0.1V	V
I_{CC}	Supply current (no loads)	-	30	42	mA

AC CHARACTERISTICS

MC20L10

Symbol	Parameter	Min.	Typ.	Max.	Units
R_{OUT}	Output Impedance (single ended)(3)	-	50	-	Ω
I_{NOISE}	Input referred Noise Current(1),(2)		223		nA_{rms}
PIN(mean), min	Optical Sensitivity (1),(2)	-27	-28	-29	dBm
I_{MAX}	Input Overload Current		3		mA_{pp}
PIN(mean), max	Optical Saturation (2)	0	+3	-	dBm
G	Small signal Transimpedance (3),(4) Single ended Diffferential	 - -	 8 16	 - -	KΩ
V_D	Differential Output Voltage (3)	-	600	-	mV
BW	Bandwidth to -3dB point (optical)(5)	830	-	-	MHz
T_{PWD}	Pulse Width Distortion	-	-	6	%
OS_{PULSE}	Pulse Overshoot	-	-	20	%
T_{AGC}	AGC Time constant	-	16	-	µs
O_{SAGC}	AGC Overshoot	-	-	12	%
PSRR	Power Supply Rejection Ratio (<4MHz)	35	-	-	dBm

MC20S10 (differences from MC20L10)

PIN(mean), min	Optical Sensitivity (6, 7)	-21	-22	-23	dBm
G	Small signal Transimpedance Single ended Differential	 - -	 4 8	 - -	KΩ
V_D	Differential Output Voltage	-	300	-	mV

NOTE:

(1) Measured with input capacitance, C_{IN}=0.7pF

(2) Assuming photodiode responsivity of 0.9A/W, extinction ratio of 10dB and BER of 10^{-10} BW=830MHz

(3) The 2010 is designed to drive a load >500Ω. Measurements are taken into >500Ω

(4) Measured at 10MHz.

(5) Multi-pole roll off.

(6) Cin=1.5pF

(7) Responsivity of 0.45A/W, ext ratio of 10dB and BEA of 10^{-12} BW=803MHz

FUNCTIONAL DESCRIPTION

TZA

The transimpedance amplifier consists of a high gain single-ended CMOS amplifier, with a feedback resistor. The feedback creates a virtual earth low impedance at the input and virtually all of the input current passes through the feedback resistor, defining the voltage at the output. Advanced CMOS design techniques are employed to maintain the stability of these stages across all input conditions.

Single-ended amplifiers have inherently poor power supply noise rejection. For this reason, an on-chip low dropout linear regulator has been incorporated into the design to give excellent noise rejection up to several MHz. Higher frequency power supply noise is removed by external decoupling.

The circuit is designed for PIN photodiodes in the "grounded cathode" configuration, with the anode connected to the input of the TZA and the cathode connected to ac ground. Reverse dc bias is applied to reduce the photodiode capacitance.

AGC

The MC20L10 has been designed to operate over the input range of +3dBm to –27dBm at long wavelengths. This represents a ratio of 1:1000, whereas the acceptable dynamic range of the output is only 1:100 which implies a compression of 10:1 in the transimpedance. The design uses a MOS transistor in the triode region as a "voltage controlled resistor" to achieve the transimpedance variation.

Another feature of the AGC is that it is only operates on signals greater than –13.5dBm (@ 0.9A/W). This knee in the gain response is important when setting "signal detect" functions in the following postamplifier. It also aids in active photodiode alignment.

Output Stage

The signal from the TZA enters a phase splitter and a pair of voltage follower outputs. These are designed to drive a high impedance (>500Ω) load. They are stable for driving capacitive loads, such as interstage filters.

Since the MC2010 exhibits rapid rolloff (3 pole), simple external filtering will suffice.

Monitor O/P

High impedance O/P sinks replica of average photodiode current for monitoring purposes.

Note that this output is provided because in this device (unlike MC2006/7/8) it is not possible to connect the photodiode cathode to V_{cc}. For the correct operation of the AGC and DC restore the photodiode cathode must be connected to the PINK pin. The MC2010 measures the photodiode current and uses this information to set the tramsimpedance and reduce the DC offset of the outputs.

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