

## High Sensitivity Transimpedance Amplifier with precision Monitor for Fiber Optical Networks up to 155Mb/s

MG2155 is a CMOS TIA with wide input dynamic range, high optical sensitivity (-38dBm with PIN) and high overload tolerance (2mA<sub>pp</sub>). Automatic gain control (AGC) circuit is implemented in order to achieve such wide dynamic range. In addition to automatically reducing TIA gain, this AGC circuit also helps to maintain integrity of input signal with excellent transimpedance linearity over frequency. A current sourcing monitor of average photodiode current is available at MON pad for receiver power monitoring for PIN photodiodes.

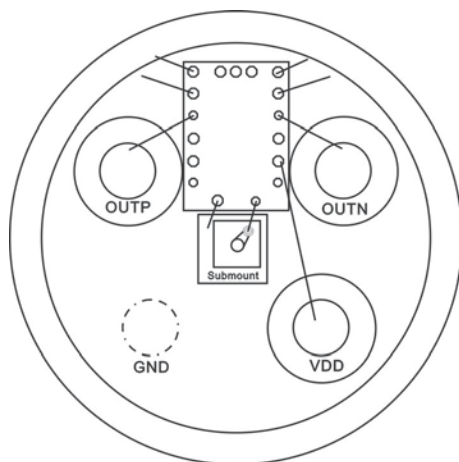
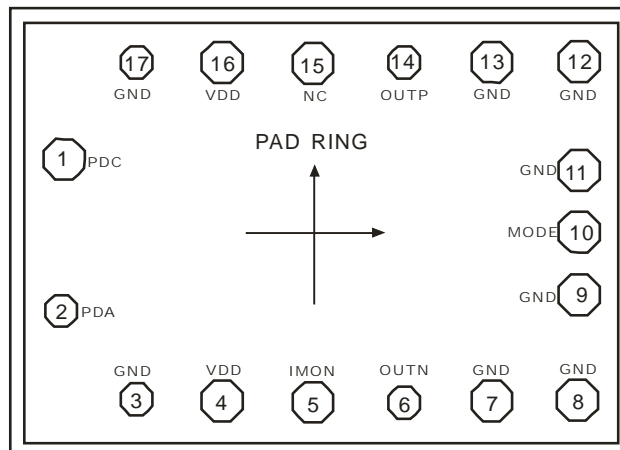
### Features

- Data rate up to 155 Mbps
- Typical Sensitivity with PIN -38dBm
- Input current overload 2mA<sub>pp</sub>
- Typical differential transimpedance 80kΩ
- Excellent gain linearity over frequency
- Precision average current monitor
- No ROSA decoupling capacitor required
- Internal or external bias for photodiode
- Low power: supply current 18mA with +3v

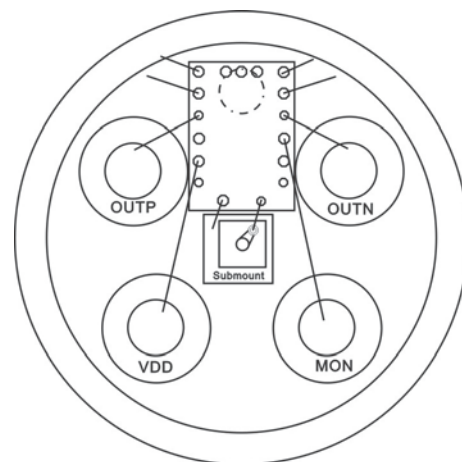
### Applications

- APON
- SDH/SONET
- Fast Ethernet
- 1x9 Transceiver

### Pad and Bonding Diagrams:



4pin TO-CAN for PIN PD without monitor



5pin TO-CAN for PIN PD with I-source monitor

## 1.0 Product Specification

### 1.1 Absolute Maximum Ratings

Absolute maximum ratings are the values of voltage, current, temperature, power dissipation etc., which should not be exceeded at any time, otherwise deterioration or destruction of the IC may take place.

Parameter	Min	Max	Units
Power supply (VCC - GND)	-0.5	4	V
Storage temperature	-55	150	°C
Input current average	0	4	mA

### 1.2 Recommended Operating Conditions

Parameter	Min	Max	Units
Power supply (VCC - GND)	2.97	3.63	V
PD capacitance for 155 Mbps	0.5	0.7	pF
Operating ambient temperature	-40	85	°C

### 1.3 DC Characteristics

Symbol	Parameter	Min	Typ	Max	Units
<b>VB</b>	Photodiode bias voltage (PDC - PDA)		2.2		V
<b>VCM</b>	Common mode output voltage		3.15		V
<b>ICC</b>	Supply current (no loads)		18	22	mA
<b>RLOAD</b>	Recommended output load (single side)	-	500	-	Ω
<b>NOTES:</b>					

### 1.4 AC Characteristics

Parameter	Conditions	Min	Typical	Max	Units
<b>Small Signal Bandwidth</b>	Input below AGC on		150		MHz
<b>Small Signal Low Frequency Cut-off</b>	Input below AGC on		30		kHz
<b>Small Signal Transimpedance</b>	Input below AGC on		80		kΩ
<b>Input Referred Noise (RMS)</b>	155 Mbps application		12		nA
<b>Optical Input Sensitivity</b>	SNR=14,ρ=0.9,er=11		-38		dBm
<b>Overload Input Current</b>			2		mA <sub>pp</sub>
<b>Differential Output Swing</b>	Input above 5μA <sub>pp</sub>		400		mV <sub>pp</sub>
<b>Total Harmonic Distortion (THD)</b>	10μA <sub>pp</sub> 10MHz Sine		5		%
<b>Output Resistance</b>			50		Ω
<b>Photo Current Monitor Offset</b>			0		μA
<b>Photo Current Monitor Ratio</b>	V <sub>MON</sub> =0 to 1.5V		1		
<b>Photo Current Monitor Ratio Accuracy</b>	Input: 10μA to 2mA	0.95	1	1.05	
<b>Power Supply Rejection Ratio</b>	DC to 4MHz		25		dB
<b>Note:</b> Typical conditions: T = 25 °C, VCC = 3.3V, C = 0.5 pF, L = 1.0 nH, load resistance=500Ω					

## 2.0 Functional Description

### 2.1 Overview

MG2155 is a CMOS TIA with wide input dynamic range, high optical sensitivity (typical -38dBm) and high overload tolerance ( $2\text{mA}_{pp}$ ). Automatic gain control (AGC) circuit is implemented in order to achieve such wide dynamic range. In addition to automatically reducing TIA gain, this AGC circuit also helps to maintain integrity of input signal with excellent transimpedance linearity over frequency. A precision current sourcing monitor of average photodiode current is available at the MON pad for photo-alignment and 'Loss of Signal' detecting for PIN photodiodes.

### 2.2 General Description

MG2155 is a continuous mode transimpedance amplifier. Its main function is to convert input light pulse streams into output voltage pulse streams over various environment conditions (supply voltages, temperature etc) and across 40dB input range. It also has an important feature: to provide an indicator of optical signal strength in term of average or peak-to-peak value.

MG2155 is constructed with transimpedance amplifier stage to convert high speed photo current signal into voltage signal, automatic gain control circuit to extend the amplifier's dynamic range, out stage to interface with outside world, and input strength monitor circuit.

### 2.3 TIA (Transimpedance Amplifier)

The transimpedance amplifier consists of a high gain single-ended CMOS amplifier (TIA) with a feedback resistor. Advanced CMOS design techniques are employed to maintain the stability of the amplifier across all input conditions. 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 a decoupling capacitor connected to PDC. The circuit is designed for photodiodes in common cathode configuration, with the anode connected to the input of TIA and the cathode connected to AC ground (PDC terminal). Reverse DC bias is applied to reduce the photodiode capacitance. Avalanche photodiode cathode can be connected externally to a higher voltage.

### 2.4 AGC

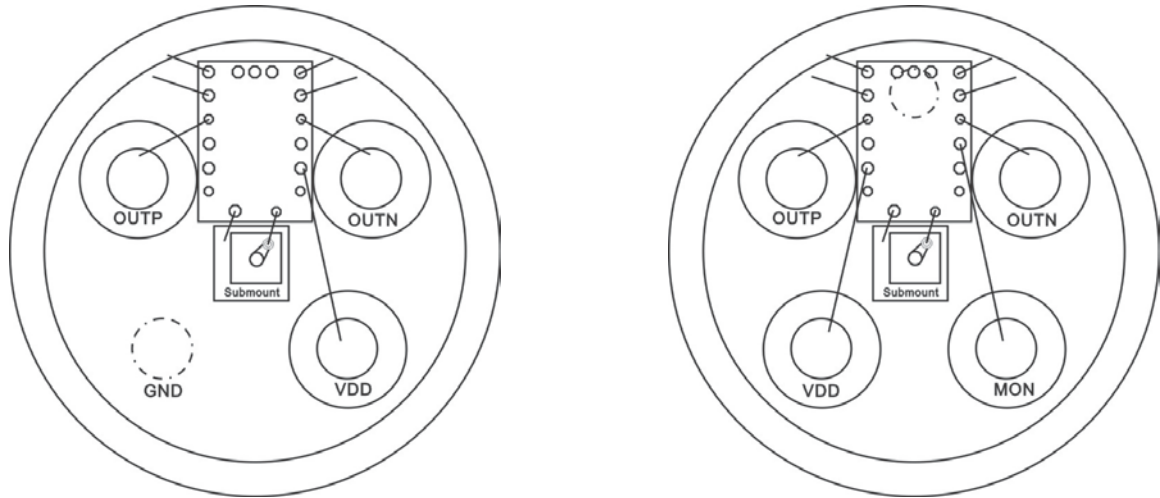
The MG2155 has been designed to operate over the input range of +3dBm to -38dBm. An advanced circuit design technique (AGC) is developed here to extend the amplifier's dynamic range by automatically limiting the transimpedance gain. Another function of AGC is that it drastically improve linearity and reduce distortion of the transimpedance amplifier when input optical signal is greater than approximately -17dBm (@ 0.9 A/W), or  $\sim 5\mu\text{A}_{pp}$ .

### 2.5 Monitor Output Configuration

MON pin in MG2155 sources current to ground accurately representing average photodiode current.

### 3.0 Applications Information

#### 3.1 TO-CAN Bonding Diagrams:



(a) 4 pin TO-CAN for PIN PD without monitor

(b) 5 pin TO-CAN for PIN PD with precision IMON

Figure 3-1 Typical TO-CAN Bonding Diagram with Photodiode Mounted on PDC

Typical TO-CAN bonding configurations are shown in Figure 3-1(a) and (b) for different applications. The VCC bond wire de-coupling capacitor is optional. If provided, it will help to reduce the bond wire coupling.

#### 3.2 TO Assembly

Typical recommended assembly of TIA in optical TO header is shown in Figure 3-2. MG2155 is designed to work with bond wire inductance of  $\sim 1\text{nH}$ . Metal Shim is often required to raise TIA so that bonding pads are horizontally in the same level as photo diode which is typically mounted on a ceramic sub-mount for appropriate focal length.

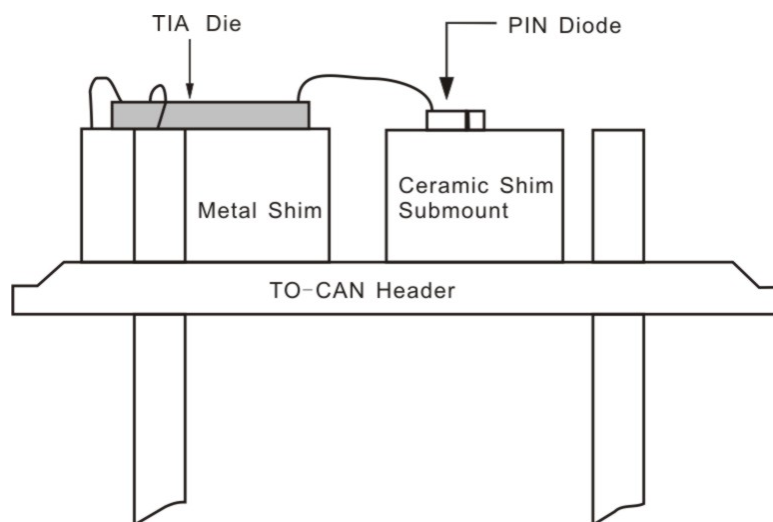


Figure 3-2 Suggested PIN Diode Connection Methods

## 4.0 Die Specifications

### 4.1 Pad Descriptions

Die Pad	Name	Function
1	PDC	PIN PD Common input. Connect to photo diode cathode (and optional cap).
2	PDA	Active PIN input. Connect to photo diode anode.
3,7-9,11-13,17	GND	Ground pin. Connect to the most negative supply (at least connect 4 GND).
4,16	VCC	Power pin. Connect to most positive supply (only one VCC pad needs to be connected).
5	MON	Analog current source output. Current matched to average photodiode current.
6	OUTN	Differential data output negative (goes low as light increases).
10	MODE	Monitor PD anode average current when this pad tied to ground; Monitor PD cathode average current when this pad not connected.
14	OUTP	Differential data output (goes high as light increases).
15	NC	Not used for normal operation.
NA	Backside	Backside. Connect to the lowest potential, usually ground.

### 4.2 Pad Coordinates

Pad Number	Pad	X	Y	Pad Number	Pad	X	Y
1	PDC	-430	100	10	MODE	434	0
2	PDA	-430	-100	11	GND	434	150
3	GND	-375	-334	12	GND	434	329
4	VDD	-228	-329	13	GND	228	329
5	IMON	-76	-329	14	OUTP	76	329
6	OUTN	76	-329	15	NC	-76	329
7	GND	228	-329	16	VDD	-228	329
8	GND	434	-329	17	GND	-375	334
9	GND	434	-150				

### 4.3 Other Notes

Die Thickness: 250µm  
 Die Size: 1060 µm x 840 µm  
 Pad Materials: Aluminum