

# FR50MxxR

## DC-50 MBd RedLink® Fibre Optic Receiver



### Datasheet



#### DESCRIPTION

The Firecomms DC-50 MBd RedLink® receiver is a fully integrated photodiode and receiver IC. The receiver is housed in a miniature package to interface to plug-terminated lengths of Plastic Optic Fiber (POF) or 200 µm Plastic Clad Silica (PCS) fiber. When paired with the appropriate transmitter, the receiver is capable of delivering 50 Mbps digital signals over fiber and operate in the temperature range of -40 °C to +85 °C. The device can operate from 5V or 3.3V DC power rails and can tolerate +/- 10% supply variation.

The receiver is a robust optical to electrical receiver with integrated pulse width distortion minimization circuitry for reliable data transmission. The receiver features a push-pull TTL compatible CMOS output. It is available in inverting and non-inverting options.

#### AVAILABLE OPTIONS

| Package Description                        | Part Number |
|--|-------------|
| 50 MBd Horizontal Package<br>Non-Inverting | FR50MHNR    |
| 50 MBd Horizontal Package<br>Inverting     | FR50MHIR    |
| 50 MBd Vertical Package<br>Non-Inverting   | FR50MVNR    |
| 50 MBd Vertical Package<br>Inverting       | FR50MVIR    |
| 50 MBd 30° Tilted Package<br>Non-Inverting | FR50MWNR    |
| 50 MBd 30° Tilted Package<br>Inverting     | FR50MWIR    |



#### FEATURES

- Ideal for use with POF or PCS fiber
- Optimized for data transmission from DC-50 MBd
- Industrial Temperature Range -40 °C to +85 °C
- Dual 5 V and 3.3 V power supply with 10 % rail tolerance
- RoHS compliant and flame retardant (UL 94 V-0)
- Inverting and Non-Inverting options available
- Horizontal Vertical and 30° Tilted options available
- Push Pull TTL Compatible CMOS output
- Ultra-low pulse width distortion to limit pulse distortion from burst mode data
- Compatible with Versatile Link cables and connectors

#### APPLICATIONS

|                    |  |
|--------------------|--|
| <b>Application</b> | Automation and Industrial Control. Serial Communications. Voltage Isolation. |
| <b>Standard</b>    | Serial RS232, RS485, CAN-Bus, MODBUS, Profibus                               |
| <b>Distance</b>    | 50 meters Step Index POF [1]<br>300 meters with 200 µm PCS fiber [1]         |
| <b>Speed</b>       | DC to 50 MBd   |

Note: 1. Depending on the installation conditions

## SPECIFICATIONS

**Table 3**  
**RECEIVER PIN DESCRIPTION**

| Pin | Name                         | Symbol |
|-----|------------------------------|--------|
| 1   | Receiver Output              | $V_O$  |
| 2   | Receiver Ground              | GND    |
| 3   | Receiver Vcc                 | Vcc    |
| 4   | No Connect <sup>(a)</sup>    | N.C.   |
| 5   | Retaining Pin <sup>(b)</sup> | GND    |
| 8   | Retaining Pin <sup>(b)</sup> | GND    |

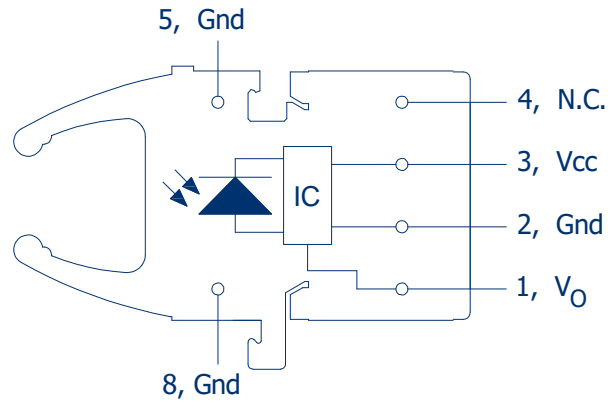


FIGURE 1 Receiver pin-out, top view

**NOTE:**

- a) Pin 4 is electrically isolated internally. Pin 4 may be externally connected to pin 1 for board layout compatibility with existing designs. Otherwise it is recommended pin 4 be grounded as in Figure 2
- b) Pins 5 and 8 are used for mounting and retaining purposes. Connect to ground

## RECOMMENDED APPLICATION CIRCUIT

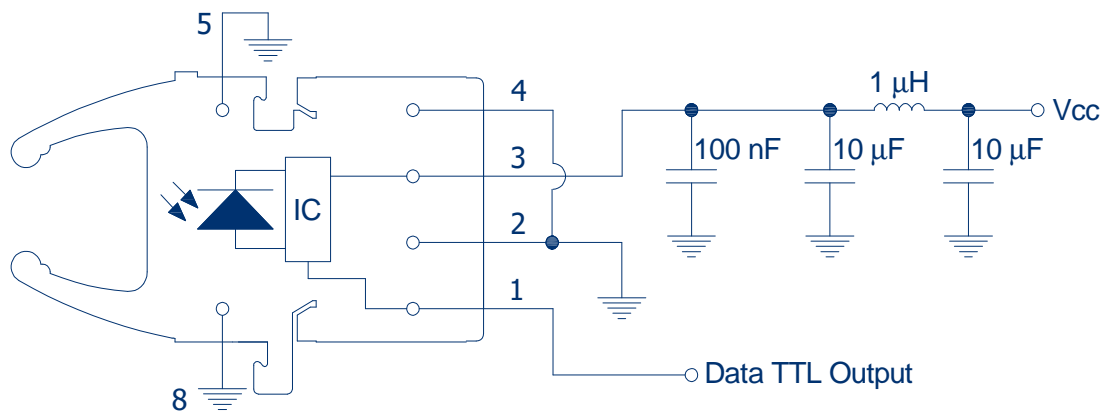


FIGURE 2 RedLink® Receiver Application Circuit

### GENERAL OPERATION FOR INVERTING RECEIVER

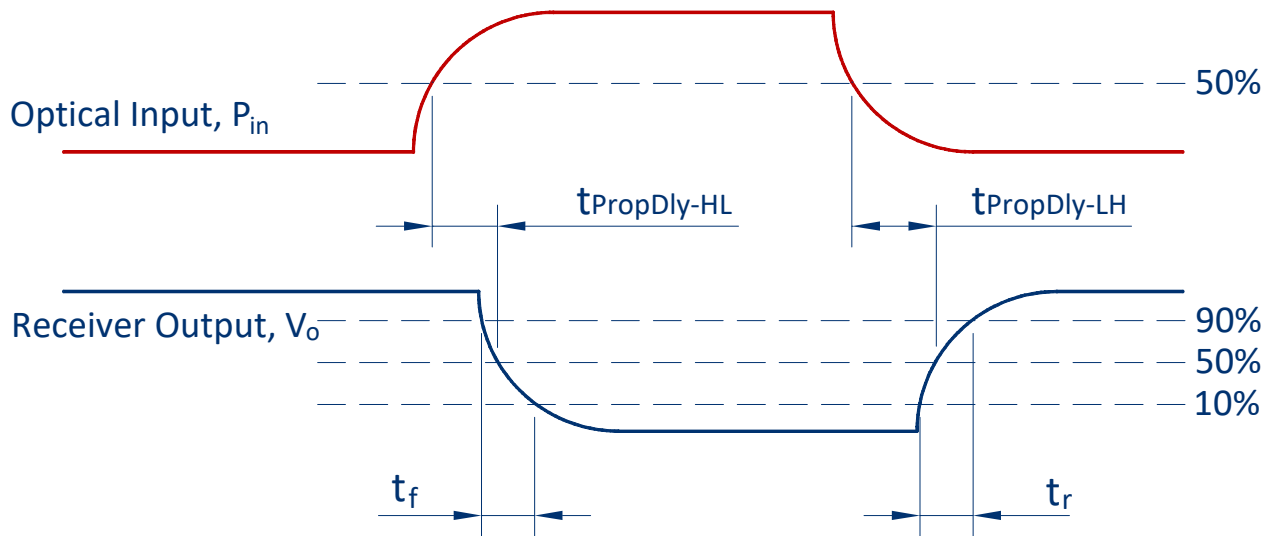


FIGURE 3 Receiver Propagation Delay and rise/fall time definitions for an inverting receiver output

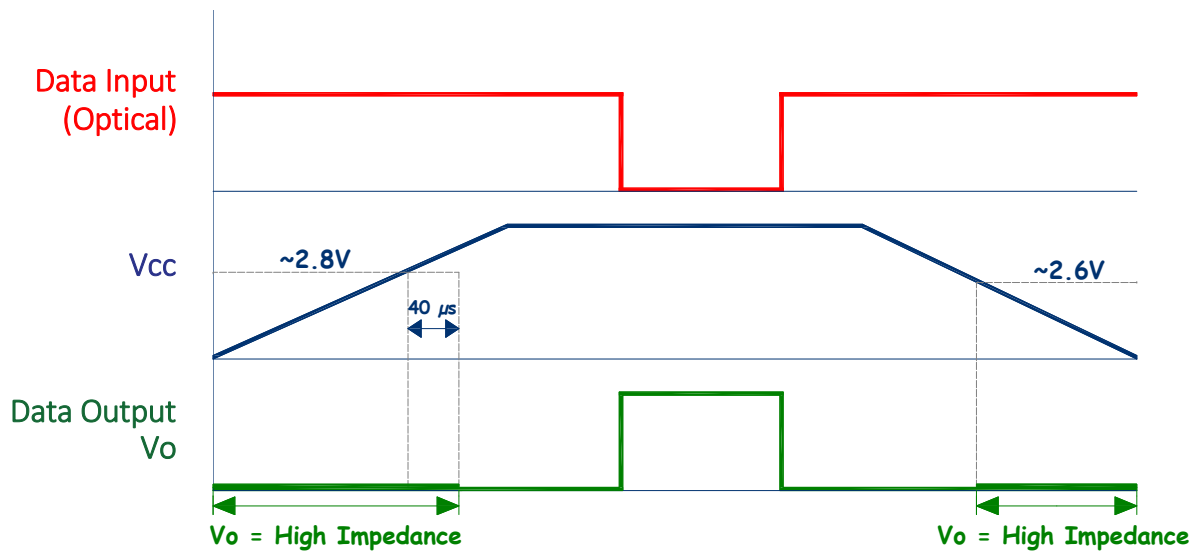


FIGURE 4 Inverting receiver output operation during power cycling

Operation of the Inverting parts FR50MxIR during power up, power down or power reset is illustrated above. During power up as  $V_{cc}$  rises to approximately 2.8 V, the output  $V_o$  is in a high impedance state. Within 40  $\mu s$  of  $V_{cc}$  reaching 2.8 V the output  $V_o$  will change to the correct logic state which in the diagram above is logic low as there is light present and the output is inverted relative to the light input. On power down once  $V_{cc}$  drops below approximately 2.6 V then  $V_o$  changes immediately to a high impedance state.

## GENERAL OPERATION FOR NON-INVERTING RECEIVER

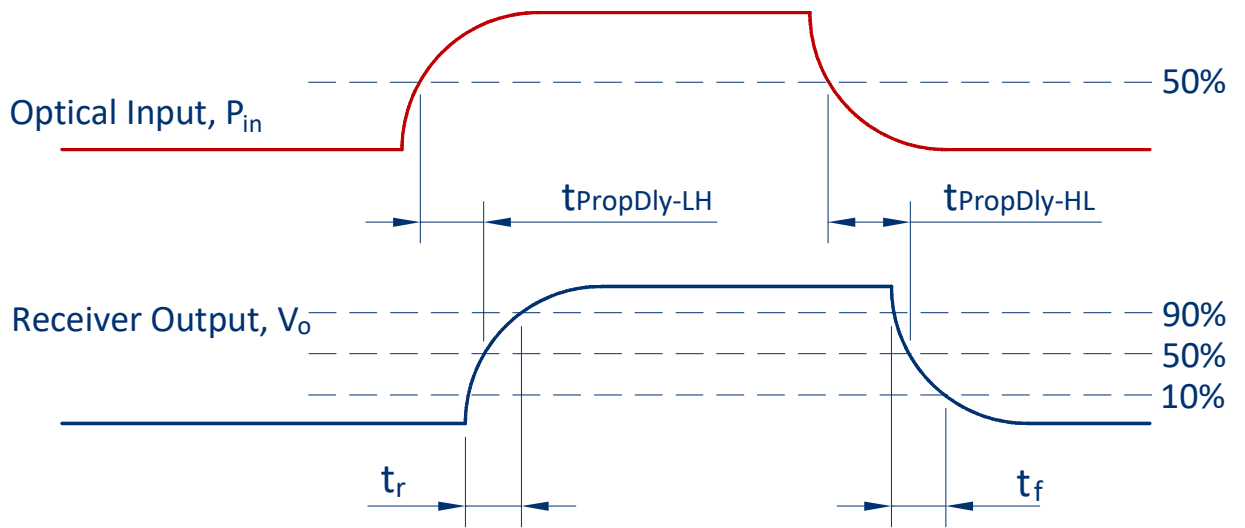


FIGURE 5  
Receiver Propagation Delay and rise/fall time definitions for a non-inverting receiver output

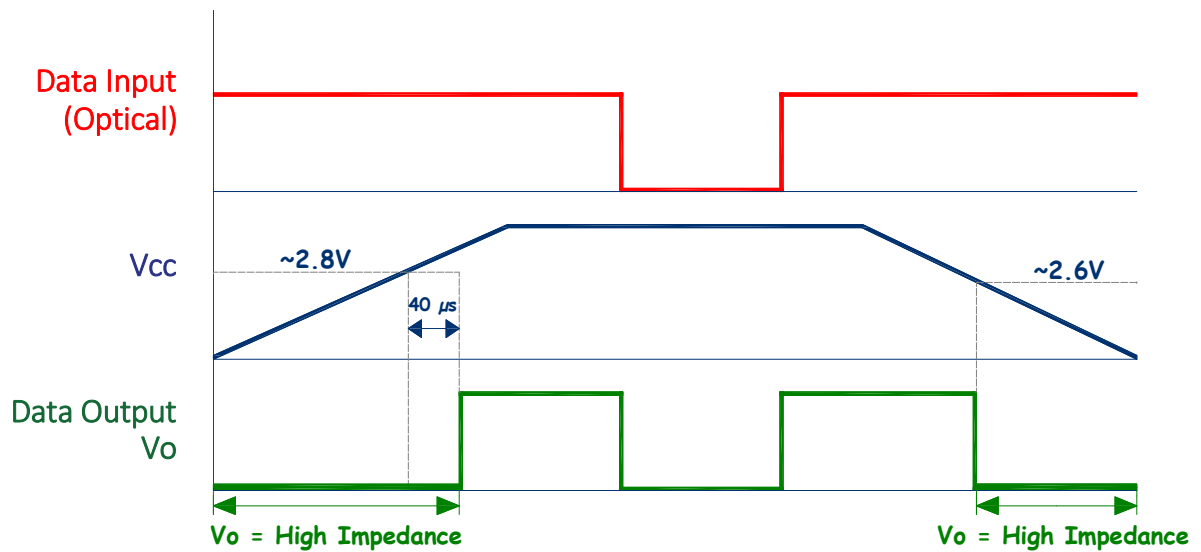


FIGURE 6  
Non-Inverting receiver output operation during power cycling

Operation of the Non-Inverting parts FR50MxNR during power up, power down or power reset is illustrated above. During power up as  $V_{cc}$  rises to approximately 2.8 V, the output  $V_o$  is in a high impedance state. Within 40  $\mu s$  of  $V_{cc}$  reaching 2.8 V the output  $V_o$  will change to the correct logic state which in the diagram above is logic high as there is light present and the output is non-inverting. On power down once  $V_{cc}$  drops below approximately 2.6 V then  $V_o$  changes immediately to a high impedance state.

## SPECIFICATIONS

**Table 4**  
**REGULATORY COMPLIANCE**

| Parameter  | Symbol    | Standard             | Level                  |
|--|-----------|----------------------|------------------------|
| Electrostatic Discharge,<br>Human Body Model (contact ESD) | HBM       | Mil-STD-883          | Level 2 (4 kV)         |
| Radiated Emissions Immunity                                | $Vm^{-1}$ | IEC 61000-4-3        | 15 $Vm^{-1}$           |
| UL Certification   | UL        | 60950-1              | File No. E362227       |
| Storage Compliance   | MSL       | J-STD-020            | 2a (4 week floor life) |
| Restriction of Hazardous<br>Substances Directive           | RoHS      | Directive 2011/65/EU | Certified compliant    |

**Table 5**  
**ABSOLUTE MAXIMUM RATINGS**

*These are the absolute maximum ratings at or beyond which the FOT can be expected to be damaged*

*Notes:*

- 260°C for 10 seconds, one time only, at least 2.2 mm away from lead root*

| Parameter                            | Symbol    | Minimum | Maximum | Unit |
|--------------------------------------|-----------|---------|---------|------|
| Storage Temperature                  | $T_{stg}$ | -40     | +85     | °C   |
| Operating Temperature                | $T_{op}$  | -40     | +85     | °C   |
| Soldering Temperature <sup>[1]</sup> | $T_{sld}$ |         | +260    | °C   |
| Receiver Supply Voltage              | $V_{cc}$  | -0.5    | +5.5    | V    |
| Receiver Output Current              | $I_o$     | -16     | +16     | mA   |

## SPECIFICATIONS

**Table 6**  
**RECEIVER ELECTRICAL AND OPTICAL CHARACTERISTICS**

*Test Conditions:*

1. *Wake up Delay is the delay from VCC > 2.75 V to when the output will respond correctly to optical input. Output is held in tristate before this time*
2. *Test data was validated using a transmitter with an emission wavelength between 635 and 680 nm, with a 5ns rise and fall time, over the full temperature range of -40 °C to +85 °C, over both supply rail voltage options of 5 V and 3.3 V ± 10%, and over the input optical received power as specified by P<sub>H</sub> and P<sub>L</sub>. Input power levels are for peak (not average) optical input levels. For 50% duty cycle data, peak optical power is twice the average optical power. Data referred to as typical are rated at +25 °C*
3. *Optical signal from the recommended Transmitter circuit.*
4. *Testing in the recommended receiver circuit (RL= 50 kΩ, CL(total)= 15 pF).*
5. *PWD for Optical Input of 50 MBd, NRZ 27-1 (PRBS7) data, resulting in a BER ≤ 10<sup>-9</sup>.*
6. *PWD for 1st to 3rd pulse is characterized with minimum Optical Input pulse width of 20 ns, with the 1st pulse being the worst case. For pulses > 20 ns the PWD will be less. If data rate < 1 MBd, then the pulse width distortion = PWD 1st to 3rd pulse.*
7. *The performance of the receiver as given in Table 6 has been characterized for transmitters operating between 635 and 680 nm. The receiver will nevertheless respond to optical sources operating from the visible to near infra-red regions although the precise performance may differ from that given in Table 6 depending upon the precise wavelength and rise/fall time characteristics of the optical source used.*

| Parameter   | Symbol                  | Min                    | Typical | Max             | Unit | Test Condition                   |
|---|-------------------------|------------------------|---------|-----------------|------|----------------------------------|
| Supply Current  | I <sub>CC</sub>         |                        | 20      | 25              | mA   | [2,3,4]                          |
| Wake Up Delay (power up)  | t <sub>power-on</sub>   |                        | 40      |                 | μs   | [1]                              |
| High Level Output Voltage                                       | V <sub>OH</sub>         | V <sub>CC</sub> – 0.05 |         | V <sub>CC</sub> | V    | I <sub>OH-max</sub> = 40 μA, [2] |
| Low Level Output Voltage  | V <sub>OL</sub>         | 0                      |         | 0.05            | V    | I <sub>OL-max</sub> =1.6 mA, [2] |
| Optical Power High (OPH)  | P <sub>H</sub>          | -22                    |         | +2              | dBm  | [2,3]                            |
| Optical Power Low (OPL)   | P <sub>L</sub>          |                        |         | -40             | dBm  | [2,3]                            |
| Data Rate   |                         | DC                     |         | 50              | MBd  | Min UI = 20 ns<br>Max f = 25 MHz |
| Output Rise Time (10% - 90%)                                    | t <sub>r</sub>          |                        |         | 5               | ns   | [2,3,4]                          |
| Output Fall Time (10% - 90%)                                    | t <sub>f</sub>          |                        |         | 5               | ns   | [2,3,4]                          |
| Pulse Width Distortion for P <sub>H</sub> range -20 to + 2 dBm  | PWD                     | -4                     |         | +4              | ns   | [2,3,4,5]                        |
| Pulse Width Distortion for P <sub>H</sub> range -20 to -22 dBm  | PWD                     | -6                     |         | +6              | ns   | [2,3,4,5]                        |
| Pulse Width Distortion 1 <sup>st</sup> to 3 <sup>rd</sup> pulse | PWD <sub>init</sub>     | -7                     |         | +14             | ns   | [2,3,4,5,6]                      |
| Propagation Delay   | t <sub>PropDly-HL</sub> |                        |         | 50              | ns   | [2,3,4]                          |
|   | t <sub>PropDly-LH</sub> |                        |         | 50              | ns   | [2,3,4]                          |
| Optical Sensitivity Range                                       | λ <sub>R</sub>          | 400                    |         | 900             | nm   | [7]                              |

## MECHANICAL DATA, HORIZONTAL

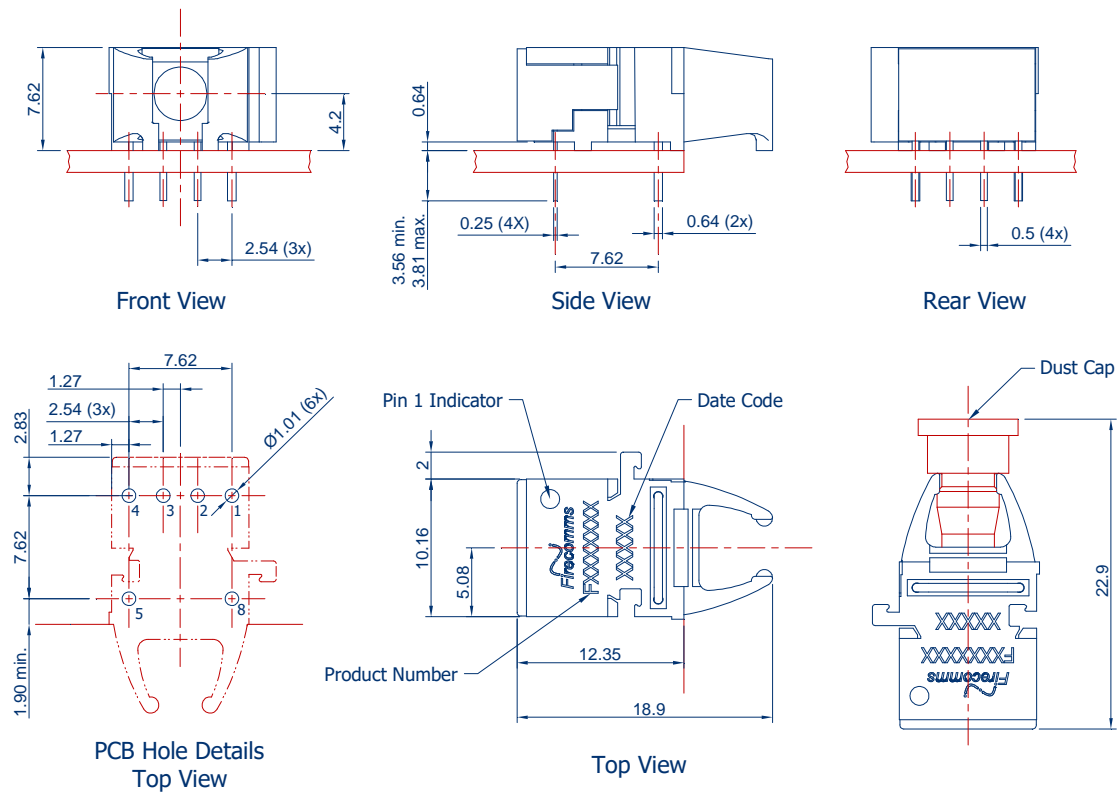


FIGURE 7  
Mechanical dimensions of the horizontal receiver connectors and PCB footprint, which is a top view  
General dimensional tolerance is  $\pm 0.2$  mm

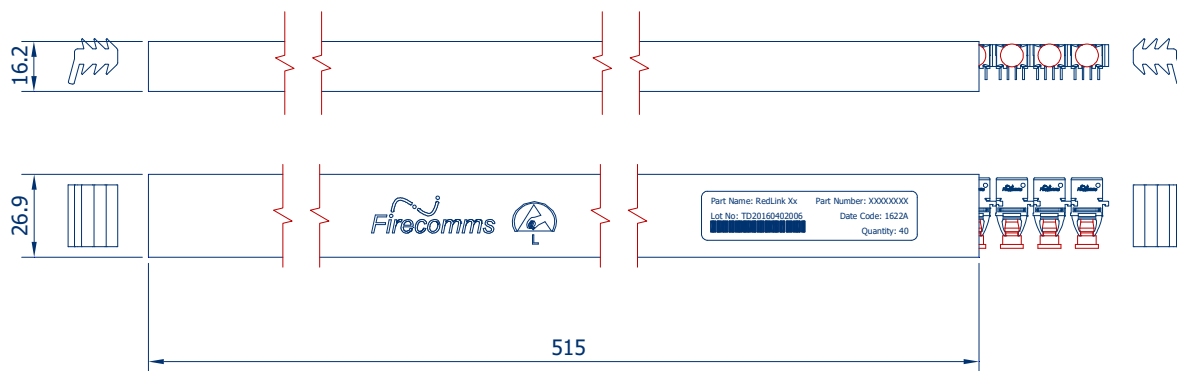


FIGURE 8  
Packing tube for Firecomms Horizontal RedLink® Receivers

## MECHANICAL DATA, VERTICAL

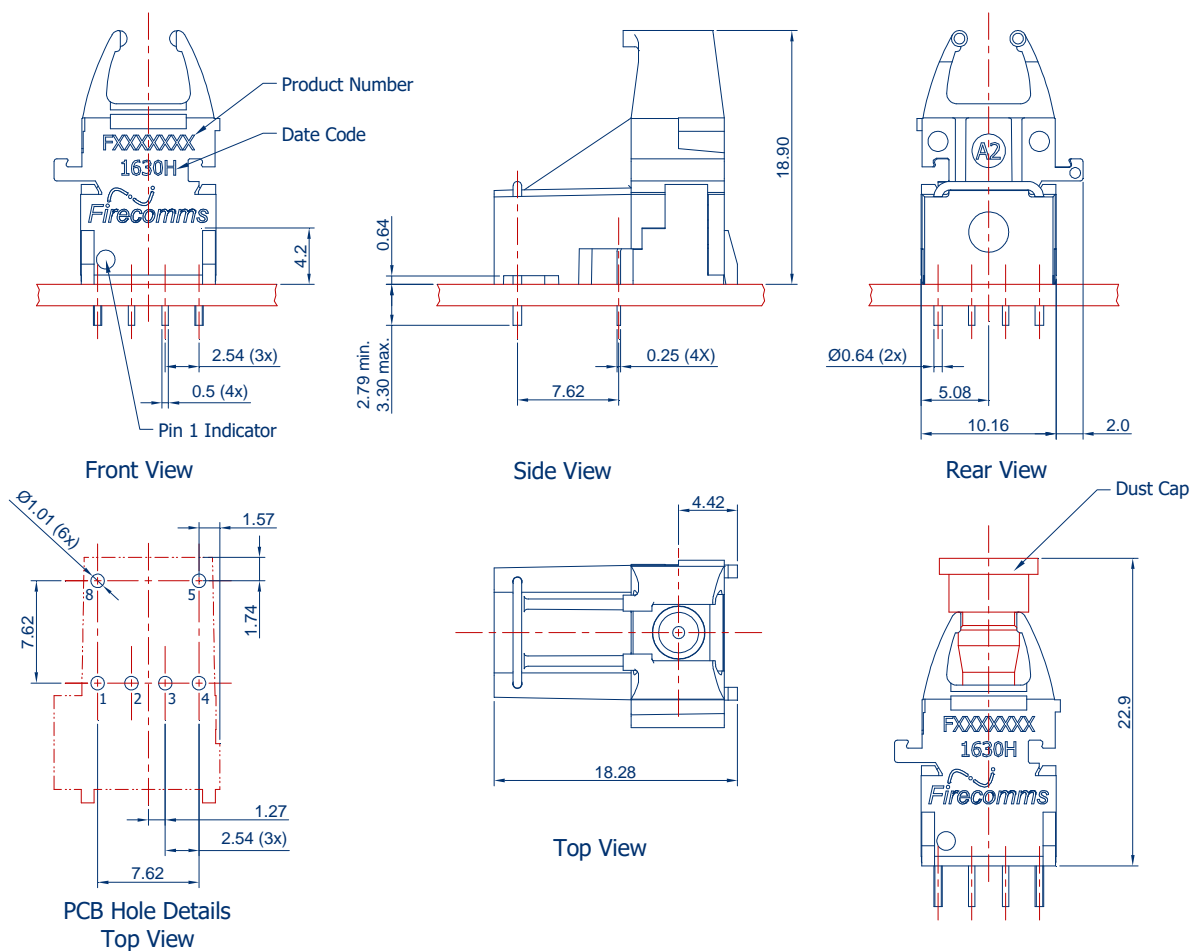


FIGURE 9  
Mechanical dimensions of the vertical receiver connectors and PCB footprint, which is a top view  
General dimensional tolerance is  $\pm 0.2$  mm

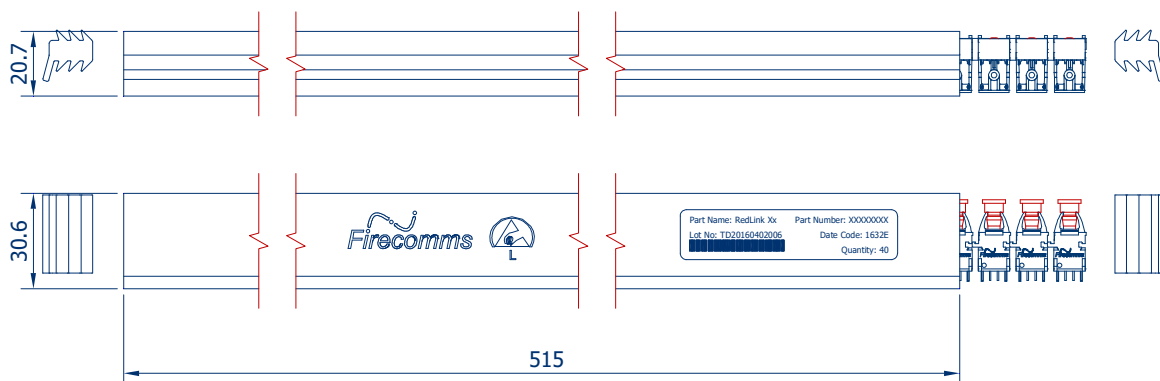


FIGURE 10  
Packing tube for Firecomms Vertical RedLink® Receivers



## MECHANICAL DATA, 30° TILTED

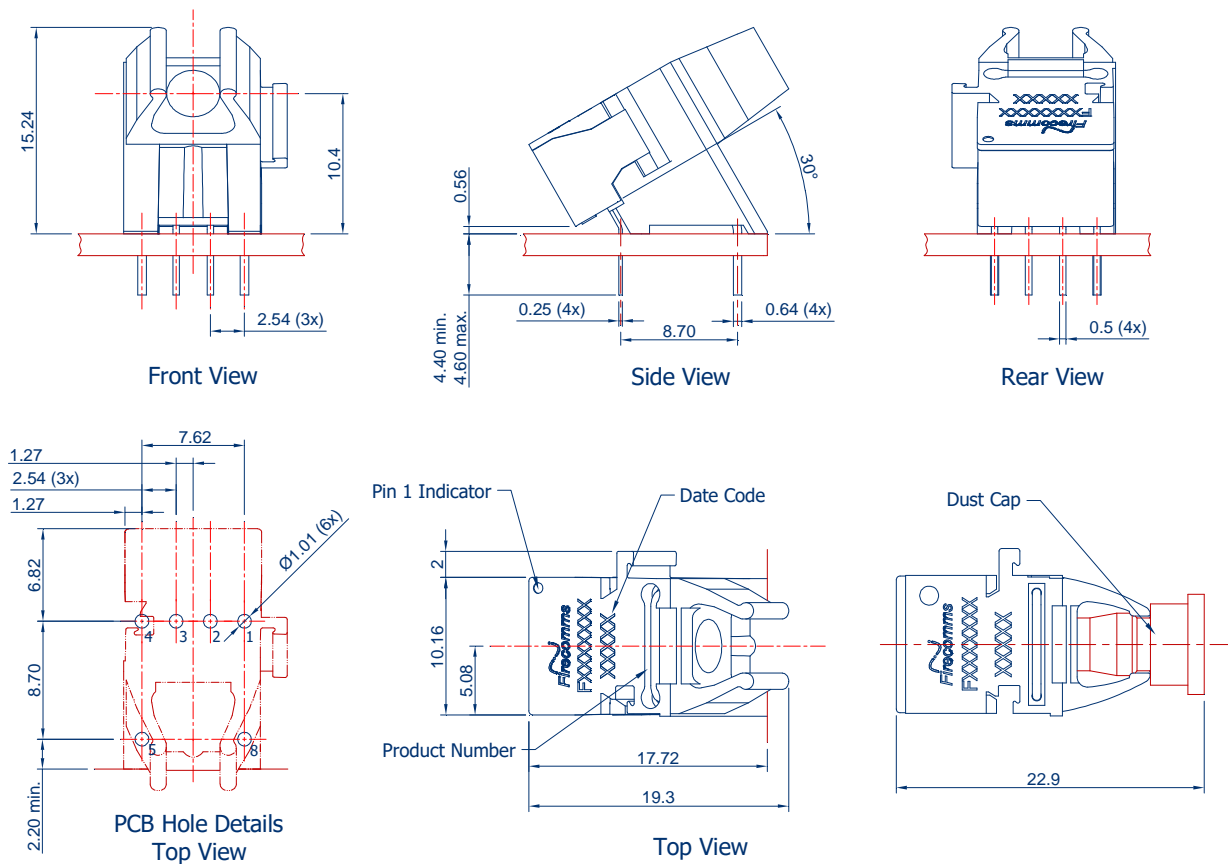


FIGURE 11  
Mechanical dimensions of the tilted receiver connectors and PCB footprint, which is a top view  
General dimensional tolerance is  $\pm 0.2$  mm

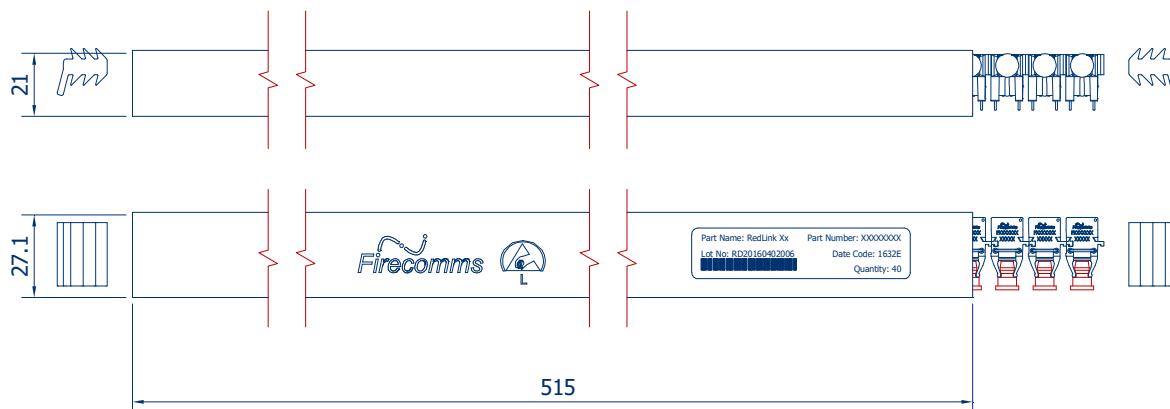


FIGURE 12  
Packing tube for Firecomms Tilted RedLink® Receivers

## **PART HANDLING**

The Firecomms DC-50 RedLink® receiver devices are color coded black. They are auto-insertable. They are tested for handling in static-controlled assembly processes (HBM). Cleaning, degreasing and post solder washing should be carried out using standard solutions compatible with both plastics and the environment. For example, recommended solutions for degreasing are alcohols (methyl, isopropyl and isobutyl). Acetone, ethyl acetate, phenol or similar solution based products are not permitted.

In the soldering process, non-halogenated water soluble fluxes are recommended. These products are not suitable for use in reflow solder processes (infrared/vapor-phase reflow). The dust plug should remain in place during soldering, washing and drying processes to avoid contamination of the active optical area of each part.

The Moisture Sensitivity Level (MSL) classification of this device is 2a according to JEDEC J-STD-020. The shelf life of an unopened MBB (Moisture Barrier Bag) is 24 months at < 40 °C and < 90 % R.H. Once the Moisture Barrier Bag is opened the devices can be either

- a) Stored in normal factory conditions < 30 °C and < 60 % R.H. for a maximum of 672 hours (4 Weeks) prior to soldering
- b) Stored at < 10 % R.H. (Dry Cabinet)

## PACKING INFORMATION

Components are packed in PVC anti-static tubes in moisture barrier bags. Bags should be opened only in static-controlled locations, and standard procedures should be followed for handling moisture sensitive components.

**Table 7**  
**PACKING INFORMATION**

|                                   | Horizontal | Vertical | Tilted  |
|-----------------------------------|------------|----------|---------|
| Components per Tube               | 40         | 40       | 40      |
| Tube Length                       | 515 mm     | 515 mm   | 515 mm  |
| Tube Height                       | 16.2 mm    | 21.0 mm  | 21 mm   |
| Tube Depth                        | 26.9 mm    | 30.8 mm  | 27.1 mm |
| Tubes per Bag                     | 5          | 5        | 5       |
| Bags per Inner Carton             | 1          | 1        | 1       |
| Inner Carton Length               | 630 mm     | 630 mm   | 630 mm  |
| Inner Carton Width                | 70 mm      | 70 mm    | 70 mm   |
| Inner Carton Height               | 105 mm     | 105 mm   | 105 mm  |
| Weight per Inner Carton, Complete | 0.77 kg    | 0.92 kg  | 0.92 kg |
| Components per Inner Carton       | 200        | 200      | 200     |
| Inner Cartons per Outer Carton    | 10         | 10       | 10      |
| Outer Carton Length               | 650 mm     | 650 mm   | 650 mm  |
| Outer Carton Width                | 235 mm     | 235 mm   | 235 mm  |
| Outer Carton Height               | 376 mm     | 376 mm   | 376 mm  |
| Weight per Outer Carton, Complete | 8.15 kg    | 9.61 kg  | 9.60 kg |
| Components per Outer Carton       | 2,000      | 2,000    | 2,000   |

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