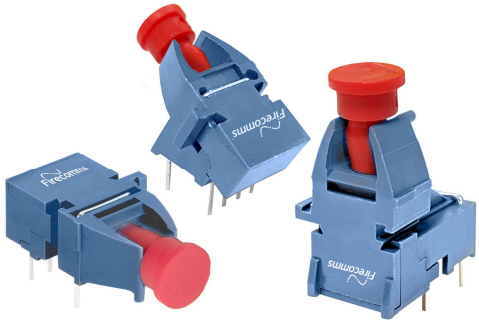
# FR01DxDR

## RedLink® Fiber Optic Receiver for Direct High Voltage Switching

## Datasheet



## DESCRIPTION

Firecomms FR01DxDR RedLink® receiver is based on a fully integrated photodiode with TIA, limiting amplifier and a MOSFET open drain output to handle switching of voltages in the range from 3 to 20 V (e.g. 3.3, 5, 12, 15 V). The part also includes an optional 1 kΩ pull-up resistor $R_L$.

Housed in non-conducting plastic the RedLink® receiver connector is blue. The housings are compatible with the Versatile Link style of fibre plug and are optimised for use with Plastic Optic Fibre (POF).

The receiver operates over the industrial temperature range of -40 °C to +85 °C supporting many industrial applications where reliable command and control response is required in electrically harsh environments.

The receiver is typically used at low switching speeds where 12 V and 15 V power electronic devices are being switched at kHz speeds but can operate up to 1 MBd if required.

## FEATURES

- MOSFET output stage typically used to directly switch 12 V and 15 V thyristor gate devices.
- Optimised for data rates from DC to 1 MBd
- Industrial temperature range -40 °C to +85 °C
- Flame retardant (UL 94 V-0) connector housings
- Fully integrated photodiode, TIA and limiting amplifier in a single IC
- 5 V TTL/CMOS compatible I/O for ease of design
- Integrated 1 kΩ pull-up resistor to $V_{CC}$ ($R_L$)
- Low pulse width distortion
- Horizontal, Vertical and 30° Tilted options
- Compatible with Versatile Link cables and connectors

## AVAILABLE OPTIONS

**Table 1**
**ORDERING INFORMATION / PART NUMBERS**

| | |
|---|---|
| **1 MBd Horizontal Package Inverting, TTL** | FR01DHDR |
| **1 MBd Vertical Package Inverting, TTL** | FR01DVDR |
| **1 MBd Tilted Package Inverting, TTL** | FR01DWDR |

## APPLICATIONS

**Table 2**
**APPLICATIONS**

| | |
|---|---|
| **Application** | Switching of 20 V, 18 V, 15 V and 12 V thyristor gate drivers. SCR and IGBT direct switching |
| **Distance** | 50 meters Step Index (SI) POF in typical operating conditions<br>30 meters in worst case conditions |
| **Speed** | DC to 1 MBd (depending on series resistance and load capacitance) |

## SPECIFICATIONS

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

| Pin | Name | Symbol |
|---|---|---|
| 1 | RECEIVER OUTPUT | $V_0$ |
| 2 | RECEIVER GROUND | GND |
| 3 | RECEIVER $V_{CC}$ | $V_{CC}$ |
| 4 | $R_L$ PULL-UP RESISTOR | $R_L$ |
| 5 | RETAINING PIN | GND |
| 8 | RETAINING PIN | GND |

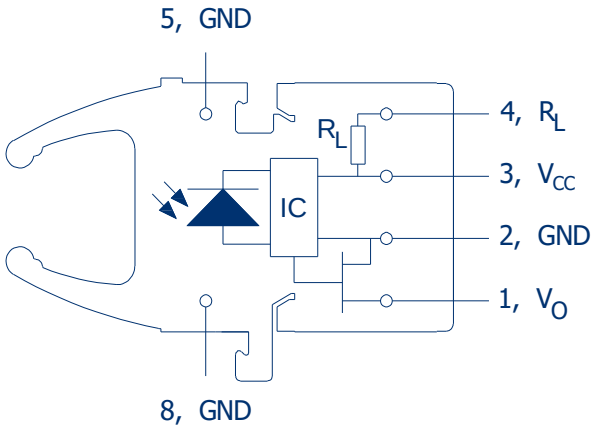



**FIGURE 1**
**Receiver pin-out, top view**

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

| Parameter | Symbol | Standard | Level |
|---|---|---|---|
| Electrostatic Discharge, Human Body Model (contact ESD) | HBM | Mil-STD-883 | Level 2 (2 kV) |
| UL Certification | UL | 60950-1 | File No. E362227 |
| Storage Compliance | MSL | J-STD-020 | 2a (4-week floor life) |
| Restriction of Hazardous Substances Directive | RoHS | Directive 2011/65/EU Incl. Amendment 2015/863 | Certified compliant |

## RECOMMENDED APPLICATION CIRCUITS

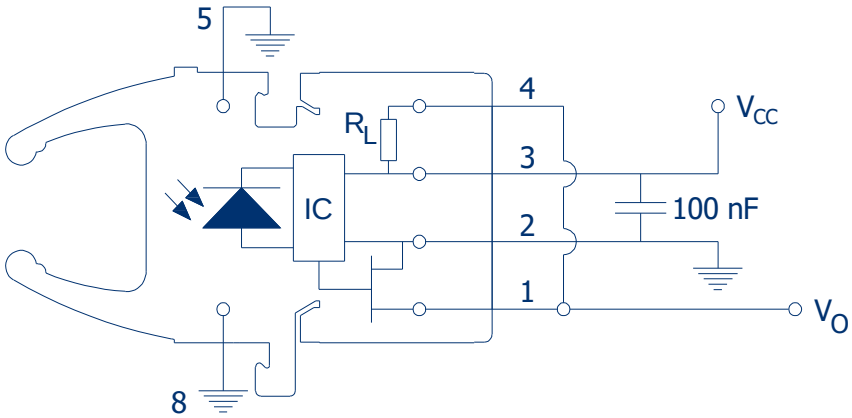



**FIGURE 2**
**RedLink® Receiver standard 5 V and or 3.3 V operation using $R_L$ pull-up resistor**
**NOTE:** $R_L$ can only be connected to Vo when the maximum value at $V_O \leq V_{CC}$

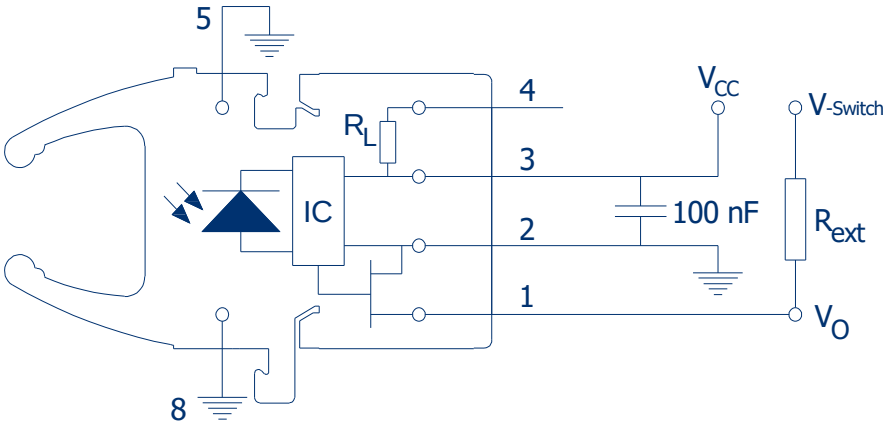



**FIGURE 3**
**RedLink® Receiver interface circuit for High Voltage (up to 20 V) switching. $V_{CC}$ can be 5 or 3.3 V. $V_{-Switch}$ is often used to switch for example 12 V and 15 V thyristor gates devices**
**NOTE:** if $V_{-switch} > V_{CC}$ then RL should not be connected to $V_O$

## SPECIFICATIONS

### Table 5
### ABSOLUTE MAXIMUM RATINGS

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

***Notes:***

1. *260 °C for 10 seconds, one time only, at least 2.2 mm away from lead root*
2. *Applying conditions above absolute maximum ratings is destructive to the device. Functional operation of the device at conditions between maximum operating conditions (5.5 V) and absolute maximum ratings is not implied. Extended exposure to stresses above recommended operating conditions will have an effect on device reliability.*
3. *The $R_L$ pin can only be used when the maximum value of $V_O$ does not exceed $V_{CC}$. The maximum $V_{CC}$ voltage is 5.5 V. For example if $V_O$ switches between 0 and 5 V and $V_{CC}$ is equal to 5 V then $R_L$ can be connected to Vo. However, if $V_{CC}$ is 3.3 V and $V_O$ switches between 0 and 5 V then $R_L$ cannot be connected to $V_O$.*
4. *$V_{Switch}$ is the External Power Supply for the external Pull-Up resistor $R_{ext}$ .The maximum allowed voltage that can be switched is 20 V.*

| Parameter | Symbol | Minimum | Maximum | Unit |
|---|---|---|---|---|
| Storage Temperature | $T_{stg}$ | -40 | +85 | °C |
| Operating Temperature | $T_{op}$ | -40 | +85 | °C |
| Soldering Temperature [1] | $T_{sld}$ | | +260 | °C |
| Supply Voltage [2] | $V_{CC}$ | -0.5 | +7 | V |
| Rx Output Current (maximum drain source current) | $I_{FDC}$ | | ±25 | mA |
| Storage Compliance | MSL | | 2a | J-STD-020 |
| Maximum Output Power | $P_{OD}$ | | 40 | mW |
| $R_L$ Pull-up Voltage [3] | $V_{RL}$ | -0.5 | Vcc | V |
| Output Voltage | $V_O$ | -0.5 | 20 | V |
| External $V_{Switch}$ Power Supply [4] | $V_{Switch}$ | -0.5 | 20 | V |

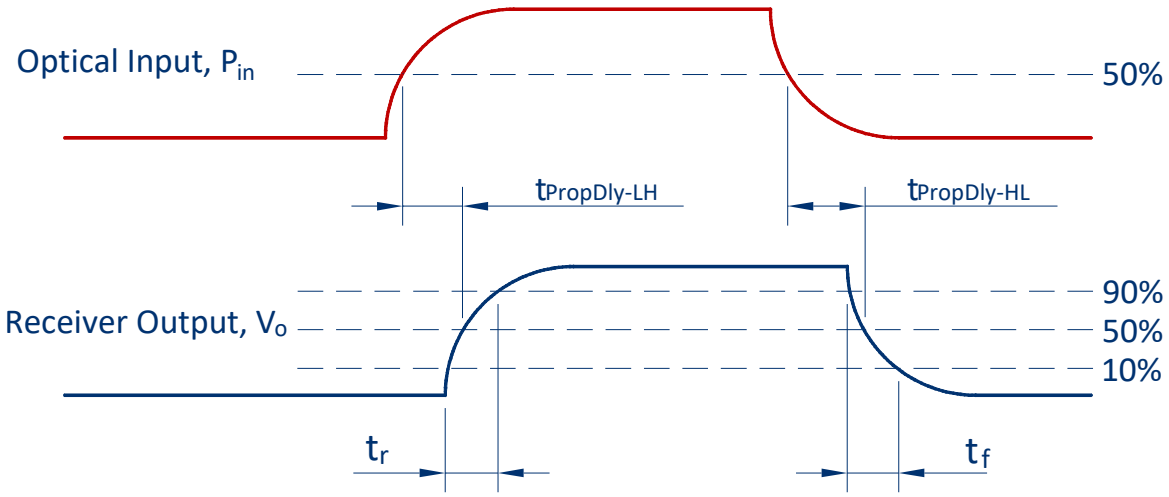



**FIGURE 4**
**Receiver propagation delay and rise/fall time definitions**

## SPECIFICATIONS

### Table 6
### RECEIVER ELECTRICAL AND OPTICAL CHARACTERISTICS

***Test Conditions:***

1. *Wake up Delay is the delay from when $V_{CC}$ > 2.75 V to when the output will respond correctly to Optical Input.*
2. *Test data was validated using a transmitter with 5 ns rise and fall time, over the full temperature range of -40 °C to +85 °C, and over the full supply rail voltage options of 5 V and 3.3 V ± 10% and over the optical received power range $P_H$ to $P_L$. 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 ambient +25 °C.*
3. *Optical signal is delivered over 1mm core, step index, 0.5NA POF.*
4. *Measured in the Interface Circuit for High Voltage, over the $V_{CC}$ and $V_{-switch}$ range 4.5 V to 5.5 V, Ambient Temperature range -40 °C to 85 °C, Received optical power $P_H$ = -1 to -20 dBm, at 1 Mbps. $R_{ext}$ = 560 Ω, $C_L$ = 22 pF. $R_L$ pin o/c.*
5. *$R_L$ cannot be connected to Vo when Vo is used to switch a voltage greater than $V_{CC}$*

| Parameter | Symbol | Min | Typical | Max | Unit | Test Condition |
|---|---|---|---|---|---|---|
| Supply Current | $I_{CC}$ | 10.5 | 13 | 16 | mA | [2,3,4] |
| Wake Up Delay | $t_{power-on}$ | | 40 | | µs | [1,2,3,4] |
| High Level Output Current | $I_{OH}$ | | 0.5 | 100 | µA | Vo=20 V, Received Power < $P_L$ maximum |
| Low Level Output Voltage | $V_{OL}$ | | 44 | 75 | mV | Io = 25 mA, Received Power > $P_H$ minimum |
| Optical Power High | $P_H$ | -20 | | +2 | dBm | [2,3] |
| Optical Power Low | $P_L$ | | | -40 | dBm | [2,3]] |
| Data Rate | | DC | | 1 | MBd | Min-UI = 1 us, Max f = 0.5 MHz |
| Output Rise Time (10% - 90%) | $t_r$ | 20 | 40 | 50 | ns | [2,3,4] |
| Output Fall Time (90% - 10%) | $t_f$ | | 3 | 10 | ns | [2,3,4] |
| Pulse Width Distortion | PWD | -40 | | 40 | ns | [2,3,4] |
| Propagation Delay Low-to-High | $t_{PropDly\_LH}$ | | | 80 | ns | [2,3,4] |
| Propagation Delay High-to-Low | $t_{PropDly\_HL}$ | | | 65 | ns | [2,3,4] |
| Supply Voltage | $V_{CC}$ | 2.97 | | 5.5 | V | |
| External $V_{Switch}$ Power Supply | $V_{Switch}$ | 2.97 | | 20 | V | $I_{0-max}$ = 25 mA |
| Output Current | $I_0$ | | | 25 | mA | Maximum DC value |
| Internal Pull-Up Resistor to $V_{CC}$ | $R_L$ | 0.7 | 1 | 1.5 | kΩ | [5] |

## MECHANICAL DATA, HORIZONTAL

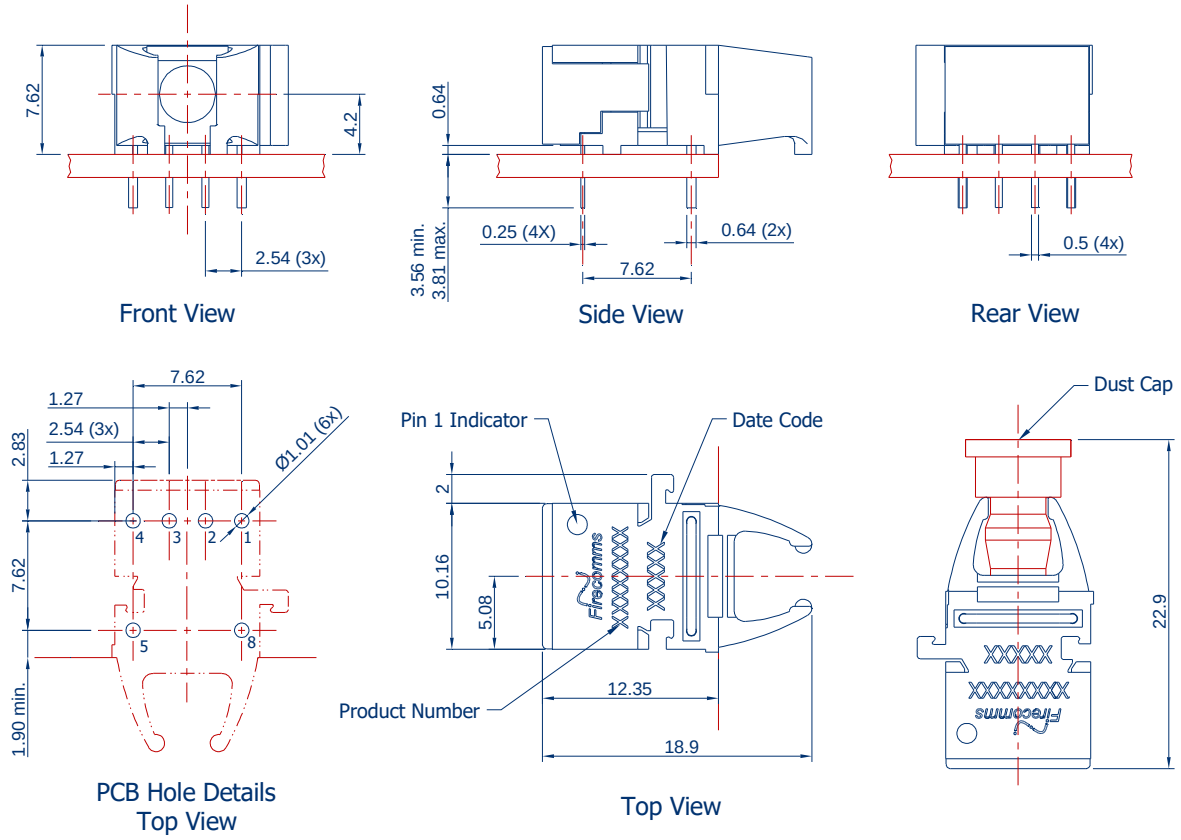



**FIGURE 5**
**Mechanical dimensions of RedLink® horizontal connectors and PCB footprint, which is a top view**
**General dimensional tolerance is ± 0.2 mm**

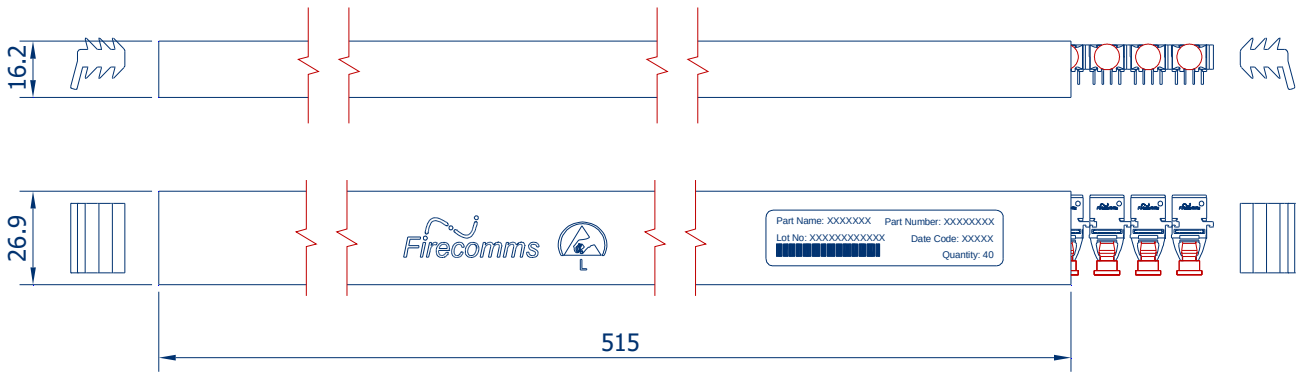



**FIGURE 6**
**Packing tube for Firecomms RedLink® horizontal connectors**

## MECHANICAL DATA, VERTICAL

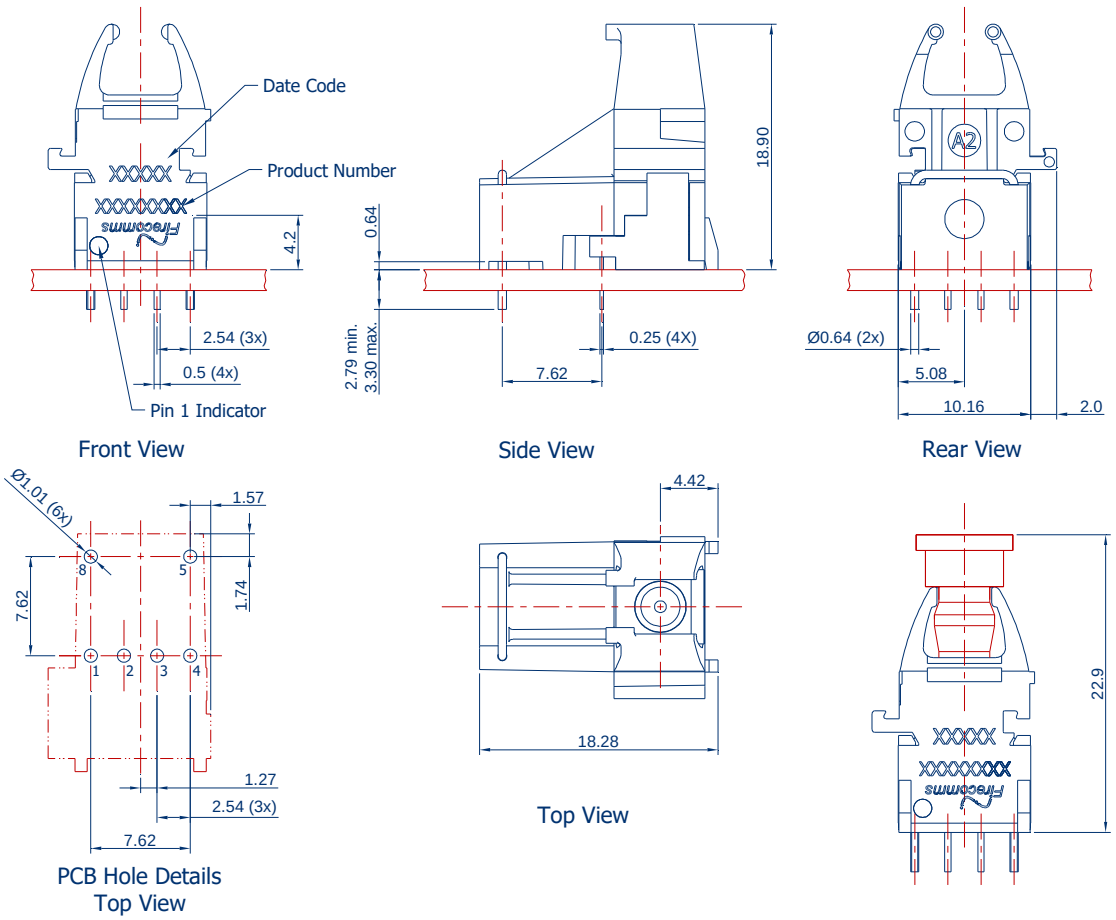



**FIGURE 7**
**Mechanical dimensions of RedLink® vertical connectors and PCB footprint, which is a top view**
**General dimensional tolerance is ± 0.2 mm**

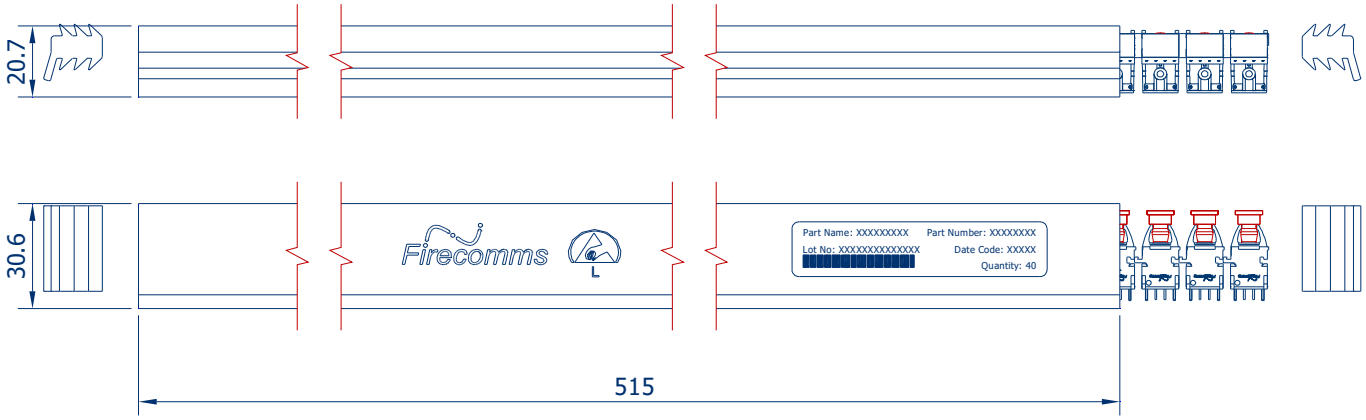



**FIGURE 8**
**Packing tube for Firecomms RedLink® vertical connectors**

## MECHANICAL DATA, 30° TILTED

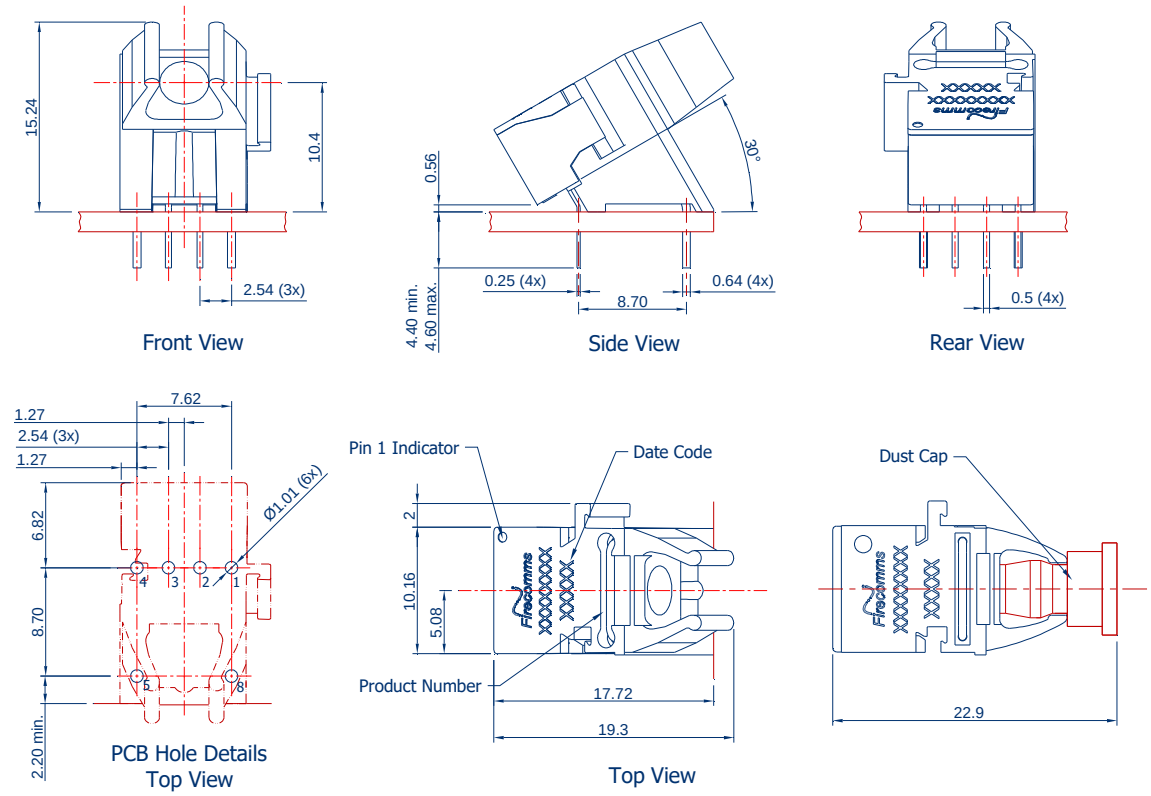



**FIGURE 9**
**Mechanical dimensions of RedLink® tilted connectors and PCB footprint, which is a top view**
**General dimensional tolerance is ± 0.2 mm**

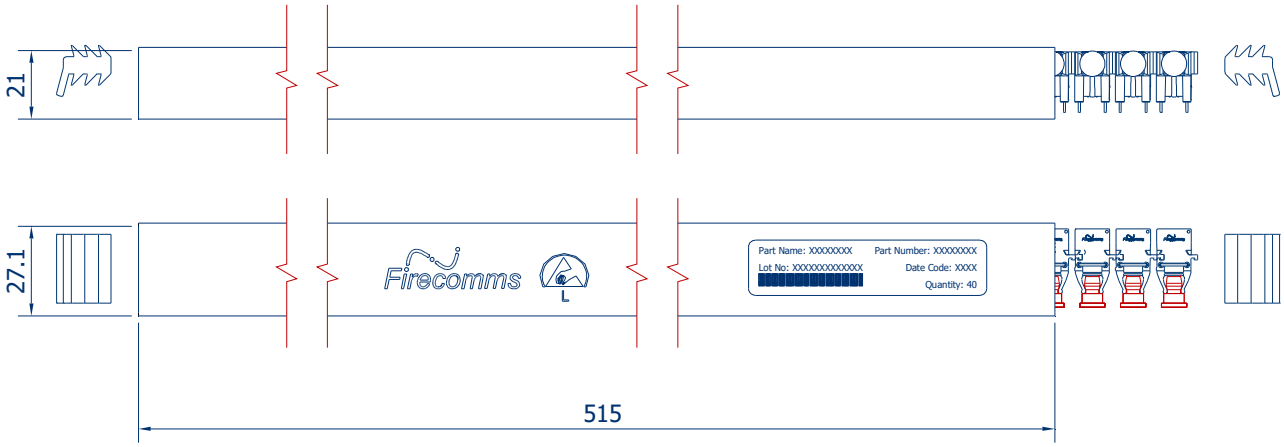



**FIGURE 10**
**Packing tube for Firecomms RedLink® tilted connectors**

## PART HANDLING

Firecomms RedLink® connectors are auto-insertable and tested for handling in static-controlled assembly processes (Human Body Model - 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. RedLink® connectors 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 and 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 | 20.7 mm | 21 mm |
| | Tube Depth | 26.9 mm | 30.6 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 | | 8.13 kg | 9.60 kg | 9.60 kg |
| Components per Outer Carton | | 2,000 | 2,000 | 2,000 |