45 Mb/s to 2.7 Gb/s Optical 2R Receiver Module with FSK Tone Detection Option

54RM Series

Key Features

- **MSA compliant**
- **Frequency Shift Keying (FSK) tone detection option allows control and status monitoring of the network**
- **1310 nm or 1550 nm operation**
- **Data rates from 45 Mb/s to 2.7 Gb/s (no CDR)**
- **APD for better than -30 dBm sensitivity**
- **-40 °C to 85 °C operation**
- **Decision threshold voltage adjustment provided for use in amplified system**

Applications

- High speed, long haul fiberoptic links for voice, data, and digital video
- Metropolitan area networks
- Wide area networks

Compliance

- Telcordia GR-253-CORE
- ITU-T G.958

The JDSU 54RM 2R series receiver module is designed for use in telecommunications systems and high speed data communications applications. This flexible device incorporates Frequency Shift Keying (FSK) tone detection. When used with the companion FSK transmitter, the 54RM provides control and status of a network with no additional fiber required. Its uniform package, pin function, and common optical and electrical characteristics are Multisource Agreement (MSA) compliant.

The 54RM 2R receiver module design uses an Indium Gallium Arsenide (InGaAs) Avalanche photodiode (APD) detector. It does not include a Clock/Data Recovery (CDR) function, thus allowing additional system design flexibility. It contains an integrated APD high voltage supply that is temperature-compensated at our factory for optimum sensitivity.

The 54RM 2R receiver module operates at continuous rates from 45 Mb/s to 2.7 Gb/s without gap and provides options for current mode logic (CML) or LVPECL outputs. The 54RM receiver also features an optical input level voltage (OILV) monitor with ±1dB accuracy and decision threshold voltage (DTV) adjustment.

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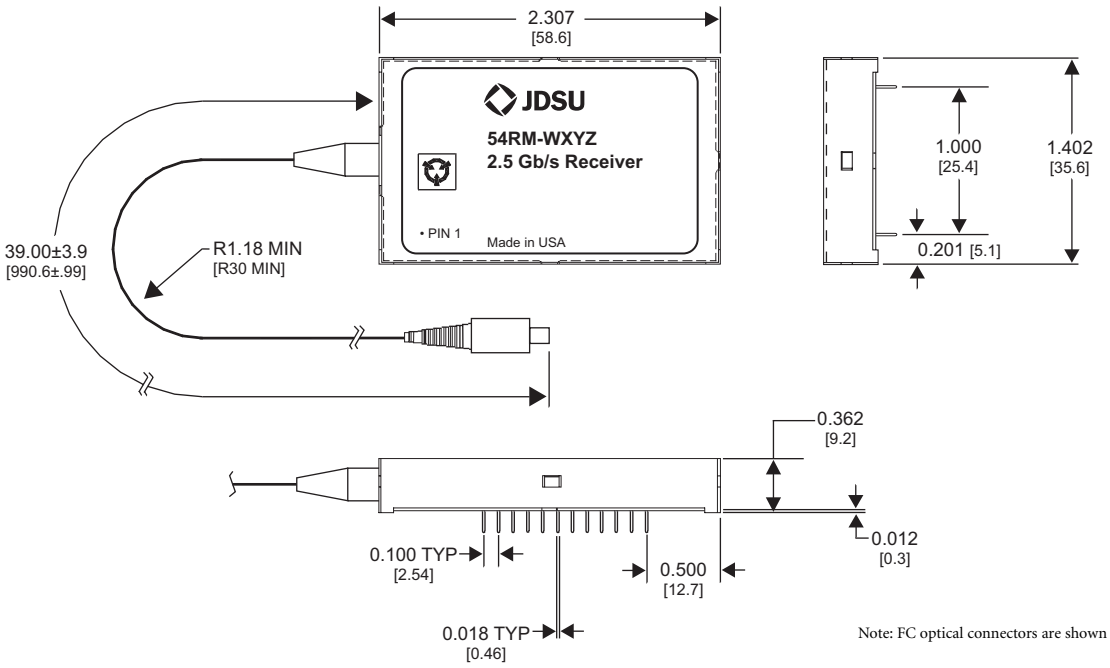
Dimensions Diagram

(Specifications in inches [mm] unless otherwise noted.)



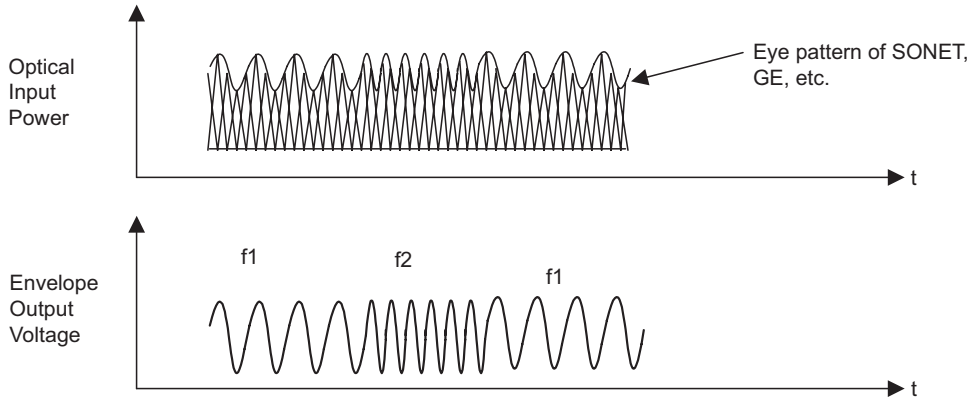
Note: FC optical connectors are shown for illustration only.

Pinout

Pin	Symbol	Description
1	FSK	FSK output
2	NUC	No user connection
3	LPA	Loss of power alarm (LOS)[1]
4	GND	Ground[2]
5	NIC	No internal connection
6	NIC	No internal connection
7	GND	Ground[2]
8	VCC	Supply voltage (5 V)
9	GND	Ground[2]
10	Dout	Data positive output
11	Dout	Data negative output
12	GND	Ground[2]
13	DTV	Decision threshold voltage
14	GND	Ground[2]
15	GND	Ground[2]
16	GND	Ground[2]
17	GND	Ground[2]
18	NIC	No internal connection
19	GND	Ground[2]
20	GND	Ground[2]
21	NUC	No user connection
22	VCC	Supply voltage (5 V)
23	OILV	Optical input level voltage
24	NUC	No user connection

1. LPA output is a logic level that indicates the presence or absence of a sufficient optical input level. A logical high level indicates an input optical level that is too low.
2. Package is at the same potential as GND.

Optical Incoming Signal and the Envelope Signal



Note: The envelope signal is a FSK signal. It is a sine wave that contains two frequencies [f1 and f2, where f2 - f1 = 14.3 KHz (max.), and 50 KHz < f1, f2 <500 KHz].

Characteristics of Envelope Detector

Parameter	Symbol	Minimum	Typical	Maximum
Output AC voltage signal (note[1])	Venv	5 mVp-p -42 dBm	- -	632 mVp-p 0 dBm
Low cut-off frequency (-1 dB)		-	-	50 KHz
Low cut-off frequency (-20 dB)		15 KHz	-	-
High cut-off frequency (-1 dB) (note[1])		500 KHz	-	-
High cut-off frequency (-20 dB) (note[1,2])		-	-	4000 KHz
Clipping and distortion (note[3])		-	-	10 %
S/N in a 40 KHz bandwidth (note[4])		14 dB	-	-
Spurious level (note[5])		-	-	6 dB above noise floor

1. Incoming optical signal with power in the range of -32 dBm to -7 dBm and modulation depth of 5% to 10% (dBm values assume a single tone, not random data with two tones for FSK channel).
2. The gain at frequencies below the Low cut-off frequency (-20 dB) and above the High cut-off frequency (-20 dB) must be smaller than -20 dB.
3. The envelope-detected signal should not be clipped to the extent the FSK signal-to-noise ratio goes below 14 dB in a 40 KHz bandwidth with an optical input of -7 dBm and modulation index of 10%.
4. The measurement is conducted at two frequencies: one centered at 80 KHz and the other at 180 KHz. In addition, the measurements are performed at:
   a. Carrier data rate of 622 MHz and PRBS 223-1 data pattern with total power into the receiver of -32 dBm and 10% modulation index
   b. Carrier data rate of 2488 MHz and PRBS 223-1 data pattern with total power into the receiver of -32 dBm and 5% modulation index
5. Spurs measured with OC 48, PRBS 223-1 signal input and measured between:
   a. 55 KHz and 105 KHz
   b. 155 KHz and 205 KHz
   at a resolution bandwidth of 3 KHz.

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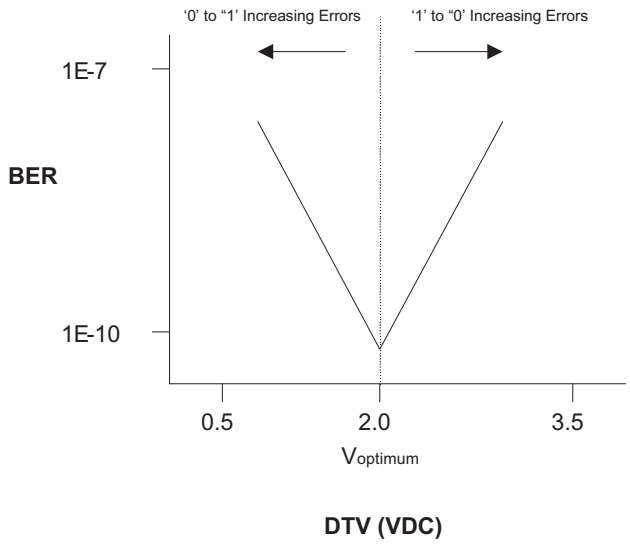
Electrical Specifications

Parameter	Symbol	Minimum	Typical	Maximum
Positive supply voltage	Vcc	4.75 V	5 V	5.25 V
APD HV supply		Internal		
Power consumption (total)		-	1.2 W	1.5 W
Differential output data voltage (LVPECL) (note[1])		0.55 V_{p-p}	-	1.2 V_{p-p}
Output rise time (20% to 80%)	Tr	-	130 ps	150 ps
Output fall time (80% to 20%)	Tf	-	130 ps	150 ps
Output data return loss				
1 MHz to 2 GHz	RL	9 dB	-	-
2 GHz to 2.5 GHz	RL	6 dB	-	-
Loss of power alarm output level				
Normal signal input	LPA	0 V	-	0.4 V
Low signal input (alarm)	Llite	Vcc - 0.4 V	-	Vcc
"Low Light" alarm assert time	T(aa)	-	-	1 ms
"Low Light" alarm de-assert time	T(a0)	-	-	1 ms
Optical input level (pin 23) at 1550 nm (note[2])	OIL			
Optical input = -40 dBm (±2 dB)		0.45 V	0.5 V	0.55 V
Optical input = -30 dBm (±1 dB)		0.95 V	1.0 V	1.05 V
Optical input = -20 dBm (±1 dB)		1.45 V	1.5 V	1.55 V
Optical input = -10 dBm (±1 dB)		1.95 V	2.0 V	2.05 V
Optical input = -5 dBm		-	2.25 V	-
Full scale range		-5 dBm	-	-40 dBm
Slope		-	50 mV/dB	-
Decision threshold voltage (pin 13) input voltage range (note[3])	DTV	0.5 V	-	3.5 V
Data, load drive capability	RL	-	50 Ω	-
Jitter generation			Meets GR-253/ITU-T G.958	
Jitter tolerance (note[4])			Meets GR-253/ITU-T G.958	
Jitter transfer (note[4])			Meets GR-253/ITU-T G.958	
Logic output level			TTL compatible	

1. Must be externally AC coupled and externally loaded by 50 Ω.
2. The OILV output is tested and tuned using a 1550 nm optical input. When a 1310 nm source is present, the OILV output may vary by ±2 dB since there may be an offset associated with receiving a 1310 nm optical signal as compared to 1550 nm. However, typically most modules will exhibit a small variation between 1310 nm and 1550 nm inputs.
3. By varying the DTV voltage at pin 13 from 0.5 VDC to 3.5 VDC the quanitization threshold level is shifted from the bottom of the data eye to the top of the data eye respectively. Threshold adjustment without optical noise ($V_{optimum}$) is symmetric about 2.0 VDC. At DTV set points of 0.5 VDC and 3.5 VDC, the BER will be shifted to a typical value of 10 E-7 from a nominal BER of 10 E-10 (i.e. no input applied at DTV). If the DTV function is not required, pin 13 should be left open. An extended DTV full-scale input range of 0.0 V to 5.0 V may be used if additional threshold adjustment range is required.
4. This requirement is only applicable when used with a CDR, which meets the given jitter tolerance and jitter transfer specifications.

Typical DTV Adjustment Range



Note: Curve shown without optical noise.
Typical $V_{optimum}$ with optical noise is 1.75 VDC.

Optical Specifications

Parameter	Symbol		54RM-4xxx 1310 nm or 1550 nm	54RM-5xxx 1310 nm or 1550 nm
ITU-T / SONET			2R (APD, No CDR)	2R (PIN, No CDR)
Center wavelength	λ_C	Minimum	1260 nm	1260 nm
		Maximum	1618 nm	1615 nm
Receiver sensitivity (note[1, 2])	Psens	Minimum	-29 dBm	-19 dBm
		Typical	-31 dBm	-20 dBm
Receiver sensitivity 45 MHz to GE (note[1, 2])		Minimum	-30 dBm	- 20 dBm
		Typical	-32.5 dBm	- 21 dBm
Receiver sensitivity with noise and path penalty (note[3])		Minimum	-23 dBm	-15 dBm
		Typical	-26 dBm	-17 dBm
Receiver overload	Povld	Minimum	-8 dBm	0 dBm
		Typical	-7 dBm	1 dBm
Maximum reflectance		Typical	-28 dB	-28 dB
		Maximum	-27 dB	-27 dB
LPA flag threshold		Minimum	-40 dBm	-22 dBm
		Maximum	-34 dBm	-30 dBm
LPA hysteresis		Minimum	0.5 dB	0.5 dB
		Maximum	2 dB	2 dB

1. Measured at BER 10^{-10} and at the connector interface with conditions at EOL with an 8.2±0.1 dB extinction ratio optical source. The receiver shall exhibit a BER slope less than -0.5 dB per BER decade down to a BER of 10^{-14}. When using the FSK option, the sensitivity will be degraded by 0.5 dB.
2. Receiver sensitivity is valid for data rates from 45 Mb/s to 2.7 Gb/s. For data rates from 45 Mb/s up to 155 Mb/s the PRBS pattern is 2^7 -1, and for data rates from 155 Mb/s to 2.7 Gb/s the PRBS pattern is 2^{23} -1.
3. Measured at BER 10^{-12}, OSNR 0.1 nm = 19 dB through 0.8 nm optical filter (square shape equivalent filter) and STM-16 PRBS 2^{23} - 1 signal with a CDR (ITU-T G.958) and an MSA transmitter with 3200 ps/nm optical path. DTV (pin 13) set to $V_{optimum}$.

Ordering Information

For more information on this or other products and their availability, please contact your local JDSU account manager or JDSU directly at 1-800-498-JDSU (5378) in North America and +800-5378-JDSU worldwide or via e-mail at customer.service@jdsu.com.

Sample: 54RM-4G21

54RM- ☐ ☐ ☐ ☐

Code	Photodetector
4	APD
5	PIN
7	APD with FSK
8	PIN with FSK

Code	Connector Type
C	ST/SPC
D	FC/SPC
G	C/SPC
L	LC/SPC
M	MU/SPC

Code	Class
1	-5 to 75 °C
2	-40 to 85 °C

Code	Data Output
1	CML output
2	LVPECL output for use with external AC coupled termination
3	LVPECL output for use with external PECL bias termination
4	CML outputs with longer pin lengths (0.148±0.015")
5	LVPECL output for use with external LVPECL bias termination