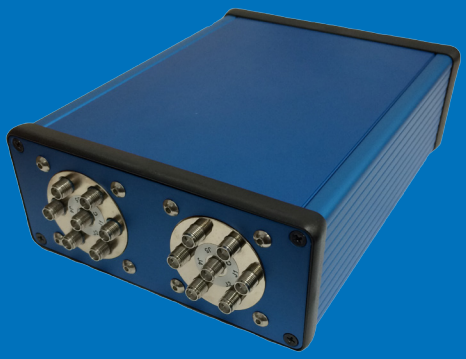
Coax Switch Matrix Selection Guide

MIMO

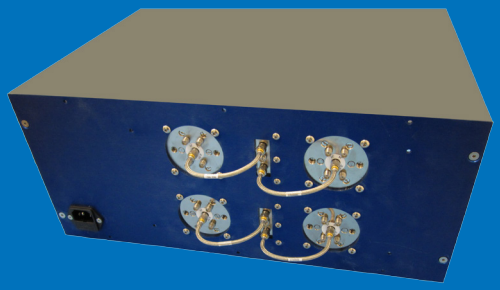
Ethernet

USB

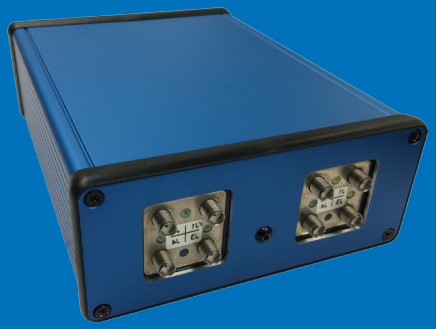
Filter Bank



Multiplexor



Mini Matrix



GPIB

Custom

TELEDYNE
COAX SWITCHES
Everywhereyoulook™

RoHS or Non-RoHS:
Your Choice!

TELEDYNE COAX SWITCHES
Everywhereyoulook™
teledynecoax.com

Switching Solutions

Industry Leader

With over 50 years experience, Teledyne is the world's innovative leader in manufacturing ultraminiature, hermetically sealed, electromechanical and solid-state switching products. Our comprehensive product line meets a wide range of requirements for industrial, commercial, medical, RF & wireless, defense and aerospace applications.

Product Assurance

Under an aggressive Total Quality Management (TQM) program, Teledyne has embraced a "continuous improvement" culture. With recognized certifications such as Boeing D1-9000, DSCC MIL-STD-790, and ISO 9001/9002, Teledyne has become a primary supplier of switching solutions with the highest quality and reliability to industry leaders around the world.

Product Development

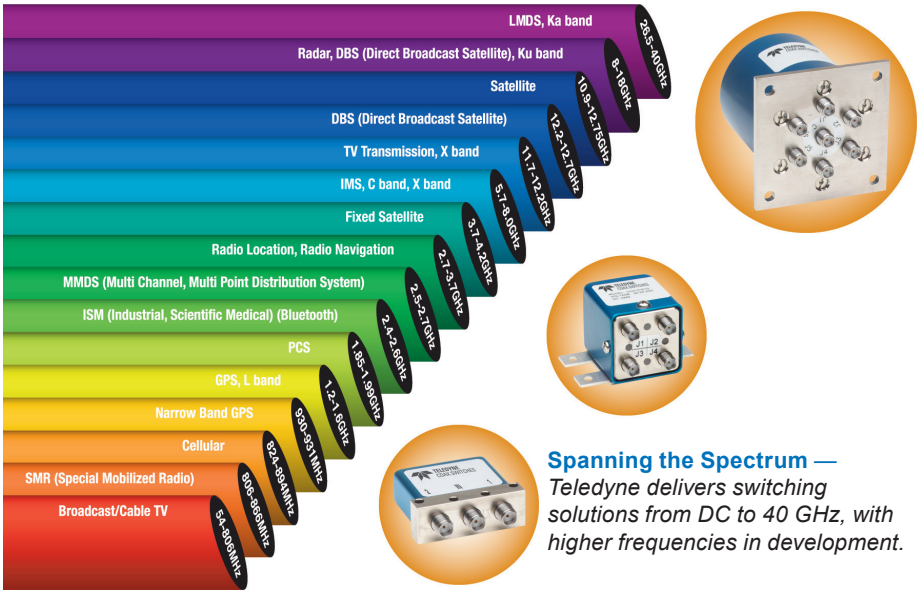
Teledyne offers a full range of comprehensive switching solutions. In addition to offering standard switching solutions, our experienced team works closely with our customers to develop tailored products for specific applications. We offer advanced engineering, state-of-the-art manufacturing techniques, and over 45 years of switching experience with a commitment to quality, costs and delivery.

Standard & Custom Matrix Assemblies

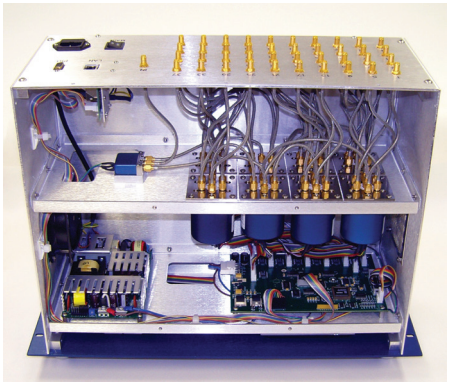
Teledyne offers a wide variety of RF matrix assemblies. Incorporating highly repeatable and long-cycle-life relays and switches, our matrices cover the spectrum from DC to 40GHz.

Teledyne's modular approach building matrices allows assembly of a vast array of customized matrices with the same standard subassemblies. The internal components utilize Teledyne's proven switches. Our universal programmable microcontroller can be used for any matrix configuration. The universal power supply allows the matrix assembly to be used worldwide.

Teledyne is highly vertically integrated, which reduces development time, qualification time, cost and leadtime, while ensuring high quality and cost-effective production.



Spanning the Spectrum — *Teledyne delivers switching solutions from DC to 40 GHz, with higher frequencies in development.*



Matrix Assemblies — *Teledyne provides matrix assemblies, such as the Model CSM-0003 1x40 Switch Matrix, that incorporate coaxial switches.*

Space-Qualified Switches

Teledyne's space-qualified coaxial switches are typically custom-designed and manufactured according to specific performance requirements. We also provide a complete line of standard, off-the-shelf switches that offer customers significant cost savings, while satisfying most typical requirements for scientific, meteorological and communication satellite applications.

Technical Service & Customer Support

Teledyne provides easy access to technical service and customer support. Our website makes it easy to find technical information, buy products and even get e-mail responses within 24 hours. Switching solutions are only a mouse click away at www.teledynecoax.com.

Featured switching solutions include:

Microwave Switch Matrix Assemblies

- Multiple standard and customized configurations
- Universal Power Supply
- Visual Display – LCD
- Standard and custom racks available

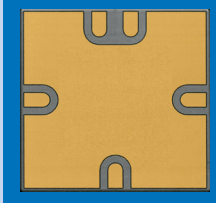
CCR-40 DC–40 GHz SPDT Switch

- Excellent insertion loss repeatability
- Ultra low passive intermodulation (PIM)
- Characterized at 5 million cycles
- Compact design up to 40 GHz

Space-Qualified Switches

- Screening as required per customer
- Custom designs available
- Proven heritage in space

Table of Contents



InP1012

- Indium Phosphide Active RF Switch
- Greater than 40 Gbps bandwidth
- Broad frequency bandwidth, 60 GHz+
- Small form factor, 3mm X 3mm X 1mm
- Low insertion loss
- Switching time of less than 100ns

See Page 26

RF121 / GRF121

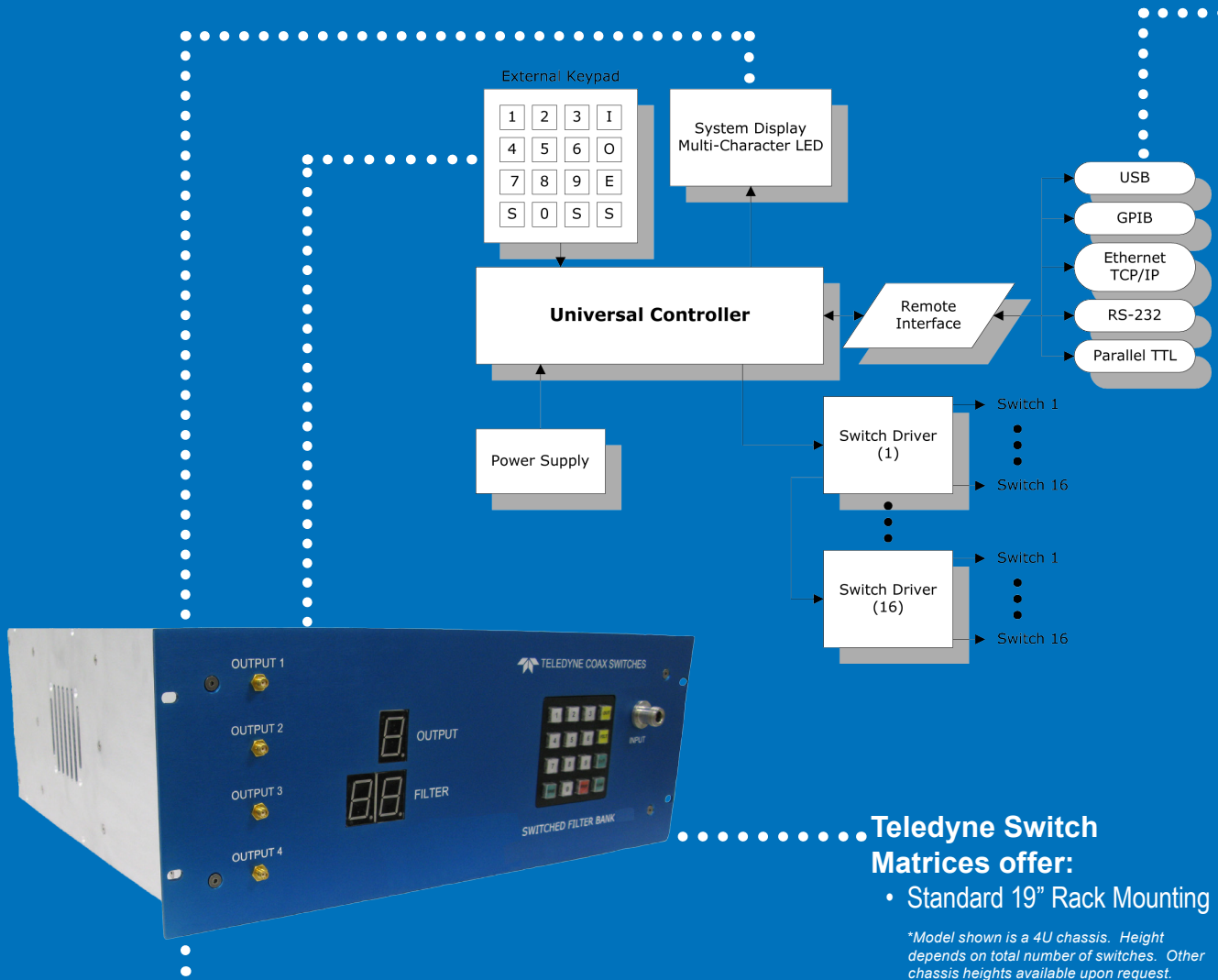
- Broader bandwidth (DC - 18GHz)
- Signal integrity up to 40Gbps
- SPDT, Magnetic Latching
- Metal Enclosure for EMI shielding
- High Repeatability
- 3 Million Cycle Life

See Page 27

Teledyne Coax Switch

What is a switch matrix?

A switch matrix is a system composed of multiple individual switches connected to achieve multi-input and multi-output configurations, allowing you to reduce space and cost. The system utilizes Teledyne's universal controller that offers multiple interface options. Integrated matrix systems by Teledyne simplify your complex switching needs by allowing you to select a combination of input ports to output ports, instead of tediously commanding individual switches to form a signal path. Teledyne Matrix Systems come in standard and customized rack mount chassis. These matrix systems are available in 50Ω and 75Ω characteristic impedance. Teledyne Switch matrices offer a turn-key solution for customers in need of high switch count applications using proven reliable Teledyne Coax Switches.



Teledyne Switch Matrices Feature:

- Relay Switch Position Indicators
- Switch Cycle Count

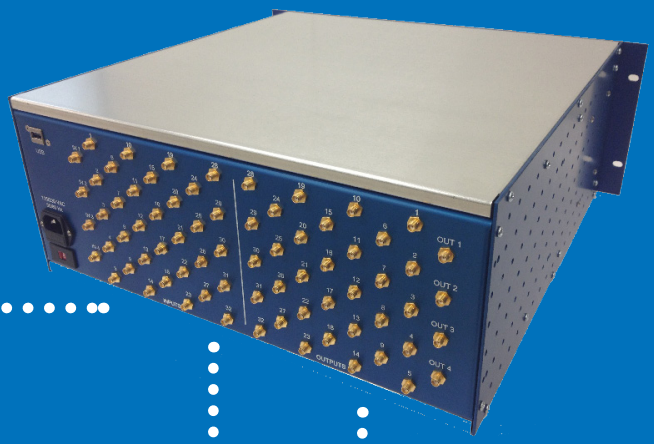
Teledyne Switch Matrices offer:

- Standard 19" Rack Mounting

**Model shown is a 4U chassis. Height depends on total number of switches. Other chassis heights available upon request. (1U = 1.75" Height)*

Matrix Intro

TELEDYNE COAX SWITCHES
Everywhereyoulook™



Teledyne Switch Matrices are available with a variety of RF connector types:

- SMA
- 2.92 mm
- TNC
- Type N
- QMA
- mini-SMB (75Ω)
- BNC (75Ω)

Standard Power Supplies support a wide variety of input sources including 400Hz airframe power

All remote communications options integrate easily with LabVIEW™

Additional optional capabilities:

Customized mounting or packaging solutions

Environmental testing:

- Acoustic Noise
- EMI/RFI
- Transient Suppression
- Ballistic Shock Fatigue
- Temperature
- Vibration
- Crash Load
- Humidity
- Altitude

Additional passive component integration such as:

- Filters
- Circulators
- Attenuators
- Splitters
- Power Dividers
- Power Combiners

Teledyne Coaxial Switch

SPDT Switches:

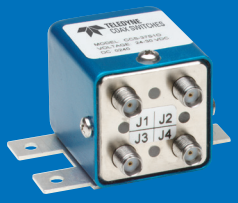
- DC-40GHz
- 2.92mm/SMA Connectors
- Failsafe & Latching
- Designed for 50Ω
- 5 Million Cycles

- DC-12GHz
- TNC & Type N Connectors
- Failsafe & Latching
- Designed for 50Ω
- High Power
- 2 Million Cycles

- DC-3GHz
- mini-SMB Connectors
- Failsafe & Latching
- 75Ω
- 5 Million Cycles

- DC-26.5GHz
- SMA Connectors
- Failsafe & Latching
- Internal 50Ω termination
- 5 Million Cycles

TRANSFER Switches:



- DC-40GHz
- SMA Connectors
- Failsafe & Latching
- Designed for 50Ω
- 5 Million Cycles

- DC-12GHz
- TNC & Type N Connectors
- BNC Connectors (Up to 3GHz)
- Failsafe & Latching
- Designed for 50Ω & 75Ω
- High Power
- 3 Million Cycles

2P3T Switches:

- DC-26.5GHz
- SMA Connectors
- Failsafe & Latching
- Designed for 50Ω
- 5 Million Cycles

Overview

TELEDYNE COAX SWITCHES
Everywhereyoulook™

Multi-Throw Switches:

- DC-40GHz
- SMA Connectors
- Normally Open & Latching
- SP3T to SP6T
- Designed for 50Ω
- 5 Million Cycles

- DC-12GHz
- SMA Connectors
- Normally Open & Latching
- SP7T to SP8T
- Internal 50Ω termination
- Designed for 50Ω
- 5 Million Cycles

- DC-12GHz
- SMA Connectors
- Normally Open & Latching
- Designed for 50Ω
- SP9T to SP10T
- Designed for 50Ω
- 5 Million Cycles

- DC-12GHz
- TNC & Type N Connectors
- Normally Open
- Designed for 50Ω
- SP3T to SP8T
- High Power
- 3 Million Cycles

Teledyne Coax Switches

Teledyne Switch Matrix Systems feature high performance coaxial switches. Teledyne's broad product line allows for maximum versatility and unlimited configuration offering.

For complete review of Teledyne Coax Switches, please download our Selection guide at: www.teledynecoax.com

Teledyne Switch

Teledyne's Switch Matrix Systems encompass four different series. Below is a quick overview outlining the matrix types, features and additional options offered within each series. A standard Teledyne Matrix System features RS-232 and 4U rack-mountable chassis. Teledyne Sytems can quickly translate from customer need, to block diagram, to reliable switching system.

MIMO/Blocking Switch Matrix

(See Example on Page 12)

- Maximum of 1024 switch paths
- SMA, mini-SMB, Type N, TNC or 2.92mm Standard options. Other connector types available upon request
- RS-232 (Standard), USB, GPIB, Parallel TTL, Ethernet TCP/IP interface options
- Compatible with LabVIEW, Python, C++, C#, Visual Basic, .NET Software, Linux, Windows
- Failsafe, Latching or Normally Open Configurations
- Switching systems for 50Ω & 75Ω applications
- Internal termination available
- 1 Million Cycle Life (per port)

Multiplexor/Fanout Switch Matrix

(See Example on Page 13)

- Maximum of 1x1024 Configuration
- SMA, mini-SMB, Type N, TNC or 2.92mm Standard options, Other connector types upon request
- RS-232 (Standard), USB, GPIB, Parallel TTL, Ethernet TCP/IP interface options
- Compatible with LabVIEW, Python, C++, C#, Visual Basic, .NET Software, Linux, Windows
- Failsafe, Latching or Normally Open Configurations, other configurations available upon request
- Switching systems for 50Ω & 75Ω applications, other impedances available upon request
- Internal Termination
- 1 Million Cycle Lifes (per port)

Matrix Overview

TELEDYNE COAX SWITCHES Everywhereyoulook™

MIMO Single Connection Switch Matrix

(See Example on Page 14)

- Maximum of 1024 switch paths
- SMA, mini-SMB, Type N, TNC or 2.92mm Standard options. Other connector types available upon request
- RS-232 (Standard), USB, GPIB, Parallel TTL, Ethernet TCP/IP interface options
- Compatible with LabVIEW, Python, C++, C#, Visual Basic, .NET Software, Linux, Windows
- Failsafe, Latching or Normally Open Configurations
- Switching systems for 50Ω & 75Ω applications
- Internal termination available
- 1 Million Cycle Life (per port)

Custom Configuration Switch Matrix

(See Example on Pages 15-17)

- RS-232 (Standard), USB, GPIB, Parallel TTL, Ethernet TCP/IP interface options
- Custom switching configurations such as: Bypass, Expandable, Independent matrices in one chassis
- Integration of passive components such as Filters and Attenuators
- Custom displays, buttons, switches, LEDs and front panel schematics
- Custom marking, painting, labeling, flanges, handles, non-enclosure switch plates
- Custom matrix interface such as military-rated connectors, Indicators, Readback
- Switching systems for 50Ω & 75Ω applications
- Internal termination available
- 1 Million Cycle Life (per port)

See matrix gallery on pages 12-17

Teledyne Switch Matrix Program

Teledyne's Switch Matrix Systems offer switching systems for a variety of markets including: Military and Defense, Aircraft, Industrial, SATCOM, Advanced TeleComm, ATE, LTE 4G and many more. Teledyne's 50 years experience in switching technology make it the most reliable matrix system on the market.

Program Oriented Design Review

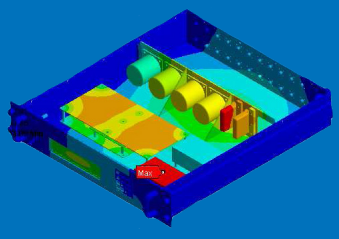
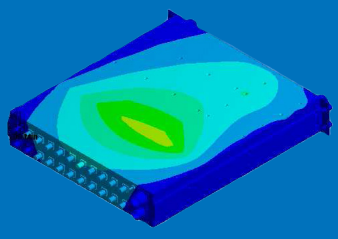
- Compliance Matrix against customer requirements
- Mechanical Layout against customer requirements
- Thermal Analysis
- Cascade Analysis with tolerances
- Power Analysis against customer requirements

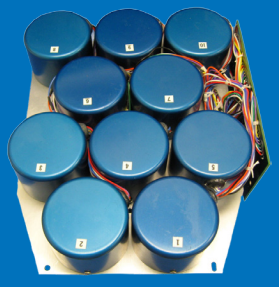
Program Oriented Development Engineering

- Qualification Test Procedure
- Qualification Testing Report
- Acceptance Test Procedure
- Test Data
- Configuration and Data Management (traceability and sustainment/logistics support)

Coax Switch Matrix Testing Capabilities:

- Shock
- Ballistic Shock
- Crash Load
- Random Vibration
- Acoustic Noise
- Temperature
- Sinusoidal Vibration
- Altitude
- Humidity



Management Capabilities

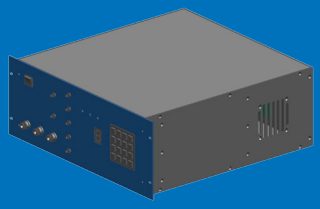
TELEDYNE COAX SWITCHES
Everywhereyoulook™

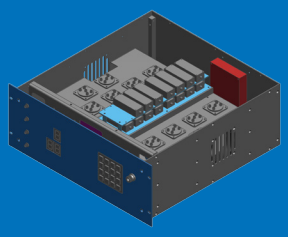
Additional Special Requirements:

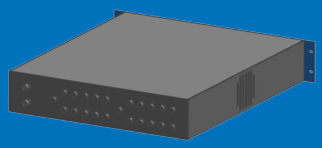
- 3D Modeling
- Transient Suppression Diodes
- EMI/RFI Suppression
- Transient Suppression Resistors
- Distortion Products
- Hazmat Requirements
- Unique Identification Marking

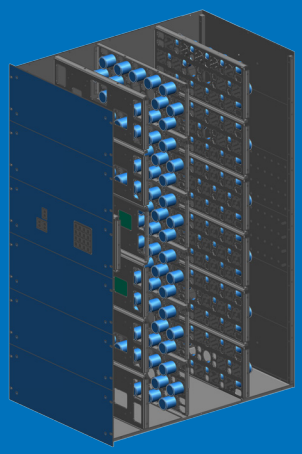
Switch Matrix Applications:

- ATE Systems
- RF Signal Switching
- Antenna Systems
- Airborne Surveillance Systems
- Video Routing & Distribution
- Flight Simulators
- Telemetry & Ground Stations
- Signal Conditioning
- 3G & 4G LTE Networks
- Calibration Fixtures/Modules
- Remote Calibration Correction
- Avionics Testing
- Electronics Warfare
- Specialized Test Equipment (STE)
- High Speed Serial Data Switching
- Wireless & Telecom Test
- Phase-Matching
- Telecommunication and Network Switching







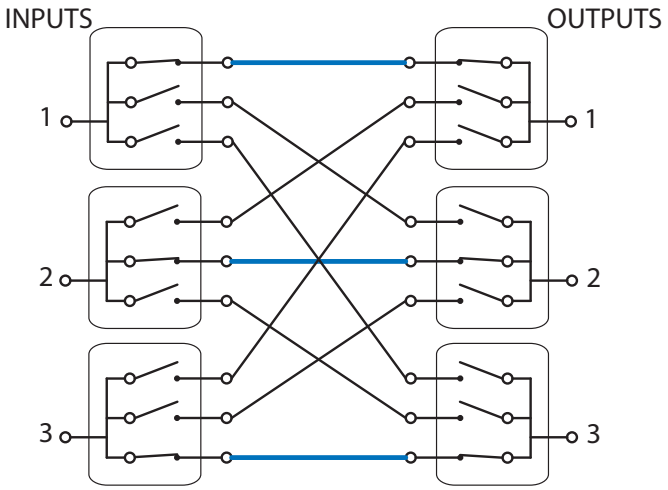


Teledyne Switch Matrix Configurations

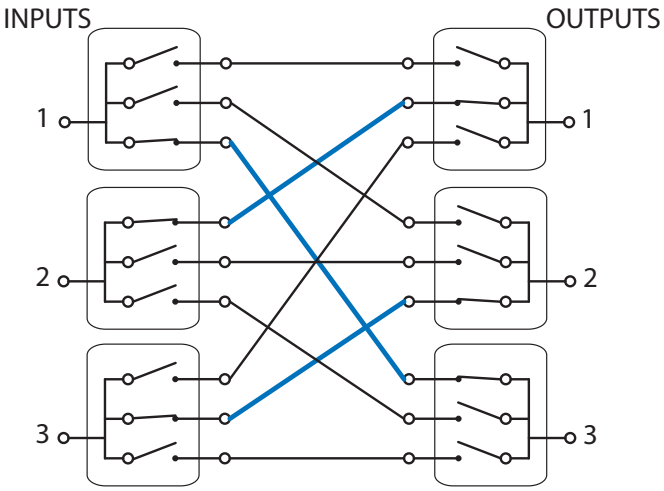
TELEDYNE COAX SWITCHES Everywhereyoulook™

MIMO/Blocking Switch Matrix

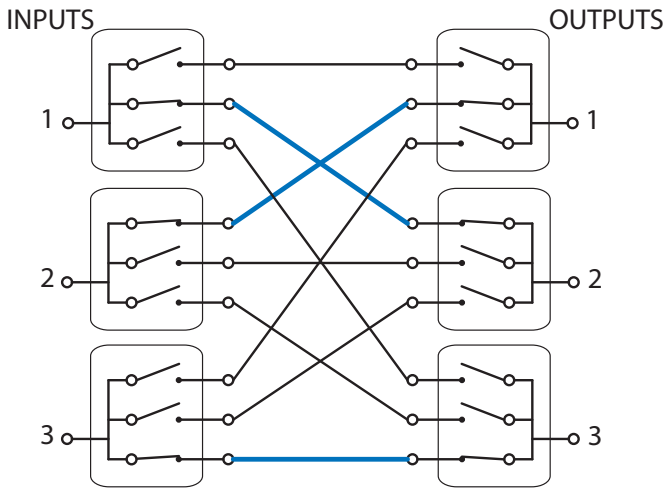
The standard MIMO matrix is a multiple-input, multiple-output (where the abbreviation MIMO comes from) matrix of size NxM; N being the number of inputs and M, the number of outputs. This may also be known as a Blocking Matrix. Here are 4 examples of a 3x3 MIMO Matrix, with 4 possible connection combinations shown (more combinations exist, but are omitted for brevity):



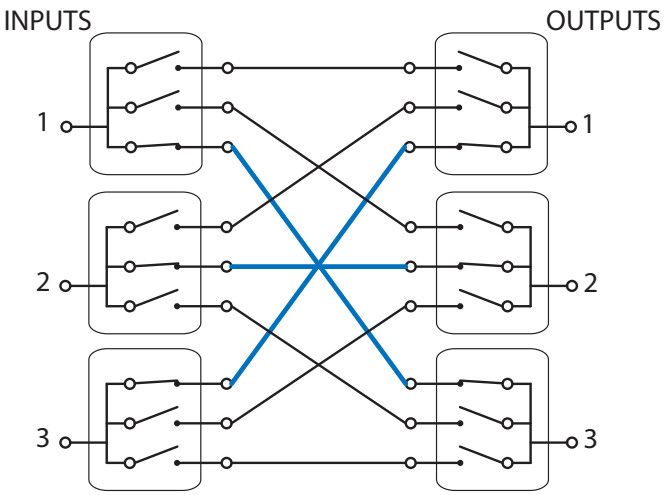
POSSIBILITY A



POSSIBILITY B



POSSIBILITY C

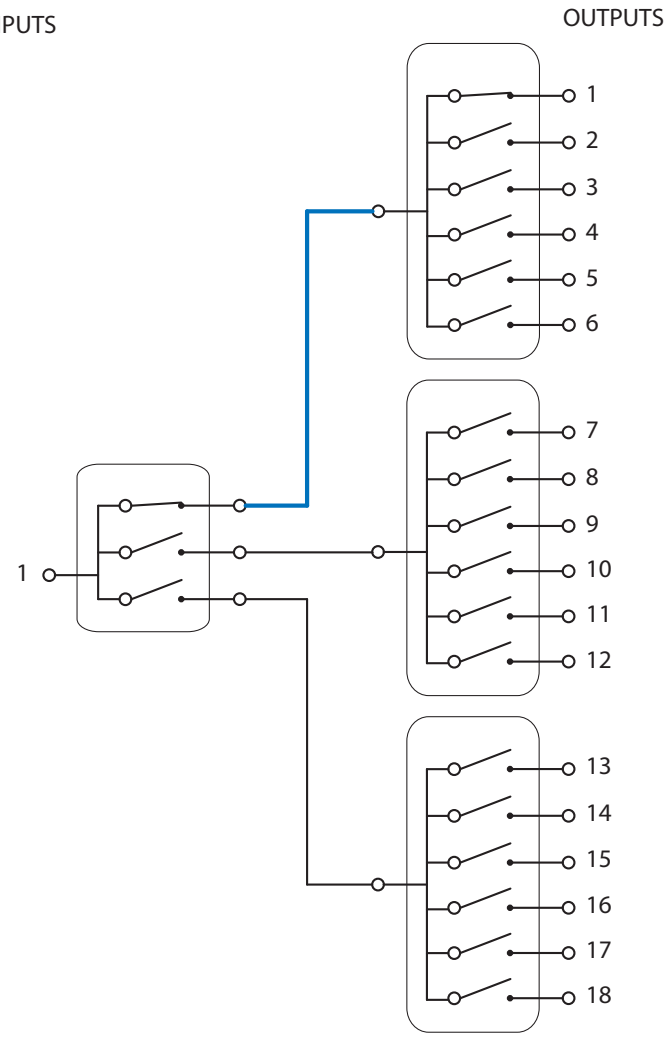


POSSIBILITY D

This matrix type, while being multiple-input, multiple-output, will allow a single connnection from any input to any output at a time. This means that the user can have (as shown in “Possibility B” Input 1 connected to Output 2, Input 2 connected to Output 1, and Input 3 connected to Output 3, all at the same time. The configuration shown would use 6 SP3T coaxial switches to create 9 distinct switch paths.

Multiplexor/Fanout Switch Matrix

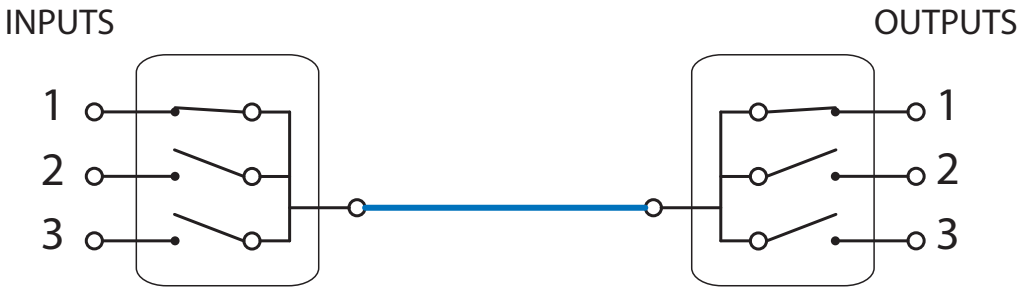
This may also be known as a fanout configuration. The Multiplexor Matrix is a 1xN matrix; a single input going to N number of outputs. Below is an example of a 1x18 Multiplexor Matrix:



The multiplexor is the simplest matrix configuration, allowing the input to be connected to any one output at a time. Before switching, for example, to Output 2 the connection to Output 1 needs to be disconnected.

MIMO Single-Connection Switch Matrix

This type of matrix is also a multiple-input, multiple-output configuration, but unlike the standard MIMO, only a single connection can be made at any time. In the example below we have the same size matrix as the example in configuration #1, a 3x3, in a MIMO Single Connection Type:



In a MIMO Single Connection Matrix, you can have Input 1 connected to Output 3, but you must disconnect this path if you were to connect Input 2 to Output 1, or any other combination.

Example System Datasheet
4x96 MIMO/Blocking

TELEDYNE COAX SWITCHES
Everywhereyoulook™

Description

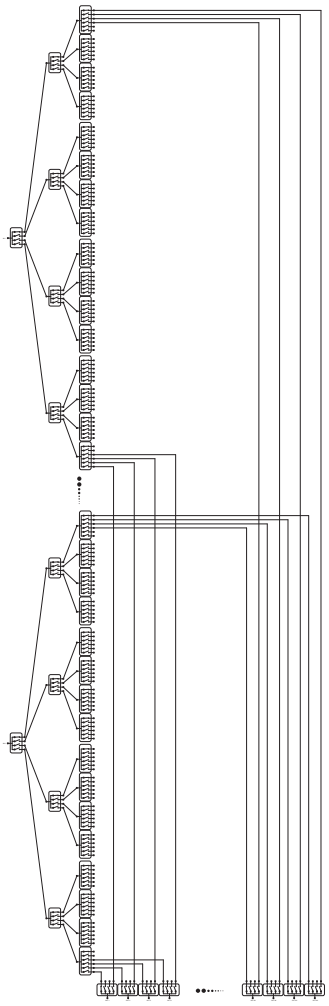
This matrix system consists of a 4x96 switching system in a 24U standard 19" chassis. This switching system was designed for an operating frequency range of DC-6GHz. The 4x96 matrix is controlled via TCP/IP (Ethernet) and features 7-segment displays which let the user know which input and output combination is currently active. There is also a local control keypad that allows users to manually command the switching system.
This matrix consists of (116) SP4T switches and (64) SP6T switches.

- **Local control Via Keypad**
- **TCP/IP (Ethernet) Remote Control**
- **SMA Connectors**
- **90-260 Vac, 47-63Hz Power**

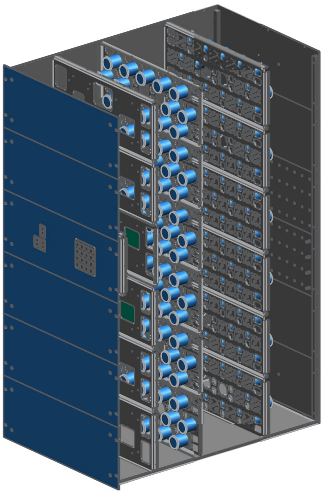
Switch Function
Normally Open
Switching Type
Electromechanical
Temperature
Storage: –40°C to +65°C Operating: –55°C to +85°C

RF Characteristics		
Frequency Range	**0.7-2.5GHz**	**2.6-6GHz**
Insertion Loss (dB)	2.5	4.0
VSWR	1.5:1	1.75:1
Isolation (dB)	75	70
Mechanical Information		
Power Handling	1W Continuous	
Line Power	Universal 90-260 VAC, 47-63Hz	
Size (WxHxD)	19", 24U, 20" Depth	
Typical Cycle Life	1M cycles per RF port	

MATRIX SCHEMATIC



FRONT VIEW



3D MODEL VIEW

Example System Datasheet
1x16 Multiplexor/Fanout

Description

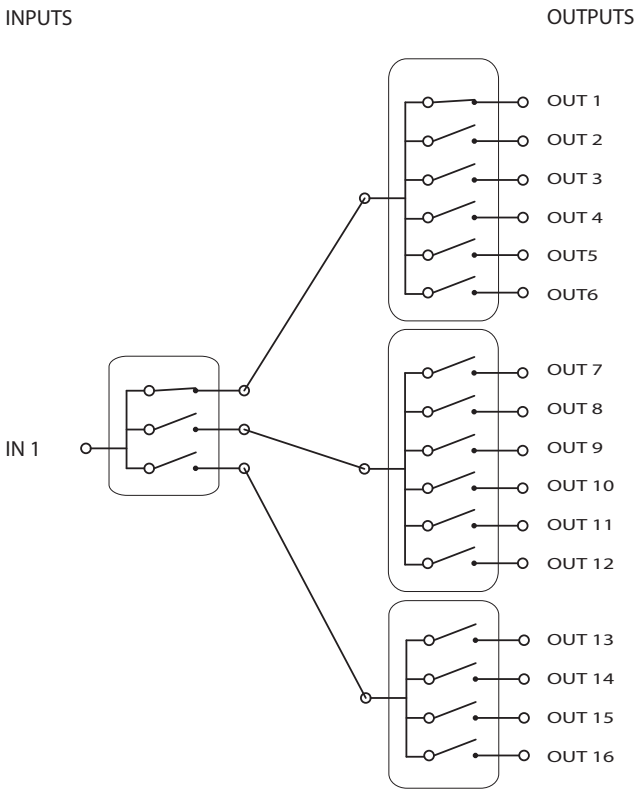
This matrix system consists of a 1x16 switching system in a 4U standard 19" chassis. This switching system has an operating frequency range of 2-4GHz (S-Band). The output ports are internally terminated to 50Ω, controlled via Ethernet and feature 7-segment displays which let the user know which output is currently active. There is also a local control keypad that allows users to manually command the switching system.
This matrix consist of (1) SP3T switch, (1) SP4T and (2) SP6T switches.

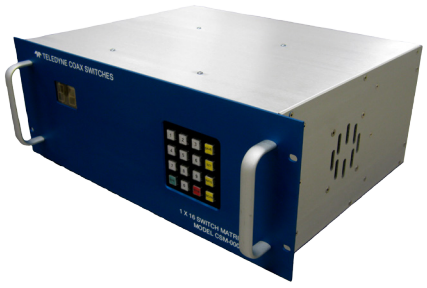
- **Local control Via Keypad**
- **TCP/IP Remote Control**
- **Internal 50Ω termination**
- **SMA Connectors**
- **90-260 Vac, 47-63Hz Power**

Switch Function
Normally Open
Switching Type
Electromechanical
Temperature
Storage: –40°C to +65°C Operating: –55°C to +85°C

RF Characteristics	
Frequency Range	2-4GHz (S-Band)
Insertion Loss	0.7dB Typical (0.8dB max)
VSWR	1.15:1 (max)
Isolation	60dB (min)
Mechanical Information	
Power Handling	1W Continuous
Line Power	Universal 90-260 VAC, 47-63Hz
Size (WxHxD)	19" Wide, 4U High, 20" Depth
Typical Cycle Life	1M cycles per RF port

MATRIX SCHEMATIC





FRONT VIEW

REAR VIEW

Example System Datasheet
4x32 MIMO Single Connection

TELEDYNE COAX SWITCHES
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Description

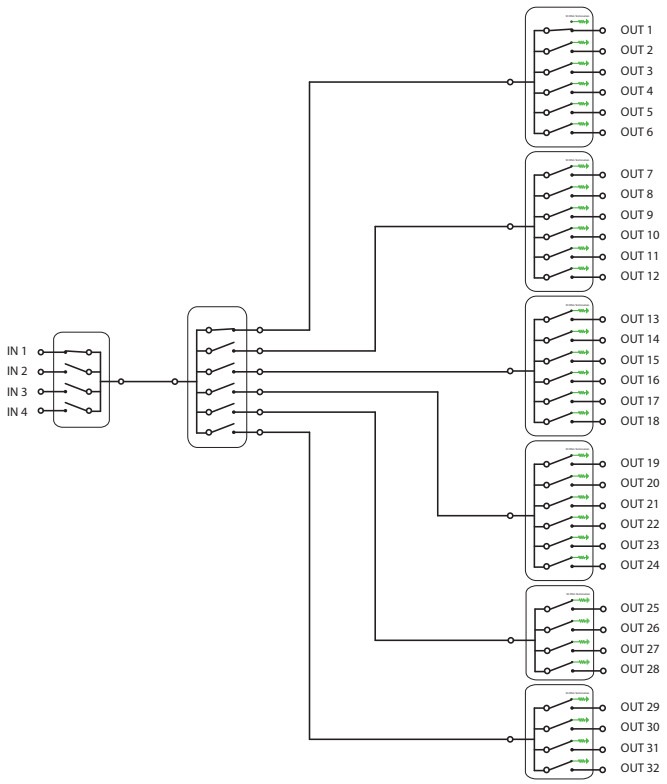
This matrix system consists of two 4x32 switching systems in a 4U standard 19" chassis. This switching system has an operating frequency range of 2-4GHz (S-Band). The output ports are internally terminated to 50Ω, controlled via USB and feature 7-segment displays which let the user know which output is currently active. There is also a local control keypad that allows users to manually command the switching system.
This matrix consist of (6) SP4T switches and (10) SP6T switches.

- **Local control Via Keypad**
- **USB Remote Control**
- **Internal 50Ω termination**
- **SMA Connectors**
- **90-260 Vac, 47-63Hz Power**

Switch Function
Normally Open
Switching Type
Electromechanical
Temperature
Storage: –40°C to +65°C Operating: –55°C to +85°C

RF Characteristics	
Frequency Range	2-4GHz (S-Band)
Insertion Loss	0.7dB Typical (0.8dB max)
VSWR	1.15:1 (max)
Isolation	60dB (min)
Mechanical Information	
Power Handling	1W Continuous
Line Power	Universal 90-260 VAC, 47-63Hz
Size (WxHxD)	19" Wide, 4U High, 20" Depth
Typical Cycle Life	1M cycles per RF port

MATRIX SCHEMATIC



REAR VIEW

FRONT VIEW

Example System Datasheet
5x3 with Transfer Switch

Description

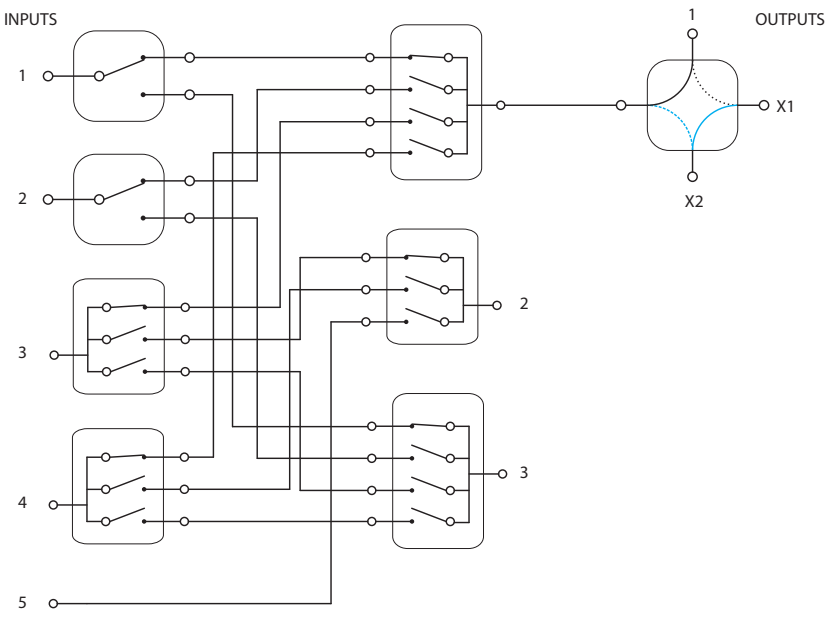
This matrix system consists of a 5x3 matrix with a bypass transfer switch in a 4U standard 19" chassis. This switching system was designed for an operating frequency range of DC-12GHz. This matrix system has unused ports unterminated, is controlled via TCP/IP or RS-232 and features 7-segment displays which lets the user know which output is currently active. There is also a local control keypad that allows users to manually command the switching system.
This matrix consists of (2) SPDT switches, (3) SP3T Switches, (2) SP4T Switches and (1) Transfer switch.

- Local control Via Keypad
- TCP/IP, RS-232 Interface
- Unterminated
- SMA & Type N Connectors
- 90-260 Vac, 47-63Hz Power

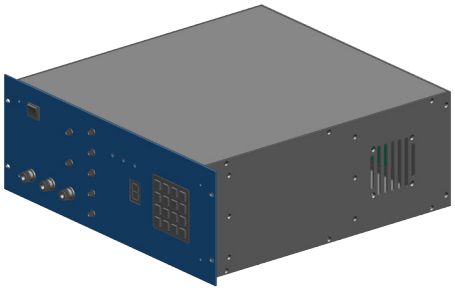
Switch Function
Normally Open
Switching Type
Electromechanical
Temperature
Storage: –40°C to +65°C Operating: –55°C to +85°C

RF Characteristics			
Frequency Range	**DC-3GHz**	**3-6GHz**	**6-12GHz**
Insertion Loss (dB)	0.5	0.7	1.2
VSWR	1.4:1	1.7:1	2.0:1
Isolation (dB)	75	75	70
Mechanical Information			
Power Handling	1W Continuous		
Line Power	Universal 90-260 VAC, 47-63Hz		
Size (WxHxD)	19", 4U, 20" Depth		
Typical Cycle Life	1M cycles per RF port		

MATRIX SCHEMATIC



FRONT VIEW



3D MODEL VIEW

Example System Datasheet
1x32 with Bypass

TELEDYNE COAX SWITCHES
Everywhereyoulook™

Description

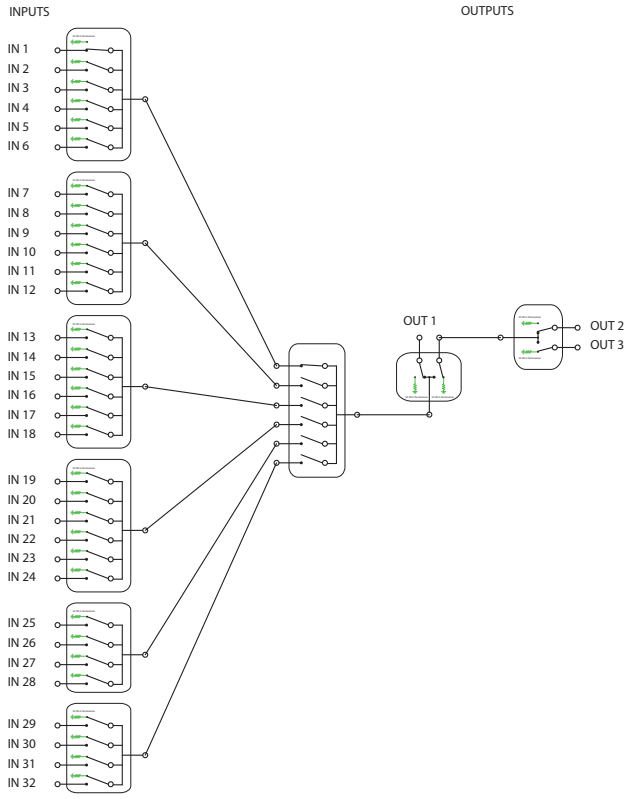
This matrix system consists of a 1x32 switching system with 2 bypass paths in a 4U standard 19" chassis. This switching system was designed for an operating frequency range of 2-4GHz (S-Band). The input and outputs are internally terminated to 50Ω, controlled via Ethernet port and feature 7-segment displays which let the user know which output is currently active. There is also a local control keypad that allows users to manually command the switching system.
This matrix consists of (4) SP6T with internal 50Ω terminated switches,(2) SP4T with internal 50Ω terminated switches, (2) SPDT with internal 50Ω terminated switches and (1) SP6T switch.

- Local control Via Keypad
- Ethernet Remote Control
- Internal 50 termination
- SMA Connectors
- 90-260 Vac, 47-63Hz Power

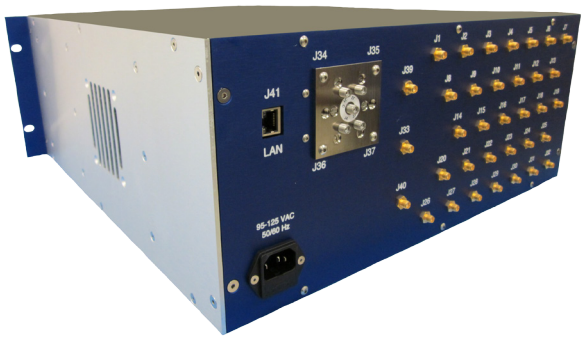
Switch Function
Normally Open
Switching Type
Electromechanical
Temperature
Storage: –40°C to +65°C Operating: –55°C to +85°C

RF Characteristics	
Frequency Range	2-4GHz (S-Band)
Insertion Loss	1.0dB Typical (2.0 dB max)
VSWR	1.15:1 (max)
Isolation	60dB (min)
Mechanical Information	
Power Handling	1W Continuous
Line Power	Universal 90-260 VAC, 47-63Hz
Size (WxHxD)	19" Wide, 4U High, 20" Depth
Typical Cycle Life	1M cycles per RF port

MATRIX SCHEMATIC



FRONT VIEW



BACK VIEW

Example System Datasheet
1x16x4 Filter Bank

Description

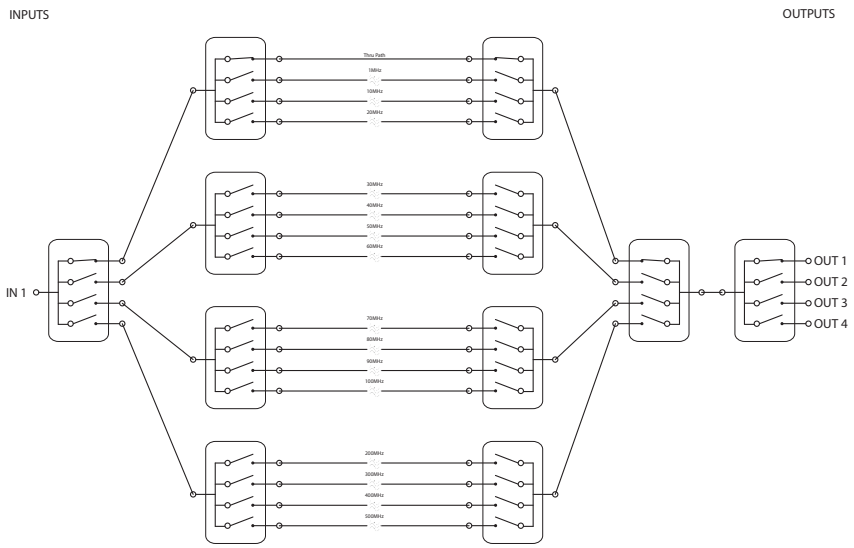
This matrix system is a custom configuration used to switch filters into 4 test paths. This switching system was design for an operating frequency range of 2-4GHz (S-Band). The pair of 1x8 matrices are internally terminated to 50Ω, controlled via USB and feature 7-segment displays which let the user know which output is currently active. There is also a local control keypad that allows users to manually command the switching system.
This matrix consists of (2) SPDT switches and (4) SP4T switches.

- Local control Via Keypad
- USB Remote Control
- Internal 50 termination
- SMA Connectors
- 90-260 Vac, 47-63Hz Power

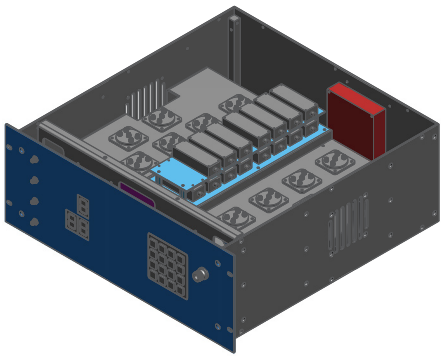
Switch Function
Normally Open
Switching Type
Electromechanical
Temperature
Storage: –40°C to +65°C Operating: –55°C to +85°C

RF Characteristics	
Frequency Range	2-4GHz (S-Band)
Insertion Loss (dB)	0.7 Typical (0.8 max)
VSWR	1.15:1 (max)
Isolation (dB)	60 (min)
Mechanical Information	
Power Handling	1W Continuous
Line Power	Universal 90-260 VAC, 47-63Hz
Size (WxHxD)	19” Wide, 4U High, 20” Depth
Typical Cycle Life	1M cycles per RF port

MATRIX SCHEMATIC



FRONT VIEW



3D MODEL VIEW

TELEDYNE COAX SWITCHES
Everywhereyoulook™

Switch Matrix Application

SWITCHING CONFIGURATION

Input Ports x Output Ports:
[ ] Inputs X [ ] Outputs

RF Port Connector Type:
[ ] K [ ] SMA [ ] TNC
[ ] N [ ] mini-SMB [ ] Other: _____

Switch Action:
[ ] Non-Latching (Normally Open)
[ ] Latching

Open Port Termination:
[ ] Yes [ ] No

Switch Load:
[ ] Carry Only
[ ] Hot Switching
If Hot Switch: Expected Pulse Width [ ]
If Hot Switch: Expected Duty Cycle [ ]

RF PERFORMANCE

Required Frequency Range:
[ ] to [ ] ; [ ] MHz [ ] GHz

Or Choose
[ ] VHF [ ] UHF [ ] L-band [ ] S-ban [ ] C-band
[ ] Other: _____

Characteristic Impedance:
[ ] 50Ω [ ] 75Ω [ ] Other: _____

Signal Power Level:
[ ] [ ] dB [ ] W [ ] dBm [ ] mW

[ ] CW [ ] Peak [ ] Avg.

Input to Output Insertion Loss (dB) (max.):
[ ] at [ ] ; [ ] MHz [ ] GHz

Return Loss (dB) or VSWR (X:1) (max.):
[ ] at [ ] ; [ ] MHz [ ] GHz

Port to Port Isolation (dB) (min.):
[ ] at [ ] ; [ ] MHz [ ] GHz

CONTROL INTERFACE

Remote Control:
[ ] PIO (TTL) [ ] RS-232 [ ] USB
[ ] Ethernet [ ] GPIB [ ] Other: _____

Local Control (Front Panel):
[ ] 4x4 Keypad [ ] Discrete Control Input Button
[ ] Other: _____

Local Display:
[ ] Alphanumeric [ ] LED Indicators
[ ] 4x24 LCD
[ ] Other: _____

OTHER REQUIREMENTS

Power Source:
[ ] Universal 90-260 VAC, 47-63 Hz
[ ] DC
[ ] Other: _____

Chassis Dimensions:
[ ] Height X [ ] Width X [ ] Depth
Or
19" Standard Rack mount [ ] U*

Standard 4U chassis height, other chassis heights available upon request.

Quantity: [ ]

Expected Delivery: [ ]

ADDITIONAL REQUIREMENTS

_____

_____

_____

CONTACT INFORMATION

Name:_____

Company:_____

Phone:_____

Email:_____

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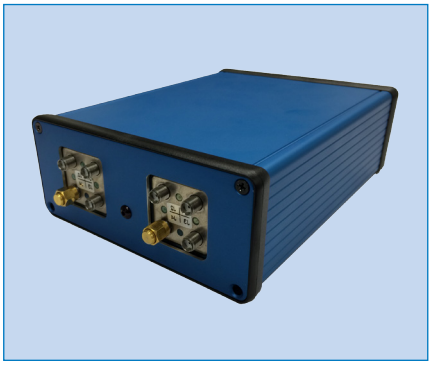
PART NUMBER DESCRIPTION

The MMA Series is an ideal solution that consists of SPDT, electromechanical coaxial switches designed to switch a microwave signal from a common input to either of two outputs. The characteristic impedance is 50 Ohms. The terminated option provides an impedance match for the unselected port.
The MMA Series is designed to allow the remote operation of 1 to 4 Single Pole Double Throw switches. Remote operation is accomplished via TCP/IP commands to the Matrix's Ethernet interface. Switch control is also accessible via the USB virtual serial port, using the provided command set. Through these interfaces the Coax Switch can be switched to the desired position and its position can be read for verification. The default switch position at power up can be set by the user. The MMA will feature a graphical user interface (GUI), which will enable user to control switches through graphical icons and visuals.



ENVIRONMENTAL AND PHYSICAL CHARACTERISTICS

Operating Temperature	–40°C to 65°C
Standard Actuator Life	5,000,000 cycles
Connector Type	SMA, 2.92mm, N, TNC, SMB
Weight Non-Terminated	
1 Switch	18 oz. (510 g) (max.)
2 Switches	20 oz. (567 g) (max.)
4 Switches	23 oz. (652 g) (max.)
Weight Terminated	
1 Switch	60 oz. (1701 g) (max.)
2 Switches	62 oz. (1758 g) (max.)
4 Switches	64 oz. (1814 g) (max.)

ELECTRICAL CHARACTERISTICS (SWITCHES ONLY)

Form Factor	SPDT, break before make
Frequency Range	Up to DC-40 GHz
Characteristic Impedance	50 Ohms, 75 Ohms (SMB only)
Operate Time	15 ms (max.)
Release Time	15 ms (max.)
Actuation Voltage	24Vdc
Actuation Current, max. @ ambient	Varies

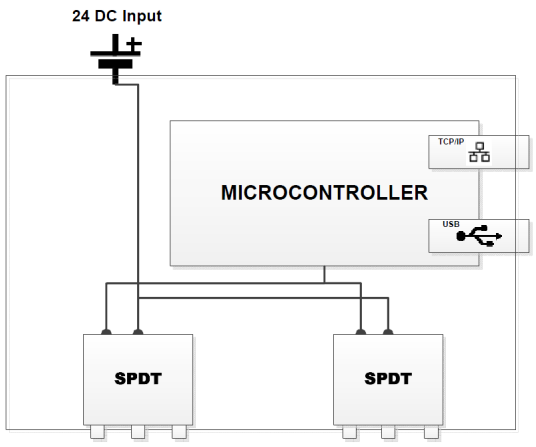
ADDITIONAL INFORMATION

Interface	USB or TCP/IP
Host Operating System	Windows, MAC, Linux
Operating System	Embedded

INCLUDED ITEMS

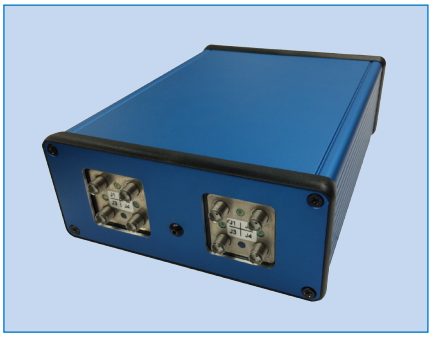
- AC/DC Power Adapter
- Power Cord
- Ethernet Cable
- USB Cable
- Installation CD

BLOCK DIAGRAM EXAMPLE



PART NUMBER	DESCRIPTION

The MMB Series is an ideal solution that consists of Transfer, electromechanical coaxial switches designed to switch a microwave signals in a DPDT configration. The characteristic impedance is 50 Ohms.
The MMB Series is designed to allow the remote operation of 1 to 4 Transfer switches. Remote operation is accomplished via TCP/IP commands to the Matrix's Ethernet interface. Switch control is also accessible via the USB virtual serial port, using the provided command set. Through these interfaces the Coax Switch can be switched to the desired position and its position can be read for verification. The default switch position at power up can be set by the user. The MMB will feature a graphical user interface (GUI), which will enable user to control switches through graphical icons and visuals.



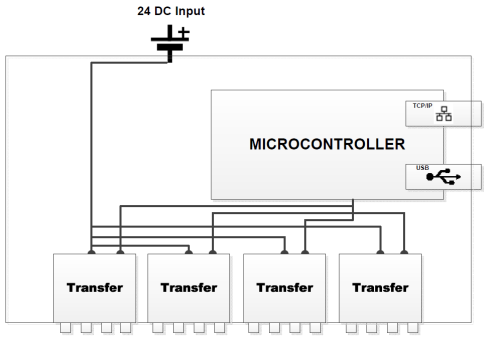
ENVIRONMENTAL AND PHYSICAL CHARACTERISTICS	
Operating Temperature	–40°C to 65°C
Standard Actuator Life	5,000,000 cycles
Connector Type	SMA, N, TNC
Weight Enclosure A - SMA Models 1 Switch 2 Switches	 22 oz. (624 g) (max.) 24 oz. (680 g) (max.)
Weight Enclosure B - SMA Models 2 Switches (N or TNC) 4 Switches	 72 oz. (2041 g) (max.) 64 oz. (1814 g) (max.)

ELECTRICAL CHARACTERISTICS (SWITCHES ONLY)	
Form Factor	DPDT, break before make
Frequency Range	Up to DC-26.5GHz
Characteristic Impedance	50 Ohms
Operate Time	15 ms (max.)
Release Time	15 ms (max.)
Actuation Voltage	24Vdc
Actuation Current, max. @ ambient	Varies

ADDITIONAL INFORMATION	
Interface	USB or TCP/IP
Host Operating System	Windows, MAC, Linux
Operating System	Embedded

INCLUDED ITEMS	
• AC/DC Power Adapter	• USB Cable
• Power Cord	• Installation CD
• Ethernet Cable	

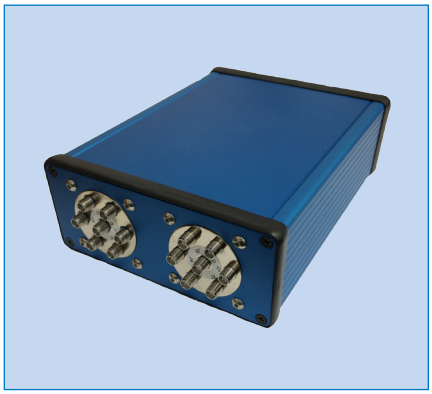
BLOCK DIAGRAM EXAMPLE



PART NUMBER DESCRIPTION

The MMC Series is an ideal solution that consists of multi-throw, electromechanical coaxial switches designed to switch a microwave signal from a common input to any of 3, 4, 5, 6, 7 or 8 outputs. The characteristic impedance is 50 Ohms. With the normally open actuator, all paths are open when the switch is de-energized.

The MMC Series is designed to allow the remote operation of 1 to 2 Single Pole Multi Throw switches. Remote operation is accomplished via TCP/IP commands to the Matrix's Ethernet interface. Switch control is also accessible via the USB virtual serial port, using the provided command set. Through these interfaces the Coax Switch can be switched to the desired position and its position can be read for verification. The default switch position at power up can be set by the user. The MMC will feature a graphical user interface (GUI), which will enable user to control switches through graphical icons and visuals.



ENVIRONMENTAL AND PHYSICAL CHARACTERISTICS

Operating Temperature	–40°C to 65°C
Standard Actuator Life	5,000,000 cycles
Connector Type	SMA, 2.9mm
Weight Non-Terminated	
1 Switch	26 oz. (737 g) (max.)
2 Switches	32 oz. (907 g) (max.)
Weight Terminated	
1 Switch	54 oz. (1531 g) (max.)
2 Switches	60 oz. (1701 g) (max.)

ELECTRICAL CHARACTERISTICS (SWITCHES ONLY)

Form Factor	Multi-Throw, break before make
Frequency Range	Up to DC-40 GHz
Characteristic Impedance	50 Ohms
Operate Time	15 ms (max.)
Release Time	15 ms (max.)
Actuation Voltage Available	24 Vdc
Actuation Current, max. @ ambient	170mA/switch

TYPICAL RF CHARACTERISTICS

Frequency	DC–6 GHz	6–12 GHz	12–18 GHz	18–26.5 GHz	26.5–34 GHz* (40 Option)	34-40 GHz* (40 Option)
Insertion Loss, dB, typ.	0.20	0.40	0.50	0.90	1.00	1.50
Isolation, dB, typ..	70	60	60	50	50	50
VSWR , typ.	1.25:1	1.40:1	1.50:1	1.80:1	1.90:1	2.00:1

For specific RF performance data please refer to Coax Switch Part number list in Glossary (page 5)

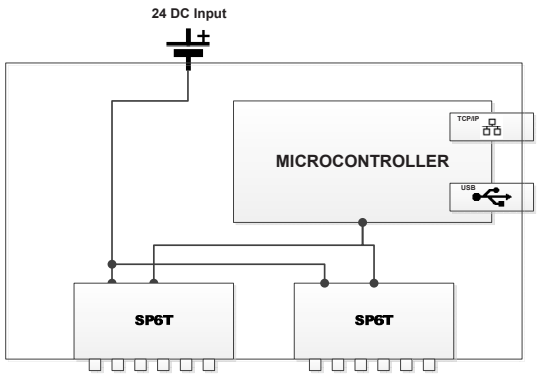
ADDITIONAL INFORMATION

Interface	USB or TCP/IP
Host Operating System	Windows, MAC, Linux
Operating System	Embedded

INCLUDED ITEMS

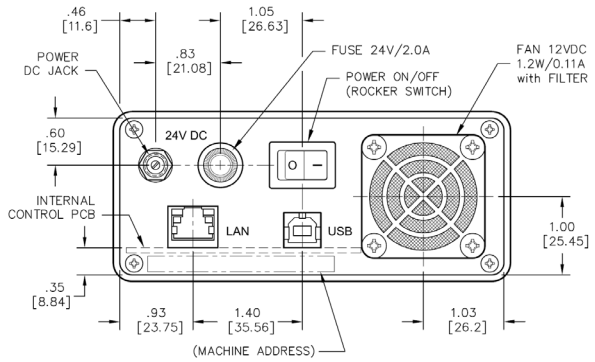
- AC/DC Power Adapter
- Power Cord
- Ethernet Cable
- USB Cable
- Installation CD

BLOCK DIAGRAM EXAMPLE

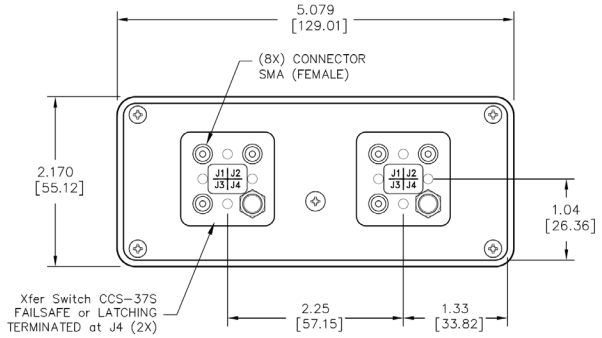


MECHANICAL OUTLINE FOR ENCLOSURE A

MMA: Up to 4 Non-Terminated SPDT Switches
Up to 2 Terminated SPDT Switches
Up to 1 Non-Terminated N/TNC SPDT Switches
MMB: Up to 2 Transfer/2P3T Switches
MMC: Up to 2 Non-Terminated Failsafe SP6T Multi-Throw Switches



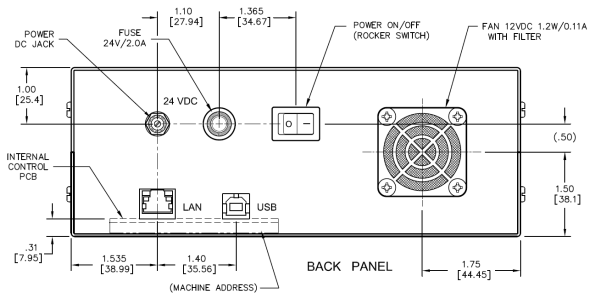
ENCLOSURE A BACK VIEW



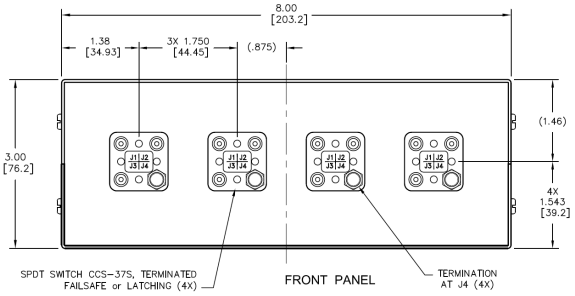
ENCLOSURE A FRONT VIEW

MECHANICAL OUTLINE FOR ENCLOSURE B

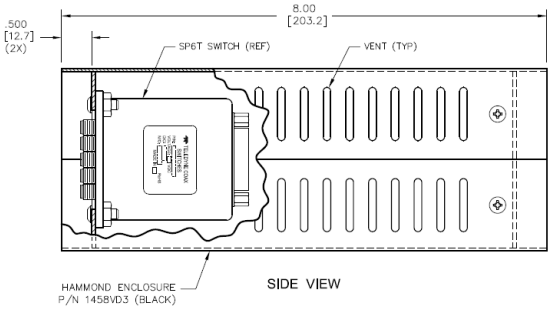
MMA: Up to 4 Terminated SPDT Switches
Up to 4 Non-Terminated N/TNC SPDT Switches
MMB: Up to 4 Transfer/2P3T Switches
MMC: Up to 2 Non-Terminated Latching SP6T Multi-Throw Switches or
Up to 2 Terminated SP6T Multi-Throw Switches or
Up to 2 Non-Terminated/Terminated Failsafe SP7T-SP8T Multi-Throw Switches



ENCLOSURE B BACK VIEW



ENCLOSURE B FRONT VIEW



ENCLOSURE B SIDE VIEW

*** Dimensions Shown in inches(millimeters)**

TELEDYNE COAX SWITCHES
Everywhereyoulook™

Mini Matrix Application

MMA SERIES (SPDT)

Number of Switches (Select One):
[ ] 1
[ ] 2
[ ] 4

Termination:
[ ] Yes [ ] No

Actuation Type:
[ ] Failsafe [ ] Latching

Connector:
[ ] SMA (DC-18GHz) [ ] SMA (DC-26.5GHz)
[ ] SMB (DC-3GHz) [ ] N (DC-12GHz)
[ ] TNC (DC-11GHz) [ ] K (DC-33GHz)
[ ] K (DC-40GHz)

Remote Control:
[ ] USB Only [ ] USB & Ethernet

MMB SERIES (TRANSFER & 2P3T)

Number of Switches (Select One):
[ ] 1
[ ] 2
[ ] 4

Termination:
[ ] Yes [ ] No

Actuation Type:
[ ] Failsafe [ ] Latching

Connector:
[ ] SMA (DC-18GHz) [ ] SMA (DC-26.5GHz)
[ ] N (DC-12GHz) [ ] TNC (DC-11GHz)
[ ] K (DC-40GHz)

Remote Control:
[ ] USB Only [ ] USB & Ethernet

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MMC (MULTI-THROW)

Number of Switches (Select One):
[ ] 1
[ ] 2

Number of Throws:
[ ] SP3T [ ] SP4T
[ ] SP5T [ ] SP6T
[ ] SP7T [ ] SP8T

Termination:
[ ] Yes [ ] No

Actuation Type:
[ ] Failsafe [ ] Latching

Connector:
[ ] SMA (DC-18GHz) [ ] SMA (DC-26.5GHz)
[ ] K (DC-40GHz)

Remote Control:
[ ] USB Only [ ] USB & Ethernet

ADDITIONAL REQUIREMENTS

_____

_____

_____

CONTACT INFORMATION

Name:_____

Company:_____

Phone:_____

Email:_____

Glossary

Attenuator
A ressitive network that provides reduction of the amplitude of an electrical signal without introducing phase or frequency distortion.

Electromagnetic Interference (EMI)
Eletromagnetic phenomena which, either directly or indirectly, can contribute to a degradation in performance of an electronic receiver or system.

Ethernet
A high-speed interface used in local area networks (LAN). Ethernet is also known as IEEE 802.3 standard.

Failsafe
A failsafe switch reverts to the default or failsafe position when the actuating voltage is removed. This is realized by a return spring within the drive mechanism. This type of switch requires the continuous application of operating voltage to select and hold any position. (Multi-position switches are normally open with no voltage applied).

Filter
A selective network comprised of capacitors, inductors and/ or resistors which passes a specific band of frequencies and attenuates the out-of-band frequencies.

General Purpose Interface Bus (GPIB)
An 8-bit wide digital interface desgined to interconnect with equipment such as PCs and ATE. GPIB is also known as IEEE-488, unlike Ethernet, GPIB cannot be connected to a network.

Latching
A latching switch remains in the selected position whether or not voltage is maintained. This can be accomplished with either a magnetic or mechanical latching mechanism.

Insertion Loss Repeatability
The variance in insertion loss that describes how nearly a measured value value is repeated on susequent actuations of a switch. It is usually expressed by the maximum deviation from the mean of all measurements used for characterization.

Internal Termination
Unselected ports are connected internally to a matched load. The load is a 50-Ohm resistive device. The max RF power rating is 2 watts CW. Without the internal termination option, the unselected ports are open circuits.

Isolation
Isolation is the measure of the power level at the output connector of an unconnected RF channel as referenced to the power at the input connector. It is specified in dB below the input power level.

Multi-Throw Switch
A multi-throw switch is a switch with one input and three or more output ports. The CCT-58 can switch a microwave signal to any of 2, 3, 4, 5 or 6 outputs from a single common input.

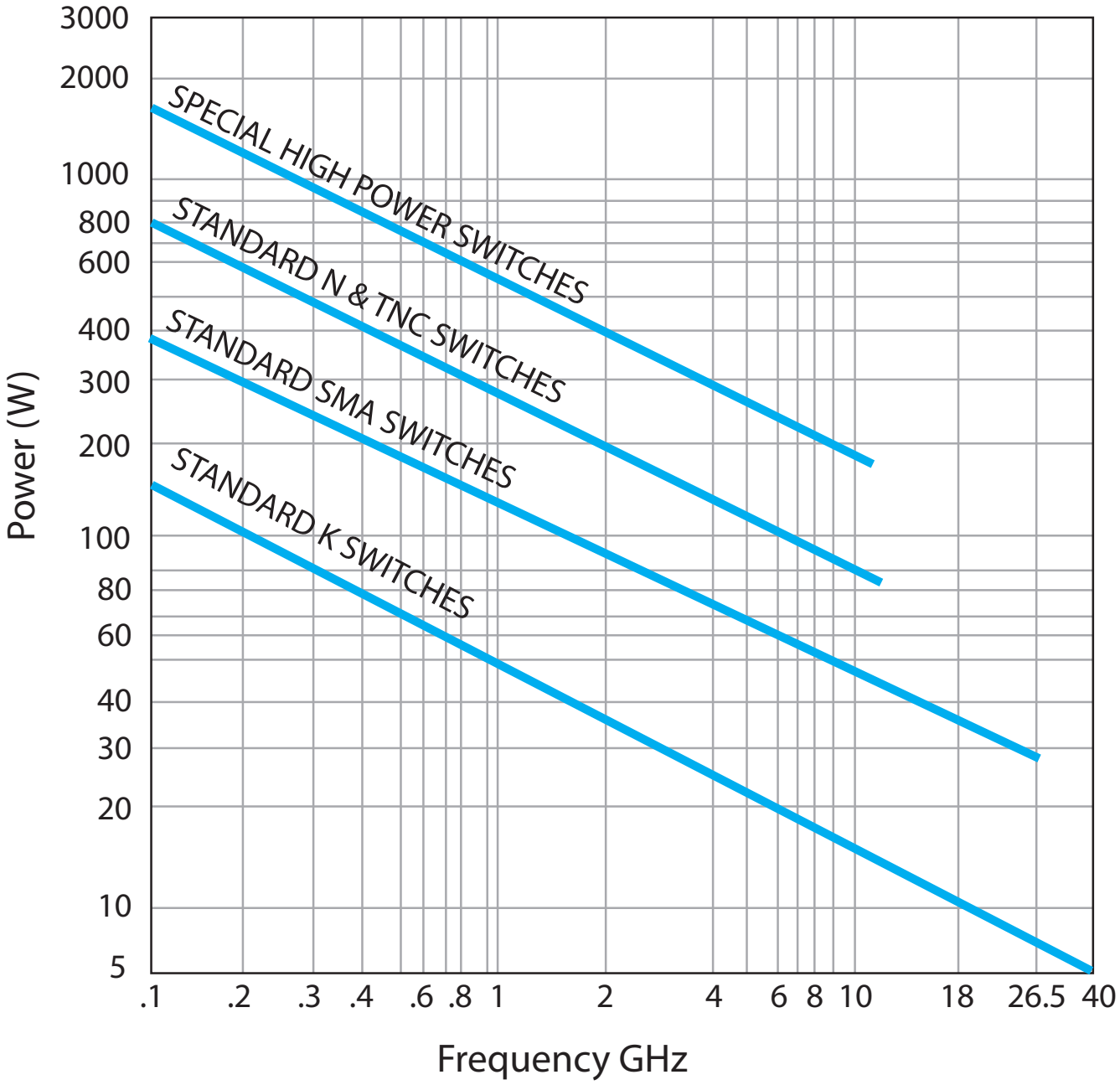
SPDT Switch
A single-pole double-throw switch has one input and two output ports.

RS-232
A standardized serial port for connecting a computer to peripheral equipment.

Transfer Switch
A four-port switch consisting of two independent pairs of RF paths. These pairs are actuated simultaneously. This actuation is similar to that of a double-pole double-throw switch. See application notes for typical usage.

Universal Serial Bus (USB)
An industry standard that defines the cables, connectors and communication protocols used in a bus for connection, communication and power supply between computers and electronic devices.

Power Handling vs Frequency Chart



Estimates based on the following reference conditions:

- Ambient temperature of 40°C or less
- Sea level operation
- Load VSWR of 1.20:1 maximum
- No high-power (hot) switching

Please contact Teledyne Coax Switches for derating factors when applications do not meet the foregoing reference conditions.

Series InP1012

SPDT DC-60GHz Active RF Switch
Signal Integrity Beyond 40Gbps

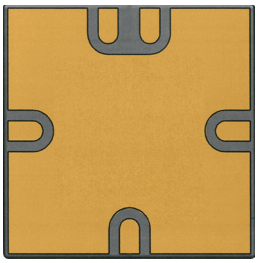
Description

The InP1012 Series is a highly compact, reflective SPDT Active RF switch, manufactured using Teledyne's high speed, low-loss InP HEMT process. The swtich die is packaged in a low-loss, surface mount package, with a small form factor: 3mm(L) x 3mm(W) x 1mm(H). It supports a wide frequency range from DC to 60GHz, and delivers low insertion loss, fast switching time, and good isolation-making this switch ideal for test and measurment, microwave communications, and radar applications. The unique contruction features and manufacturing techniques provide excellent robustness to environmental extremes and overall high reliability

Features

- High digital bandwidth, greater than 40Gbps
- Very high linearity
- Low insertion loss
- Very fast switching time of less than 100ns
- Radiation tolerant up to 100 krads

Frequency Range
DC -60GHz
Bit Rate
40+ Gbps
Operate Time
60-100ns
Enclosure
Low-Loss Surface Mount Package
Dimensions
3mm (L) x 3mm (W) x 1mm (H)
Temperature
Storage: –65°C to +125°C Operating: –65°C to +125°C

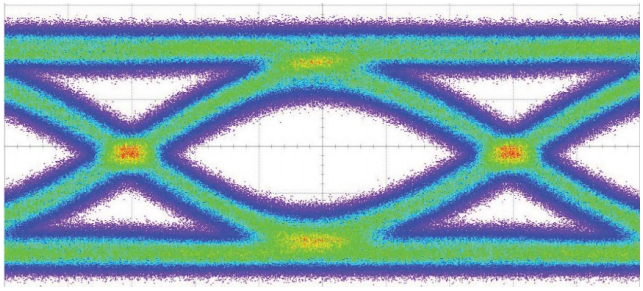


InP1012

** Also available in Die form **

Part No.	Typical RF Performance			
	Frequency	Insertion Loss (dB)	Isolation (dB)	Return Loss (dB)
	DC (20mV-200mV)	2.0	---	---
	10KHz	0.9	67	---
	100MHz	1.2	60	23
	6GHz	1.6	37	21
	14GHz	2.0	30	21
	20GHz	2.3	27	23
	30GHz	2.6	24	26
	40GHz	2.9	21	25
	50GHz	3.3	19	25
	60GHz	3.7	17	16

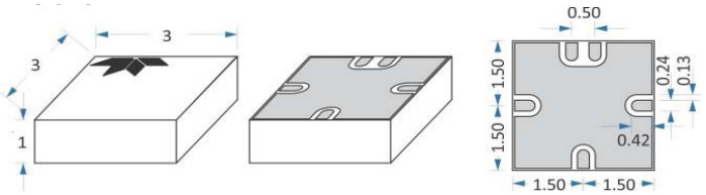
TYPICAL SIGNAL INTEGRITY CHARACTERISTICS @ 40 Gbps

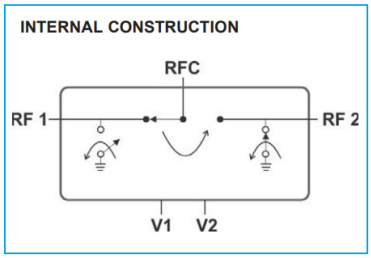


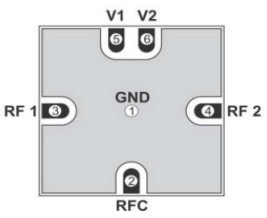
PATTERN GENERATOR SETTINGS

- 2^{31}-1 PRBS signal
- 40Gbps data rate
- Data amplitude of 500mVpp

OUTLINE DIMENSIONS







Series RF121 / GRF121

SPDT Magnetic-Latching
Up to DC-18GHz RF Relay
Signal Integreity up to 40Gbps

TELEDYNE RELAYS
Everywhereyoulook™

Series GRF121 Electromechanical Relays

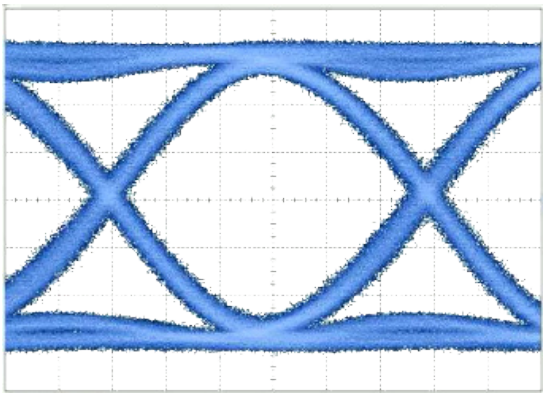
The ultraminiature GRF121 relay is designed to provide a practical surface-mount switching solution with RF performance and repeatability to 18GHz. The GRF121 improves on Teledyne Relays' heritage of miniature RF relays by incorporating a precision trasmission line structure in the internal construction of the contact system. GRF121 relays feature a unique ground shield to facilitate surface mounting and to extend the frequency range when compared to through-hole solutions.

- Broader bandwidth (DC - 18GHz)
- Excellent Signal integrity up to 40Gbps
- Hermetically Sealed
- High Resistance to ESD
- Metal Enclosure for EMI shielding
- High Repeatability
- 3 Million Cycle Life

Relay Type
SPDT Magnetic-Latching
Frequency Range
RF121 = DC - 12 GHz GRF121 = DC - 18 GHz
Bit Rate
RF121 = 20 Gbps GRF121 = 40 Gbps
Mounting
RF = Thru-hole GRF = Surface-Mount (Stub)
Available Coil Voltages
5V: Coil Resistance (Ω) = 61 12V: Coil Resistance (Ω) = 500
Temperature
Storage: –65°C to +125°C Operating: –55°C to +85°C

Part No.	Typical RF Performance			
	Frequency (GHz)	VSWR (max)	Isolation (dB)	Insertion Loss (dB) (max)
 **RF121**	DC - 4	1.3 : 1	55	0.25
	4 - 8	1.50 : 1	50	0.45
	8 - 12	2.0 : 1	40	1.35
 **GRF121**	DC - 4	1.1 : 1	65	0.2
	4 - 8	1.20 : 1	50	0.2
	8 - 12	1.35 : 1	40	0.5
	12 - 16	2.0 : 1	30	0.95
	16 - 18	2.3 : 1	30	1.1

RF121 : 20 Gbps

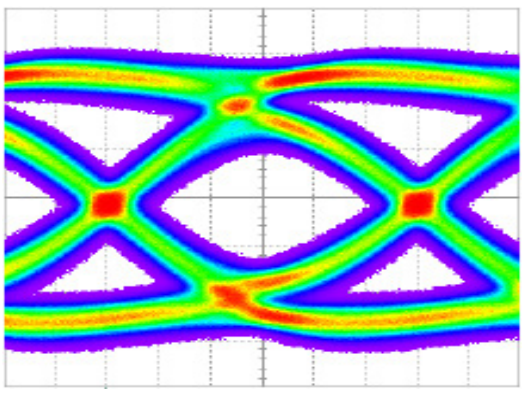


Bit Rate	Eye Height	Eye Width	$Jitter_{P-P}$
20 Gbps	360 mV	40.3 ps	6.93 ps

PATTERN GENERATOR SETTINGS

- 20 Gbps Random Pulse Pattern Generator
- 2^{31} - 1 PRBS signal
- PRBS output of 500 mV_{P-P} (nominal)
- RF PCB effect (negligible) not removed from measurement
- Data shown is typical of both contacts

GRF121 : 40 Gbps



Bit Rate	Eye Height	Eye Width	$Jitter_{P-P}$
40 Gbps	95 mV	13.34 ps	8.73 ps

PATTERN GENERATOR SETTINGS

- 40 Gbps Random Pulse Pattern Generator
- 2^{31} - 1 PRBS signal
- PRBS output of 500 mV_{P-P} (nominal)
- RF PCB effect (negligible) not removed from measurement
- Data shown is typical of both poles

Teledyne has over 50 years of experience in developing a wide spectrum of custom solutions.

Experienced in Custom Hybrid Solutions

Teledyne Relays is a leading manufacturer with the capability of providing build-to-print solutions on hybrid microcircuits devices. Our current products portfolio includes solid state power controllers, DC/DC converters, high current drivers, digital-analog converters, activator control hybrids, deflection amplifiers, base drivers, custom designed multi-layers thick-film/thin film substrates and many more...

With over 50 years of heritage in serving the space, aerospace, and defense markets, Teledyne continues to uphold the same standards and commitment to excellence. Our optimized solutions are supported by teams of engineers and manufacturing personnel with wide ranging experiences in developing products deployed in highly demanding applications, such as electrical power systems, radar receivers, and stores management solutions, for ground or aerial defense platforms.

Teledyne is accredited by Defense Logistics Agency (DLA) in accordance with MIL-PRF-38534, Class H and Class G Qualified Manufacturers List (QML). Since 2014 Teledyne has successfully launched over twenty hybrids into production for our customers. We welcome opportunities to partner with our customers to provide customized solutions to your hybrid needs. Our typical custom solution development cycle is as follows:

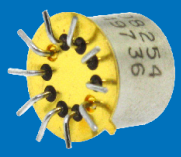
TELEDYNE RELAYS
Everywhereyoulook™

Did you know...

Teledyne Relays offers electromechanical relays for various markets?

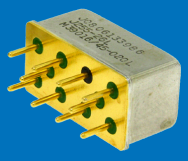
RF RELAYS

- *Signal Integrity up to 40Gbps*
- *DC - 18GHz*
- *Surface-Mount*
- *DPDT, SPDT, 4PST and Loopback Relays*

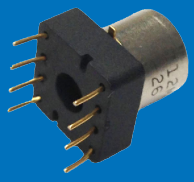
MILITARY GRADE RELAYS

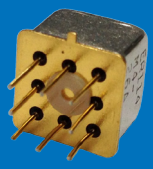
- *Built and tested to meet MIL-PRF-39016*
- *Built and tested to meet MIL-PRF-28776*
- *Built-in Diodes, Transistor Driver and CMOS*
- *Low Power coils*



TELEDYNE ESTABLISHED RELIABILITY RELAYS

- *Fully defined product requirements and screening levels*
- *Spacer/Spreader pad options not allowed by military specifications*
- *Reduced lead time and cost vs Military Grade*





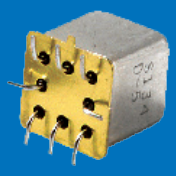
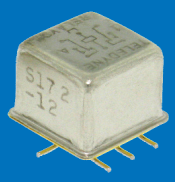
HIGH PERFORMANCE RELAYS

- *-65 °C to +200 °C*
- *Shock up to 4,000 g's*
- *Vibration up to 380 g's*
- *Non-Latching & Magnetic-Latching*



COMMERCIAL RELAYS

- *Standard electrical tests at 25 °C*
- *"Low cost" switching solutions*
- *Surface-Mount*
- *Short lead times*


TELEDYNE RELAYS
Everywhereyoulook™

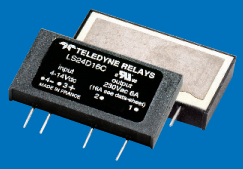
Did you know...

Teledyne Relays offers Commercial/Industrial Solid State Relays?

SINGLE PHASE AC SOLID STATE RELAYS

- *Up to 690Vac, 125A*
- *Input & Output Protection*
- *Chassis, DIN Rail and PCB Mount*
- *Zero-Cross & Random Switching*
- *Touch-Proof Covers*



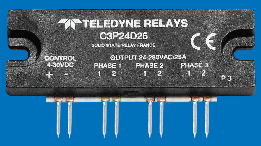


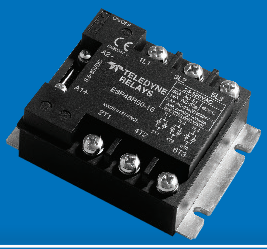
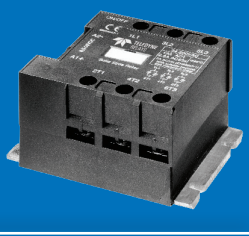
DUAL-PHASE AC SOLID STATE RELAYS

- *Up to 600Vac, 50A*
- *Output Protection*
- *Chassis and DIN Rail*
- *Zero-Cross & Random Switching*
- *Touch-Proof Covers*

3 & 4 PHASE SOLID STATE RELAYS

- *Up to 600Vac, 75A*
- *Output Protection*
- *Chassis and DIN Rail*
- *Zero-Cross & Random Switching*
- *DC & AC Control*

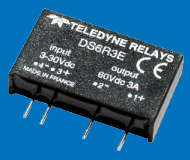


DC SOLID STATE RELAYS

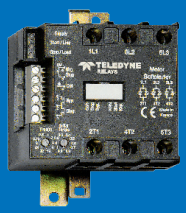
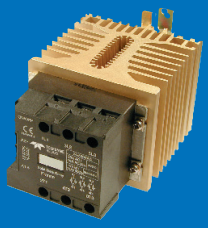
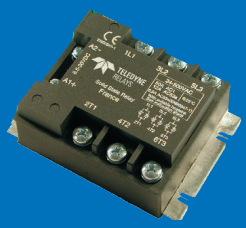
- *Up to 1400Vdc, 100A*
- *Output Protection*
- *Chassis, DIN Rail and PCB Mount*
- *IGBT and MOSFET*
- *Touch-Proof Covers*





SOFT START MOTOR CONTROLLERS AND MOTOR REVERSERS

- *Up to 26kW, 480Vac*
- *Star & Delta Configurations*
- *DIN Rail*
- *Output Protection*
- *Built-in Diagnostics and Self Test*

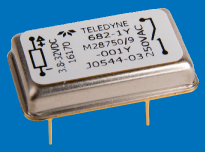
Did you know...

TELEDYNE RELAYS
Everywhereyoulook™

Teledyne Relays offers Military Solid State Relays?

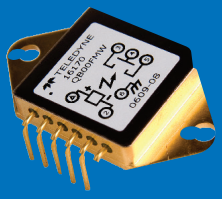
DC SOLID STATE RELAYS

- *Meet MIL-PRF-28750*
- *Tested Per MIL-STD-704*
- *Silicon Carbide MOSFET*
- *Up to 250Vdc, 1A*
- *Chassis and PCB Mount*
- *Short-Circuit Protection*
- *Plastic and Hermetically Sealed*



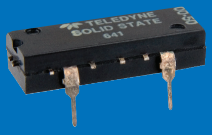
BI-DIRECTIONAL/AC SOLID STATE RELAYS

- *Meet MIL-PRF-28750*
- *Tested Per MIL-STD-704*
- *Up to 250Vac, 25A*
- *Chassis and PCB Mount*
- *Short-Circuit Protection*
- *Plastic and Hermetically Sealed*



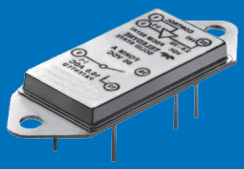
COMMERCIAL, LOW POWER, I/O MODULES

- *Up to 250Vac, 10A*
- *Short-Circuit Protection*
- *Chassis and PCB Mount*
- *Zero-Cross & Random Switching*
- *Low Off-State Leakage Current*

SILICON CARBIDE TECHNOLOGY

- *Up to 270Vdc, 20 A*
- *Meet MIL-PRF-28750*
- *Tested Per MIL-STD-704*
- *Low ON resistance*
- *Low Profile Hermetic Package*
- *Options: Trip Status, Switch Status*
- *Short Circuit Protection*



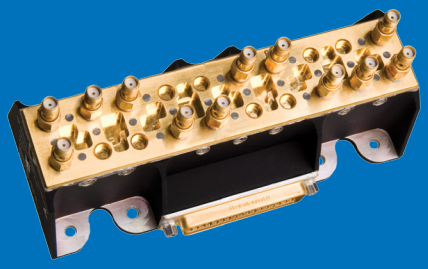
Did you know...

TELEDYNE RELAYS Everywhereyoulook™

Teledyne Relays offers Space Qualified Switches?

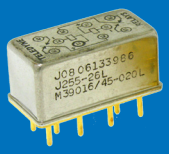
SPACE MARKET SEGMENTS SERVED

- *Deep-Space Probes*
- *Manned Programs*
- *Communications Satellites*
- *Launch Vehicles*
- *Earth Observatory / Weather Satellites*
- *Commercial / Military Satellites*



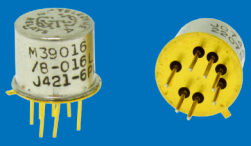
CAPABILITIES

- *Logistic Infrastructure*
- *Chemical Analysis Lab*
- *Scanning Electro Microscope*
- *In-house Plating Shop*
- *Enviroment Test Lab*
- *Field Technical Support*



ELECTROMECHANICAL RELAY SPECIFICATIONS

- *MIL-PRF-39016*
- *MIL-PRF-28776*
- *NASA/GSFC S-311-P-754*
- *NASA EEE-INST-002*
- *ESA/SCC 3601 & 3602*



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