EUROTHERM® FLEXIBLE SOLUTIONS

Thyristors

A SELECTION GUIDE

...the control of power

invensys®
EUROTHERM®

Excellence in control and data management

Eurotherm® is recognised worldwide for the excellence of its control and data management products. Temperature and process controllers are extensively used throughout manufacturing industry, process industries and scientific research.

Complete product range

For the control of electrical heating or other switching applications, Eurotherm has a range of thyristor units to suit every need. Whether the load is constant or variable resistance, inductive or transformer coupled, single or three phase, we have thyristors to meet your exact requirements. Our standard range will cater for currents up to 1500 amps but by using separate driver and power units, this range can be extended up to several thousand amps.

Choice of optimum firing mode

Thyristors can deliver power in long or short bursts - even down to one cycle of the supply voltage - in order to match the load and heater requirements exactly. Alternatively, phase angle firing can be used for inductive or transformer coupled loads or applications where current limitation is required. This tight control of delivered power gives better temperature control which results in improved product quality. Additionally, the thyristor's ability to switch rapidly reduces the thermo-mechanical stresses on the heater elements, resulting in less downtime and lower maintenance costs.

Digital communications

Adding digital communications to thyristor units introduces further sophistication into process management. This enables digital accuracy in downloading setpoints and is ideal for large, multi-zone installations. The need for calibration of analogue signals is eliminated and wiring is reduced since only a single digital link is needed to connect all zones to a central programmer. Digital communications also provides logging of process parameters, energy consumption, abnormal conditions, faults and alarms.

How to use this selection guide

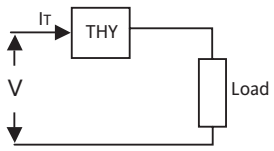
This Thyristor Selection Guide enables the correct thyristor unit to be chosen to match your requirements:

1. If you know what type of load you are using, then section headed "Load types" will provide a route to selecting a thyristor to suit that load.
2. If you know the features that you require of a thyristor, the "Thyristor features guide" section will allow you to select the thyristor with the appropriate characteristics.
3. The intermediate pages give additional information about the thyristors in relation to the specific load types.
4. On this page you will find the formulae required to calculate the thyristor currents for resistive loads.

Thyristor current calculations

The formulae below provide a simple way to calculate the thyristor current (IT) for various resistive loads. The calculated value of IT should then be multiplied by 1.2 to allow for variations in supply voltage and manufacturing tolerances of the load.

Single Phase

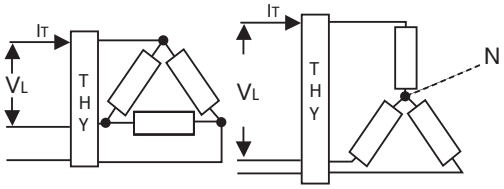


Thyristor current (IT) = $\frac{\text{WATTS}}{\text{V}}$

Example: A 3kW load across 230 volts
IT = $\frac{3000}{230}$ = 13 A

Applying safety factor, current = 13 x 1.2 = 16 A
A 16 A, 230 volt thyristor unit can be used.

Three Phase (3 or 4 wire load)



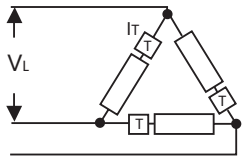
Thyristor current (IT) = $\frac{\text{WATTS}}{1.732 \times \text{VL}}$

Example: A 60 kW load across 415V, 3 phase supply
IT = $\frac{60{,}000}{1.732 \times 415}$ = 83 A

Applying safety factor, current = 83 x 1.2 = 100 A
A 100 A, 415 volt three phase thyristor can be used.

HINT: If voltage = 415 volts, just multiply the number of kW by 1.4 to get IT. E.g. In above example IT = 60 x 1.4 = 84 A or multiply by 1.7 to include a 20% safety factor.

Three Phase (6 wire open delta)

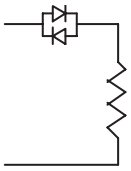


(IT) = $\frac{\text{WATTS}}{3 \times \text{VL}}$

Example: A 100 kW load with 415V, 3 phase supply
IT = $\frac{100{,}000}{3 \times 415}$ = 80 A

Applying safety factor, current = 80 x 1.2 = 96 A
A 100 A, 415 volt three phase thyristor can be used.

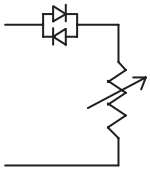
LOAD TYPES



Resistive elements whose ohmic value does not change greatly over their temperature range

(Low temperature coefficient of resistance) e.g. Austentic alloys (NiCr, NiCrFe). Example trade name Nikrothal. Typical resistance change 7%

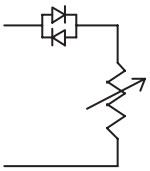
Go to Constant Load Resistance



Resistive elements whose ohmic value changes with temperature *(Especially elements with large positive temperature coefficient of Resistance) e.g. Tungsten (W), Molybdenum (Mo) or Molybdenum disilicide ($MoSi_2$).*

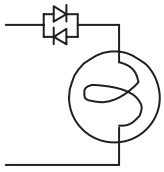
Trade name for latter is Kanthal Super. Resistance change 20:1

Go to Variable Load Resistance



Resistive elements whose ohmic value changes with time *(They may also have a temperature change of resistance) e.g. Silicon Carbide. Example trade name is Hot Rod. Typical resistance increase of 2 to 4 tmes with time (and temperature).*

Go to Variable Load Resistance



Infrared Heaters

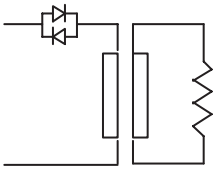
This will be dependent on the wave length of the headers

Long Wave
(>1.5µm) (and most Medium)

Go to Constant Load Resistance

Short Wave
(>1.5µm) (and some Medium)

Go to Variable Load Resistance



Resistive elements which are connected via a transformer

Go to Variable Load Resistance

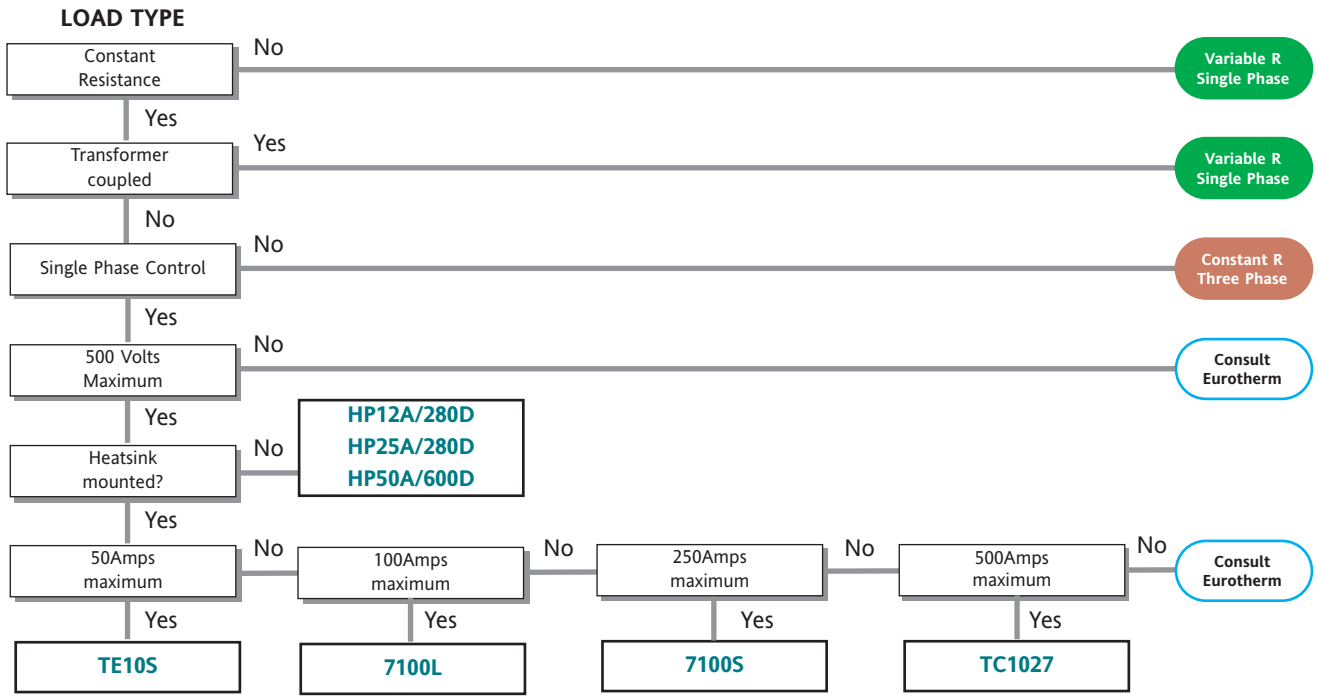
?

Load characteristics unknown

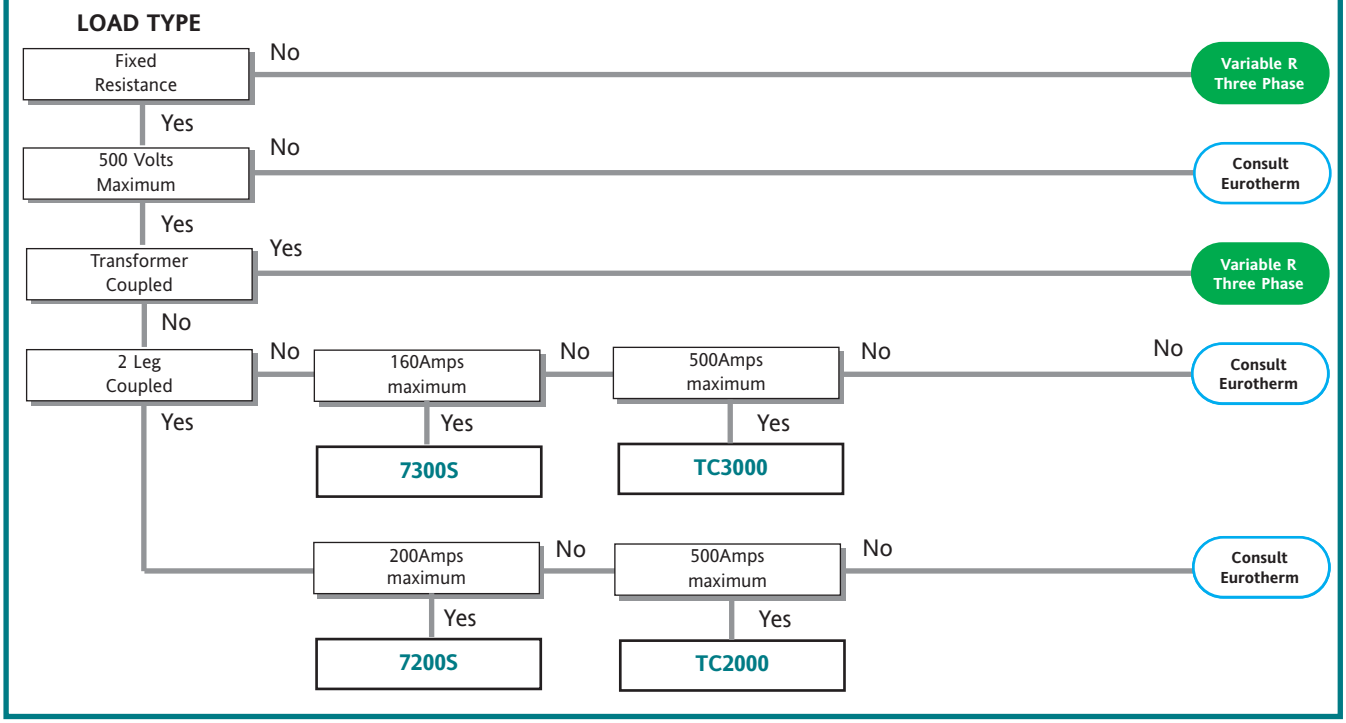
Contact Eurotherm

Thyristor selection chart for Constant Resistance Loads

Single Phase Constant Resistance Loads

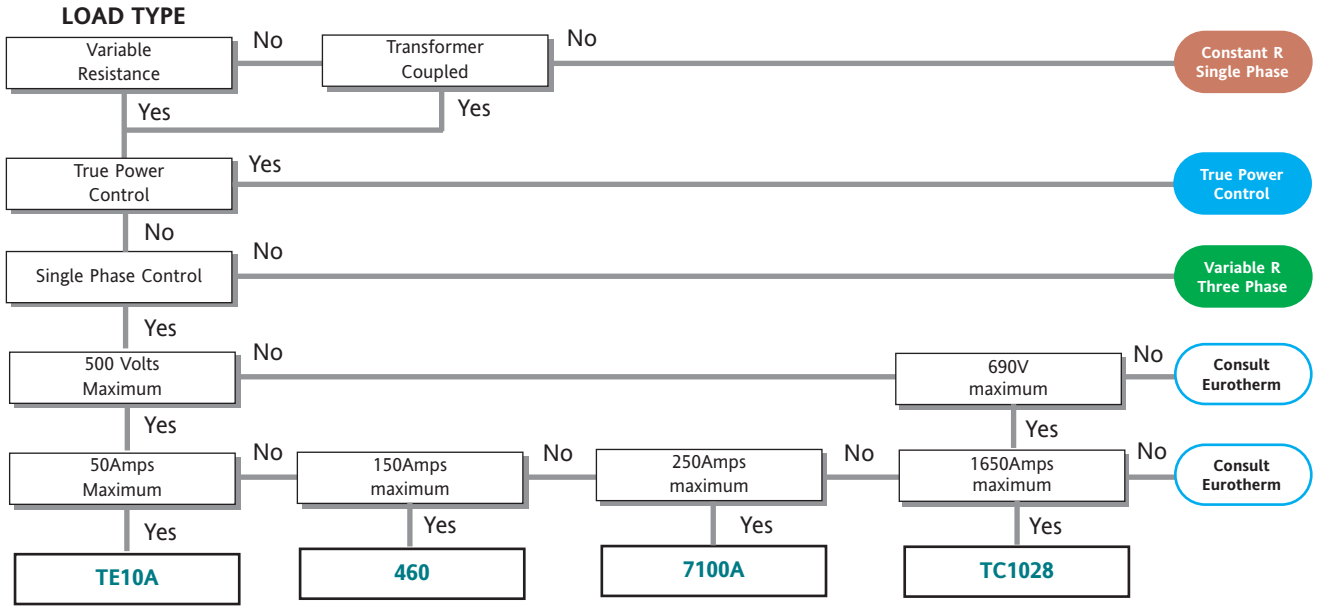


Three Phase Constant Resistance Loads

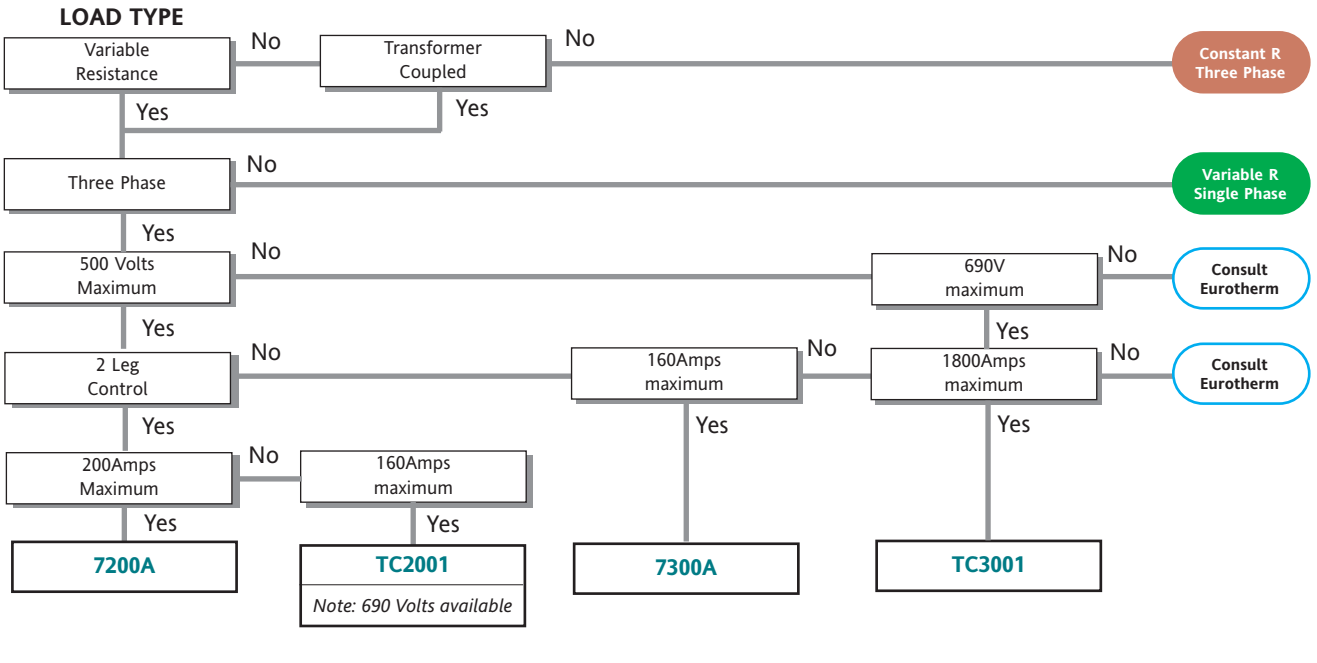


Thyristor selection chart for Variable Resistance Loads

Single Phase Variable Resistance Loads



Three Phase Variable Resistance Loads



Solid State Relays

The Eurotherm range of solid state relays can drive resistive heating elements from a few watts up to hundreds of kW. Models are available to take AC and DC logic signals as well as analogue inputs. These products are ideal for:-

- SWIR heaters
- Thermo-forming
- Ovens
- Plastic extrusion
- Plastic moulding
- Packaging
- Laboratory furnaces
- Electrical heating
- HVAC

CONSTANT RESISTANCE LOADS

HP Series

Zero crossing 'Hockey puck' style
DC logic input
Indicator LED

CONSTANT RESISTANCE LOADS

7100L

Economical 'fixed build' units
AC/DC logic input
Current ratings up to 100 A
DIN rail or bulkhead mounting

CONSTANT RESISTANCE LOADS

TE10S

Suitable for shortwave infrared loads
Small footprint
Partial load failure detection
Suitable for SWIR loads

CONSTANT RESISTANCE LOADS

7100S

Single phase communicating SSR
AC/DC logic input or 4-20mA analogue input
Alarm options:-
Thyristor short circuit, Partial load failure, Load open circuit
Current ratings up to 250 A
Modbus comms
Suitable for SWIR loads

CONSTANT RESISTANCE LOADS

TC1027

High current - up to 500 A
AC/DC Logic or analogue input
Zero crossing firing

Also available TU Series thyristors for specialist applications.

Zero crossing firing
Indicator LED

CONSTANT RESISTANCE LOADS

3RC18A/510D

Two leg switching of three phase, three wire constant resistance loads
Current ratings up to 200 A
Diagnostic failure detection
AC/DC logic or analogue time proportional input
Suitable for SWIR loads

CONSTANT RESISTANCE LOADS

7200S

Two leg switching of three phase, three wire loads

Suitable for constant resistance loads
Current ratings up to 500 A
Partial load unbalanced detection available
2 x single phase control

CONSTANT RESISTANCE LOADS

TC2000

Three leg switching of three phase constant resistance loads

Current ratings up to 160 A
Input DC logic or analogue
Logic/fast cycle firing
Diagnostic load failure detection

CONSTANT RESISTANCE LOADS

7300S

True three phase control of inductive, resistive or variable resistance loads
Phase angle or fast cycle firing
Current ratings up to 500 A
Logic and analogue inputs

INDUCTIVE LOADS

CONSTANT RESISTANCE LOADS

TC3000

Also available TU Series thyristors for specialist applications.

Power Controllers

The Eurotherm range of power controllers can drive complex and transformer coupled loads. These products can take inputs from discrete controllers and plcs and have a wide range of full wave, half wave and phase angle firing modes to suit all load types.

VARIABLE RESISTANCE LOADS

TE10A

Compact and robust design
Analogue input
Phase angle, Advanced Single Cycle + burst firing
Current limitation available
Current rating up to 50 A

VARIABLE RESISTANCE LOADS

7100A

Phase angle or fast cycle firing
Optional current limit
Alarms for; thyristor short, load open and partial load failure
Also suitable for transformer burst firing
Current ratings up to 250 A

VARIABLE RESISTANCE LOADS

460

Plug-in facility
Phase angle or fast cycle firing
Current limit
Partial load failure alarm
Suitable for transformer burst firing
Current ratings up to 150 A

VARIABLE RESISTANCE LOADS

TC1028

High current - up to 1650 A
Phase angle or fast cycle firing
Current limit
Partial load failure alarm
Suitable for tranmsformer burst firing
See also MC1028 Driver Unit

VARIABLE RESISTANCE LOADS

INDUCTIVE LOADS

7200A

Two leg switching of three phase, three wire loads
Current ratings up to 200 A
Analogue input
Single cycle + burst firing
Suitable for inductive loads
Diagnostic load failure analysis

VARIABLE RESISTANCE LOADS

INDUCTIVE LOADS

TC2001

Two leg switching of three phase, three wire loads
Suitable for inductive loads
True power feedback
Analogue input
Partial load unbalance detection
Currents up to 1650 A

TU Series thyristors for specialist applications.

True three phase control of inductive, resistive or variable resistance loads
Phase angle or fast cycle firing
Partial load unbalance detection
Current up to 1800 A
Digital communications
True power control

VARIABLE RESISTANCE LOADS

INDUCTIVE LOADS

TC3001

Single phase power control current ratings up to 400 A
Voltage ratings up to 500 V
Phase angle or fast cycle firing suitable for inductive constant or variable resistance loads
Digital communications

True Power Control

TE10P

Single phase power control suitable for all load types
Current ratings up to 125 A
Separate driver for higher powers
Burst and phase angle firing with current limit
Voltage, current or power feedback
Plug in design and front panel sockets aid setting up and maintenance

True Power Control

470

... related power control products

REMIO digital communications interface
Eurotherm Solid State Relays such as the 7100L, 7100S or TE10S may be distributed using the REMIO interface to communicate with the comms master. Time proportioning control of up to 32 SSRs is available, giving economical, multizone control via digital communications.
A comms in/comms out version is for use with simple communicating SSRs.

MC series driver units
The control electronics from the TC series thyristor units is repackaged as a series of MC drivers for use with external, high current, air or water cooled thyristor devices. The MC1028 is used for single phase applications, the MC2001 for two leg control of three phase loads and the MC3001 is used for full three phase control.

483 Load Sequencer
The 483 load sequencer prevents multiple heating loads from being switched on simultaneously. This reduces disturbances to the electrical supply network. Each 483 can control up to four loads and by cascading units together up to sixteen loads can be controlled.

TU1400 Series
The TU Series allow 4 loads to be driven by one power controller, reducing cabling and installation costs. Constant resistance loads can be driven by the TU1450 and TU 1470. Variable resistance and transformer coupled loads by the TU1451 and TU1471.
All TU products are available with Modbus and Profibus comms.

Thyristor features guide - selection chart and technical specifications

	SOLID STATE RELAYS								
	 HP Series	 7100L	 TE10S	 7100S	 TC1027	 3RC18A	 7200S	 TC2000	 7300S
HEATER TYPE									
RESISTIVE	●	●	●	●	●	●	●	●	●
SWIR (Short wave infred)			●	●	●		●	●	●
Variable resistance									
Inductive/Transformer coupled									
TRUE POWER CONTROL									
Max. current (amps)	50A*	100A	50A	250A	500A	18A	200A	500A	160A
Controlled phases	1	1	1	1	1	3	2	2	3
INPUT	L	L	L	A/L	L	L	A/L	A/L	A/L
FIRING MODE	B	B	B	B	B	B	B	B	B
OPTIONS									
PLF and/or PLU			●	●			●	●	●
Current limit									
Plug in construction									
Diagnostics				●			●		●
Alarms			●	●			●	●	●
Digital comms				●					

* If mounted on a compliant heat sink

L = Logic fired A = Analogue fired B = Burst firing P = Phase angle firing S = Single cycle firing

POWER CONTROLLERS

	 TC3000	 TE10A	 7100A	 460	 TC1028	 7200A	 TC2001	 7300A	 TC3001	 TE10P	 470
	●	●	●	●	●	●	●	●	●	●	●
	●	●	●	●	●		●	●	●	●	●
		●	●	●	●	●			●	●	●
	●	●	●	●	●	●	●	●	●	●	●
			●				●	●	●	●	●
	500A	50A	250A	150A	1200A	200A	1650A	160A	1650A	400A	150A
	3	1	1	1	1	2	2	3	3	1	1
	A	A	A	A	A	A	A	A	A	A	A
	P/B/S	P/B/S	P/B/S	P/B/S	P/B/S	B/S	B/S	P/B/S	P/B/S	P/B/S	P/B/S
	●		●	●	●		●	●	●	●	●
		●	●	●	●			●	●	●	●
				●							●
	●		●		●		●	●	●	●	●
	●	●	●	●		●		●	●	●	●
								●	●	●	●

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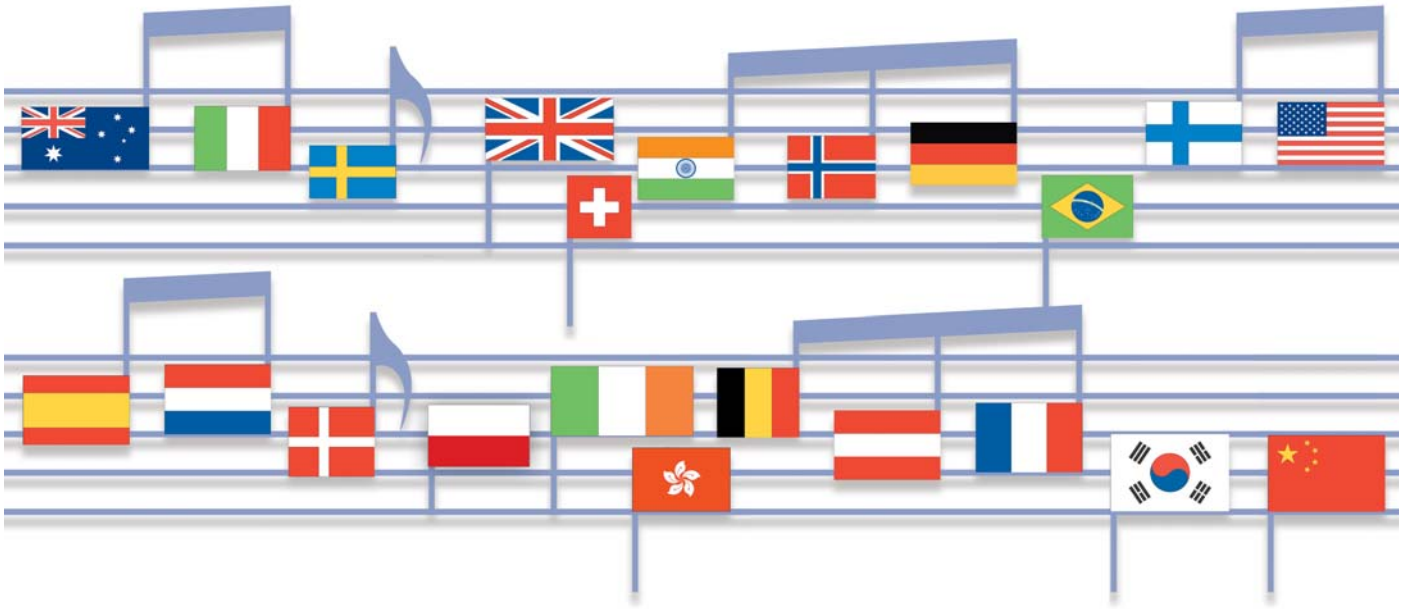

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