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Colour Chart for Telephone Wiring over CAT-5 cables

I hope you find the charts below useful. I find them indispensible for just about every implementation project I work on! **If you also find them useful, please send me an email at** chris.moller at evonet.com**, and let me know!**

Two competing standards!

Just to make life complicated, there are two conventions in common use in the UK for putting telephone pairs over 4-pair structured cabling. They are roughly equally common.

The converters to change an RS-45 socket to a BT socket are known as Line Adapter Units (LAU) or (incorrectly) as Baluns or 'Mod-Taps' (a brand name). The wiring of the LAUs determines the scheme to be used over the structured cabling. Nimans is the only supplier I am aware of that supports both types of LAU. They call them Type 1 and Type 2, and I will use their terminology here.

Type 1	Type 2
Nimans (default)	Nimans (on request)
Pressac	Molex / Mod-Tap
Maplin	RS Components
Austin Taylor	Inmac

In summary, the difference between the two conventions is that the bell and earth wires are the same in both types, but the A and B wires are swapped. Lines 1 and 6 are also swapped.

Type 1 Chart

CAT-5			ISDN		UK Phones				US Phones		
RJ-45	EI-568B	10Base-T	ISDN	US Flat-8	BT 631A	UK Flat	BT	Krone 237A	US	RJ-11	US Flat4
1	W/Or	Tx+	Pwr	Blue	4(3)	Green	(Gnd)	4	-	5	Yellow
2	Or/W	Tx-	Pwr	Orange	3(4)	Blue	Bell (1.8µF)	3	-	2	Black
3	W/Gn	Rx+	Tx+	Black	1(6)	Orange	-	[5]	-	[1]	-
4	Bl/W	-	Rx+	Red	5(2)	White	B	2	Ring	4	Green
5	W/Bl	-	Rx-	Green	2(5)	Red	A(1.8µF)	1	Tip	3	Red
6	Gn/W	Rx-	Tx-	Yellow	6(1)	Black	-	[6]	-	[6]	-
7	W/Br	-	Pwr	Brown	-	-	-	-	-	-	-
8	Br/W	-	Pwr	Grey/White	-	-	-	-	-		-
Note 6	Note 7	-	Note 2	Note 5	Note 6	Note 5	Notes 3,8	-	Note 3	Notes 1,4,6	Note 5

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Type 2 Chart

CAT-5			ISDN		UK Phones (note 9)				US Phones		
RJ-45	**EI-568B**	**10Base-T**	**ISDN**	**US Flat-8**	**BT 631A**	**UK Flat**	**BT**	**Krone 237A**	**US**	**RJ-11**	**US Flat4**
1	W/Or	Tx+	Pwr	Blue	4(3)	Green	(Gnd)	4	-	5	Yellow
2	Or/W	Tx-	Pwr	Orange	3(4)	Blue	Bell (1.8µF)	3	-	2	Black
3	W/Gn	Rx+	Tx+	Black	6(1)	Black	-	[6]	-	[6]	-
4	Bl/W	-	Rx+	Red	2(5)	Red	A(1.8µF)	1	Tip	3	Red
5	W/Bl	-	Rx-	Green	5(2)	White	B	2	Ring	4	Green
6	Gn/W	Rx-	Tx-	Yellow	1(6)	Orange	-	[5]	-	[1]	-
7	W/Br	-	Pwr	Brown	-	-	-	-	-	-	-
8	Br/W	-	Pwr	Grey/White	-	-	-	-	-	-	-
Note 6	Note 7	-	Note 2	Note 5	Notes 6,9	Note 5	Notes 3,8	-	Note 3	Notes 1,4,6	Note 5

Notes

1. RJ-11 1/2/3/4 - BT631A 2/3/4/5 is used in some countries, eg Israel.

2. ISDN BRI S-Bus - Each data pair must be terminated with 100ohms at the end of the chain. Power is generally absent from 1,2,7,8, but limited power (40v, 1W) provided from the network as +ve on centre tap of 4,5 (Rx pair), -ve on centre tap of 3,6 (Tx pair)

3. A/Tip has Z to ground, B/Ring has Z to (-ve Batt) or (-ve Batt+Ring Current) during ringing. However, this is not rigorously adhered to.

   Line voltage may be -50v (BT PSTN, iSDX), -48v (US), -36v (Nokia) or -24v (Mitel SX-2000).

4. Strictly, RJ-11 is 6-pin with only 4 populated ("4/6"), RJ-12 ("6/6") has all 6 present.
   Note that there is a smaller RJ-11-style plug, usually referred to as "4/4", which only has space for 4 pins - this is used for handsets only.

5. Flat cable is often crimped with the colours in the opposite order. Beware of cables made up crossed, ie Pin 1 at one end is connected to Pin 8 at the other! Don't use flat cable for data, if you can possibly avoid it - it both generates and is susceptible to noise, and won't meet CAT-5 specs.

6. To identify Pin1 on a plug, see the picture below. Note that some BT631A documentation confusingly adopts the opposite convention (pin nos. in the table shown in brackets)!

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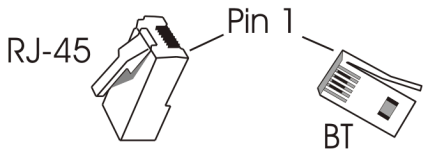

7. EIA-568B is preferred for CAT-5/5e. EIA-568A is also widely found - there's no difference in function, but swap Green and Orange in all cases. Note that it is common for the punchdown blocks on the back of CAT-5 sockets and patch panels NOT to be in numerical order!

8. Ground is rarely connected nowadays. Some proprietary featurephones may require pins 1,6 to be connected through. Hybrid featurephones typically have the analogue voice on 2&5, but use the centre pins for digital signals, instead of Bell and Ground (and therefore should not be used with master sockets).

9. In Type 2 Master LAUs, RJ-45 pin 2 is disconnected (ie the CAT-5 cabling and the PBX are not connected to the bell wire). Switchable LAUs are Type 2, and connect the bell wire to the capacitor to the A wire in the "Master" position and to the structured cabling in the "Secondary" position.

Different kinds of phones

- **Analogue phones** (the kind that have been around for years) are also known as POTS phones (Plain Old Telephone Service) or SLTs (Single Line Telephones). They use pins 2,5 of the BT connector for the signal, and pin 3 as the bell wire (common between all the sockets, and with just one 1.8µF capacitor shared between all the sockets between the bell wire and the A wire, but not connected back to the exchange.)

- **Digital Phones** are proprietary to a particular brand of PBX. They use pins 1,6 (occasionally 3,4).

- **Hybrid telephones** use analogue (POTS) technology for the voice path (pins 2,5), and use two of the other pins (usually 3,4) for additional signalling for the extra buttons and lights on the phone (see below for the implications of this).

- **IP telephones** of course connect directly to the CAT-5 wiring, and are not part of this discussion.

When should I use a Master LAU, a PBX Master or a Slave LAU?

If you use a Slave, where you should use a Master, everything will work except the phone will not ring. Analogue POTS / SLT phones need master LAUs. Digital phones need Slave LAUs. Hybrid phones need Type 2 Slave LAUs (see below)

Master LAUs include a surge protector and a resistor. The surge protector is to give the phone a fighting chance of surviving a lightning strike, so it's only really important where the cabling is outside on poles. The resistor enables some public exchange testing equipment to confirm that the line is OK, even when there's no phone connected. A PBX Master is a Master LAU with these two components omitted.

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Does it make any difference whether I use Type 1 or Type 2?

For standard POTS telephones or single-pair digital telephones, neither convention is better than the other.

Hybrid telephone systems typically use pins 2,5 for the speech pair, and 3,4 for the signalling. It is therefore important that master LAUs aren't used for hybrid phones, as they put a capacitor between pins 2,3. However, to use a POTS phone on a hybrid system, a master LAU should be used, but it is important that the capacitor between 2 and 3 is not seen by the PBX. This means that **Type 2 *MUST* be used** - or if Type 1 is used, the connection between pin 3 (Bell) and the RJ-45 must be cut.

A telephone system that has a mixture of digital, hybrid and analogue phones must therefore present the digital pair on pins 1,3 and 4,6, and the analogue pair on 2 and 5. Type 2 is definitely preferred for this kind of environment.

Multi-pair Telephone Cable Colours

Multi-pair CW1308 internal telephone cable colour coding is based on a primary colour and a secondary colour. Every conductor is colour-coded with a primary colour alternating with a secondary colour. A pair consists of one wire with the primary colour predominating, and one wire with the secondary predominating. There are 5 primary colours, and 5 secondary, so a complete set is sufficient for 25 pairs. Larger cables are wrapped into bundles of 20 or 25 pairs. The colours are:

Pairs	Primary	Pairs	Secondary
1,6,11,16,21	Blue	1-5	White
2,7,12,17,22	Orange	6-10	Red
3,8,13,18,23	Green	11-15	Black
4,9,14,19,24	Brown	16-20	Yellow
5,10,15,20,25	Slate (Grey)	21-25	Violet

An older colour scheme used the same colours, and a pair comprised a wire with a primary colour twisted with a wire with a secondary colour. This has fallen into disfavour, because identifying a pair relied on getting the twisting right. However, this scheme is still found in some cables for special purposes.

Last updated by Chris Moller, 10Feb2008.