TC-5
Generator/Reader/Converter
LTC-Midi-USB

*** Large (0.56”/ 14 mm) Ultra Bright LED Display..... Easy to Read**
*** Source LTC .....Output: Regenerated LTC, Midi, USB Midi**
*** Source Midi .....Output: Regenerated LTC, Midi, USB Midi**
*** Source USB Midi.....Output: Regenerated LTC, Midi, USB Midi**
*** Source Virtual Machine.....Output: Regenerated LTC, Midi, USB Midi**
*** Virtual Machine ..... Controlled from 5pin Din and USB MMC Commands**
*** Reference Inputs..... Video, Word Clock or Source**
*** Timecode Regeneration..... Dropout and Jitter Suppression**
*** Front Panel Controls.....Full control and setup**
*** FP Start, Stop, Locate .....MMC to selected Timecode Source**
*** Auto Configure..... From MTC, LTC or Video Syncs**
*** Auto Detect Word Clock .....Presence and Frequency**
*** Auto Detect Video Syncs ..... SD Video, HD Video and Frame Rate**
*** Real Time Clock ..... Option**
*** Timecode Test Tool ..... Frequency, Phase , Difference**
*** GPIO Port ..... Biphase I/P, Start, Stop, Locate, Coincidence detector**
*** User Configuration and Software Update.....Windows or Mac**
*** 1U 1/2 Rack (8.5x1.75", 216x44mm).....Supplied with Optional Rack Mount Kit**

The TC-5 is a professional MTC/LTC interface with LED display, Video Sync, Word Clock input and USB port. The TC-5 is designed to be equally at home in Audio, Video and Lighting Environments, applications include Digital Audio Workstations, Non Linear Video Editors, Mixing Consoles, Show Control and Lighting Control.

As a test tool the TC-5 can also check the frequency of Timecode, MTC, Video and Word Clock. Check the Phase of LTC, MTC or MTC over USB . Compare LTC with MTC or USB MTC

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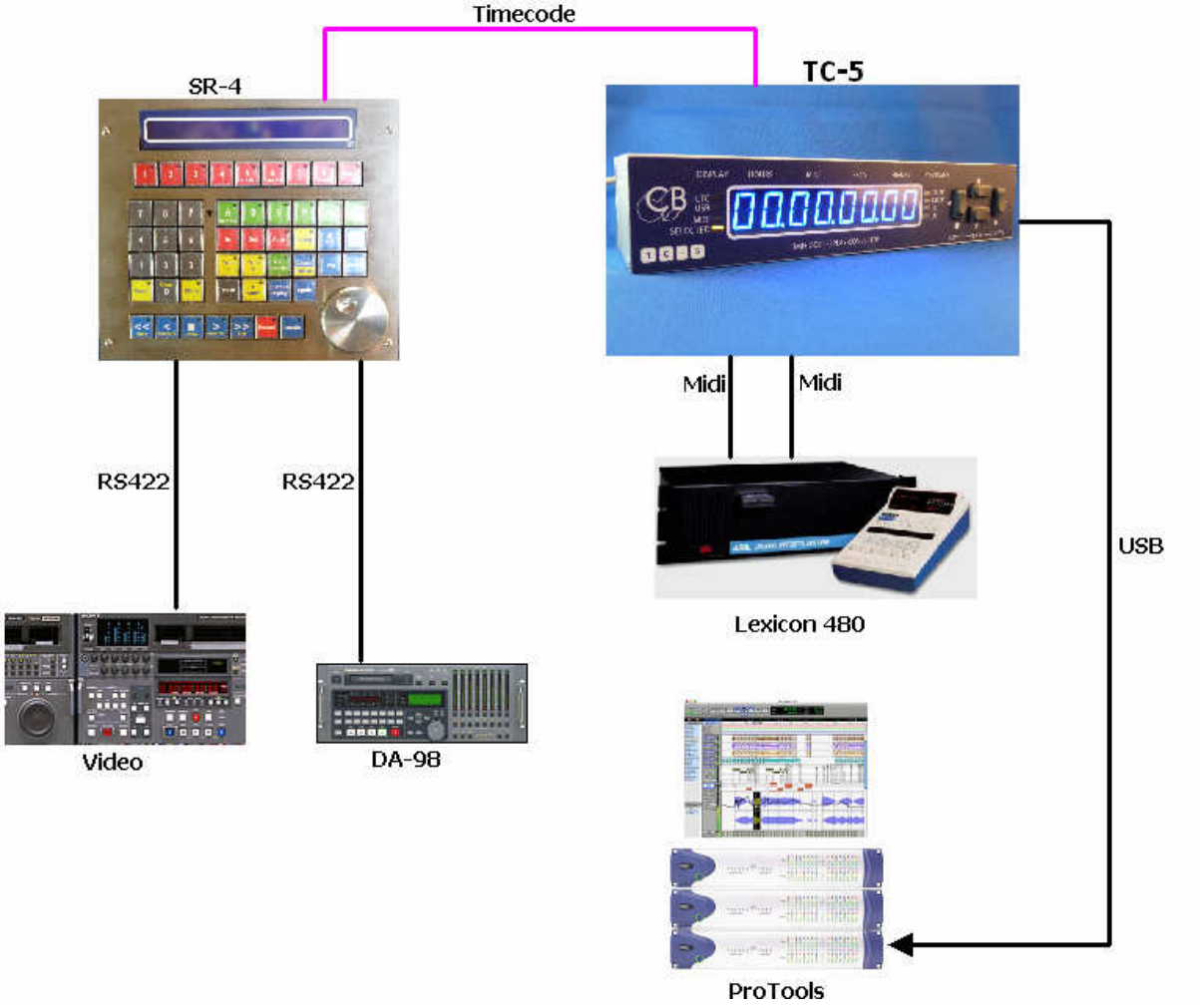
Connecting to a DAW with USB and to Legacy Midi Equipment



Audio Only Enviroment

When using timecode in a digital audio environment it is important that the timecode frame rate is locked to the incoming sample rate. The TC-5 is designed to use wordclock as a reference source. When the TC-5 is referenced to wordclock and jammed to a timecode source the generator is phase aligned to the source after 10 frames, the timecode then free runs locked to wordclock.

Audio and Video Enviroments

In a Audio+Video environment there are two referece sources Wordclock and Video Syncs. They should always be locked, an easy way of doing this is to use a combined Video Sync and Wordclock generator. The timecode should be locked to the videosyncs as there are 1920 wordclocks to every video frame (48KHz/25fps). Locking to video syncs ensures that the audio keeps the correct phase relation ship to the video.

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But when do you use lock to source?

Audio sources are not always locked to an external reference, in this case the TC-5 can be used in two possible ways.

1) If the audio source will lock to MTC then you can use the virtual machine in the TC-5 to generate both LTC and MTC locked to an external reference.

2) Generate LTC and MTC locked to the incoming LTC or MTC, the TC-5 averages the incoming timecode over 256 frames so as to minimise the jitter on the outgoing timecode.

Lock Indication

Until the timecode output is locked to video syncs or to a external source the Timecode Standard LED will flash.

Operational Modes	
LTC -> Midi+USB+LTC	Read LTC(Smpte), convert to Midi Timecode on USB and 5 pin Din, Regenerate LTC Output
MTC -> LTC+USB	Read MTC(Midi timecode) from 5 pin Din Midi Input, convert to LTC and USB-MTC
USB -> LTC+Midi	Read MTC(Midi timecode) from USB-Midi Input, convert to LTC and 5 pin Din MTC
VMC -> LTC+Midi+USB	Generate LTC, MTC-USB and MTC 5 pin Din from virtual machine, controlled from the front panel or MMC(Midi Machine Control) on USB or 5 pin Din Input
Real Time Clock	Generate Timecode from RTC locked to Video Syncs

Locking the Front Panel keys

To prevent inadvertent change of the timecode output the [<] and [>] keys can be locked out. The [^] and [v] keys will still operate allowing the user to look at incoming timecodes.

To lock the front panel keys, depress and hold the [v] key until "Loc On" in displayed. The [^] and [v] keys will still operate as normal but depressing the [<] or [>] key will display "Loc On"

To unlock the front panel keys, depress and hold the [^] key until "Loc OFF" is displayed.

Using the Generator only

The generator is controlled by selection the virtual machine as the timecode source. The Generator can then be controlled from the front panel, from a computer using Midi Machine Control or the TC-5 App
http://www.colinbroad.com/cbsoft/tc-5/tc5-win.zip
http://www.colinbroad.com/cbsoft/tc-5/TC5-mac.zip

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Enable the config and set the Source as Virtual machine "Src Uir", set the reference as required "rEF Src" will lock to crystal, "rEF Vid" for video lock or "rEF Cloc" to lock to word clock.

Controlling the Generator from the front panel

The generator timecode may be set to any value using a locate command
Depress and hold locate until only one decimal point is showing "00.000000"
Once the Locate has opened use the <, >, /\, and \/ keys to set the value you want
Exit locate by depress and hold the Locate key intil three decimal points are showing "00.00.00.00"

Every time you enter and leave Locate the generator will locate the value that you have entered.

Depressing the ">" key will run the generator, the "[]" key will stop the generator

Front Panel Leds and Switches

LED	Display –Normal Operation	
LTC	LTC(Smpte) Linear Time Code	
Midi	5 pin Din Midi Timecode	
USB	USB Midi Timecode	
Selected	Defined by Configuration Menu	**SEL Vir** Virtual Machine Timecode
		SEL GEn Generator Timecode
		SEL LtcU LTC User Bits
		SEL rtc/S No rtc Real Time Clock
		SEL hui USB/Midi Hui Counter
		SEL tESt Show selected test function
Note: The Selected Display LED will flash if the timecode displayed is **not** the timecode source or Generator output.		

Keyboard/Display modes		
Keyboard/Display Mode	**Display**	**Select/Exit**
Normal Operation	Selected Position	
Config Menu	Menu Selection	Depress and Hold '<' Key
Define Locate	Locate Point/Set RTC	Depress and Hold '>' Key

Key Functions				
Mode	**'<' Key**	**'>' Key**	**'^' Key**	**'v' Key**
Normal	MMC Stop	MMC Play	Display Select	Display Select
Key-Held	Enter/Exit Config	Set/Send Locate	-	-

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Config Menu	Prev menu	Next Menu	Inc Selection	Dec Selection
Define Locate	Prev Digit	Next Digit	Inc Digit	Dec Digit

In most cases the Generator is referenced to Video but it may also be locked to Internal Crystal, Word Clock, LTC or Midi. Providing multiple reference sources the TC-5 is designed to be equally at home in Audio Only environments or Combined Video and Audio Environments.

Sel	Generator Frame Rate Reference	
reF Vid	Video Syncs, bi-level(SD) or tri-level(HD)	
reF Cloc	Word Clock (Uses Video Sync input)	
reF Src	Defined by Source Menu	**Src Vir** – Internal Xtal
		Src Midi – 5 pin DIN Midi Timecode
		Src USB – USB Midi Timecode
		Src Ltc – Linear Timecode Input

Normal Configuration Menu's		
Menu	**Function**	**Options**
1	Select Config	**ConFiG 1 .. ConFiG 4**
2	Display Brightness	**briGht 1 .. bright 8**
3	Timecode Generator Source	**Src Vir** : Virtual Machine **Src Midi**: MTC from 5 pin Din Midi Input **Src USb** : MTC from USB Midi Input **Src Ltc** : LTC Timecode **Src rtc** : Real Time Clock(If Fitted)
4	Generator Reference	**reF Vid** : Standard or High def video syncs **reF Cloc**: Wordclock, Frame edge taken from TCG Source after 10 frames. **reF Src** : Dependant on Menu 3 TCG Source as follows **Src Vir**: Internal Crystal **Src Midi**: 5 pin Din MTC frame rate **Src USb**: USB MTC frame rate **Src Ltc**: LTC Timecode frame rate
5	Standard & Rate	**PAL25, Nond 30, Filn 24, droP 30** **PAL 249, Nond 299, Filn 239, droP 299** Note: Updated by reference if present
6	LTC Stationary code	**StAt ON** :Stationary Timecode Always On **StAt OFF** :Burst Output on position change
7	Selected Display	**SEL Uir** : Virtual Machine **SEL Gen** : LTC Generator **SEL LtcU** : LTC Reader User bits **SEL rtc/ S No rtc** : Real Time Clock **SEL hui** : Hui Clock Display from Midi or USB

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		SEL tESt : Test function see menu 8

When Advanced mode is enabled (Windows/Mac GUI) the following enhanced menu's are available. These allow the TC-5 to be used to test the reference frequency and compare timecodes.

Advanced Configuration Menu's		
Menu	**Function**	**Options**
8	Test Display	**T0 rEF**: Reference frame rate **t1 Cloc**: Wordclock Samples per second **t2 Lt Ph**: LTC Phase **t3 Ni Ph**: 5 pin Din MTC Phase **t4 Ub Ph**: USB MTC Phase **t5 Ur-Lt**: Difference Virtual machine - LTC, **t6 Ur-Ub**: Difference Virtual Machine – USB MTC **t7 Ur-Ni**: Difference Virtual Machine – 5pin Din MTC **t8 Lt-Ub**: Difference LTC – USB MTC **t9 Lt-Ni**: Difference LTC – 5 pin Din MTC **tA Ub-Ni**: Difference USB MTC – 5 pin Din MTC
8	5 pin Din Midi ID	**Nidi Id 0**, **Nidi Id 1**, **Nidi Id 2**, **Nidi Id 3**
9	5 pin Din Midi Full Frame	**N FulLoc**: MTC Full frame Position & Locate Cmd **Nidi Full**: MTC Full frame Position **N LocAtE**: MTC Locate Command (Protools)
10	5 pin Din Midi Through Function	**Nidi thru**: Buffered Midi Input **Nidi Out2**: Second Midi Output
11	USB Midi ID	**USb Id 0**, **USb Id 1**, **USb Id 2**, **USb Id 3**
12	USB Full Frame	**U FulLoc**: MTC Full frame Position & Locate Cmd **USb Full**: MTC Full Frame Position **U LocAtE**: MTC Locate Command (Protools)
13	Measured Word Clock Rate	**Cloc 441, Cloc 48, Cloc 88.2, Cloc 96, Cloc 176.4, Cloc 192**
14	Reset to Factory	**No ChAnG, FACtory**

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GPIO Connections 9 pin 'D' Male on TC-5

Pin		O/P	I/P	GP Output Function	GP Input Function
1			GPI-8		Play
6		GPO-1	GPI-1	Midi Record On	
2		GPO-2	GPI-2	USB Record On	
7		GPO-3	GPI-3	Midi Record Off	
3		GPO-4	GPI-4	USB Record Off	
8		GPO-5	GPI-5		
4		GPO-6	GPI-6	Source Stop	
9		GPO-7	GPI-7	Source Locate	
5		**Ground**			

GPO Event programming

Using the Mac/Windows program you can program up to 10 timecode events on the GPIO ports and mask inputs and outputs. The GPIO screen can be accessed via the View menu.

By default all GPO's are cleared on stop, the Clear On Stop Mask can be used to disable this. The GPO's pulse for about 100mSec and can be selected to Latch(Toggle).

By default all GPI's are enabled, the GPI Mask can be used to disable the Midi/USB and Source transport commands, The timecode coincidence detector uses the timecode generator so that timecode dropouts are ignored care should be taken to ensure that the correct source and reference are selected.

Currently only the configuration is read from the TC-5 not the events

For an example see below

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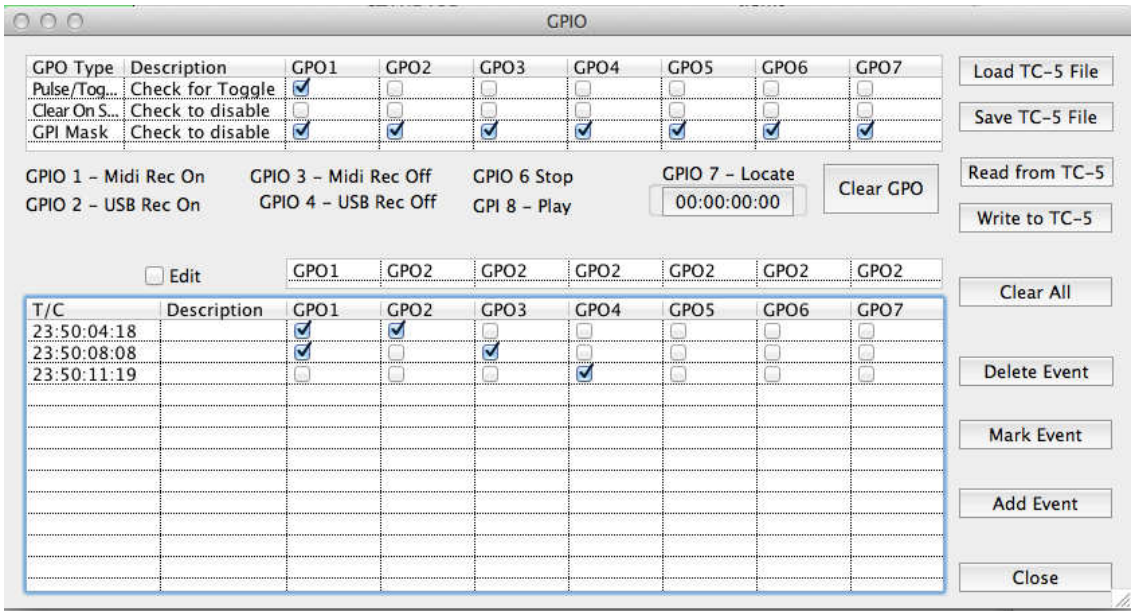
Simple GPO Example

In the following example
GPO1 is a Latching Output

GPO 2 - 7 are Pulse Outputs

GPO 1-7 will go Off if the timecode stops

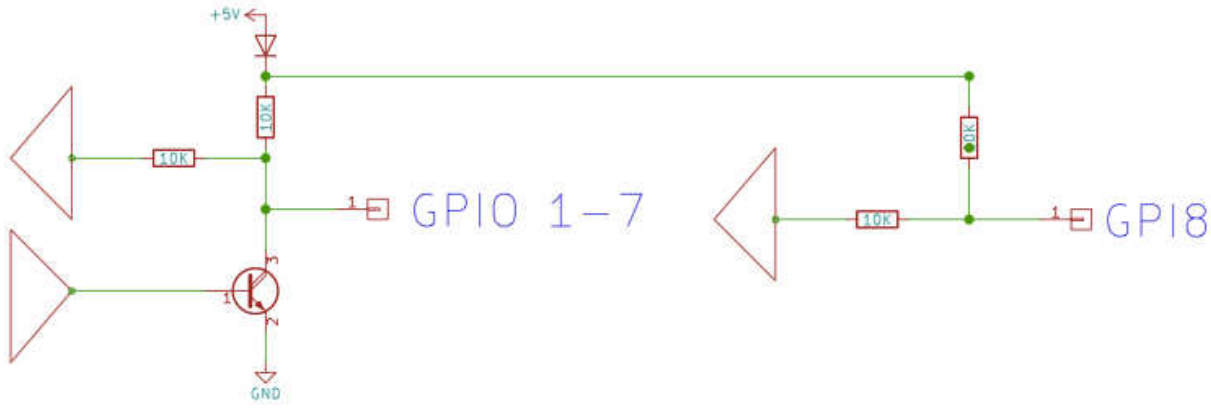
GPI 1 – 7 are disabled



When the timecode runs

Timecode	GPO1 (Latched)	GPO2	GPO3	GPO4
23:50:04:18	On	On	Off	Off
10 frames later	On	Off	Off	Off
23:50:08:08	On	Off	Off	Off
10 frames later	On	Off	Off	Off
23:50:11:19	Off	Off	Off	On
10 frames later	Off	Off	Off	Off

GPIO Schematic



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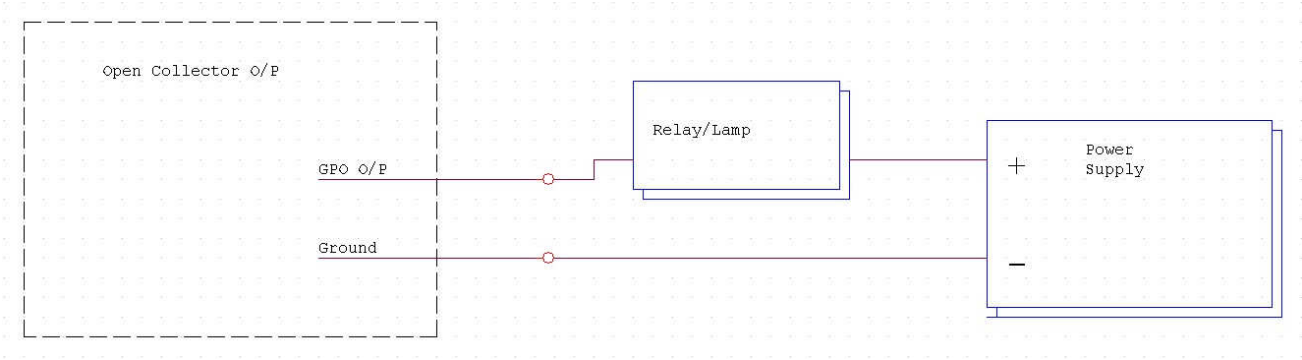
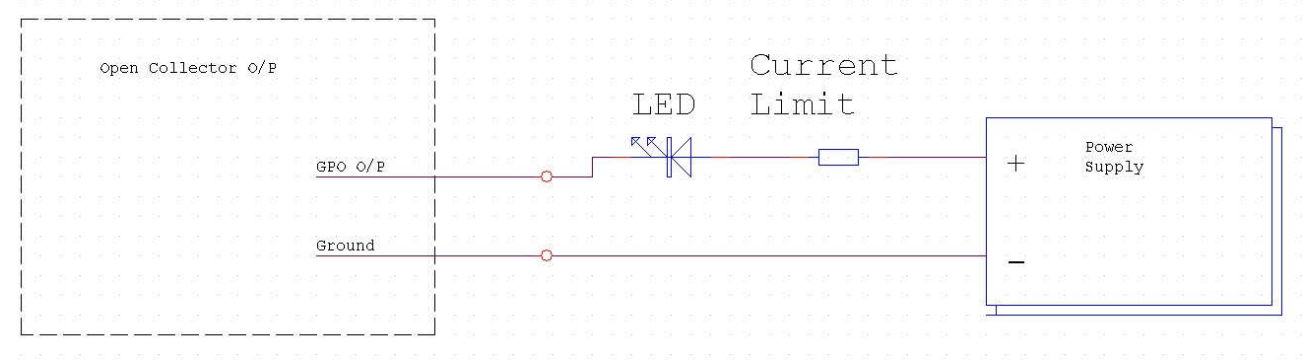
Connecting a lamp to a Open collector outputs

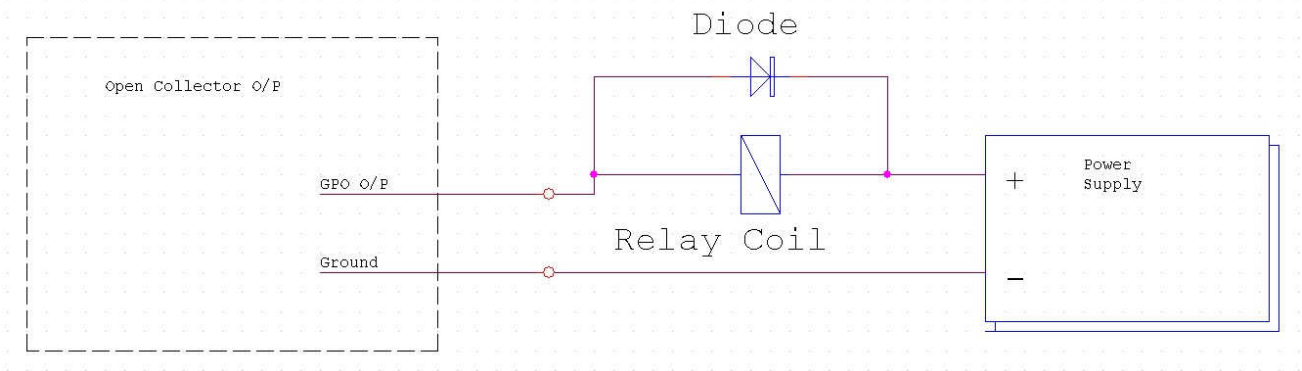


Connecting a LED to a Open Collector Output



The Current Limit resistor can be calculated typically 330R for a 5v Supply and 1K for a 12v Supply.

Connecting a Relay to a Open collector output



The Diode is optional

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Recovery Mode

When programming the TC-5 a power failure or any corruption can cause the TC-5 not to work. A recovery mode is provided to overcome this problem, to enter the recovery mode-

1) Disconnect the Power (USB)
2) Depress and hold the '^' and '>' keys
3) Connect the Power (USB)
4) When the power up sequence is finished the display should read 'UPd ProG'
5) Re-programme the TC-5 using TC-5.bin and Windows or Mac software available from - http://www.colinbroad.com/cbsoft/tc-5/tc-5.html

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