GeneQuery™ Human Transcription Factors qPCR Array Kit (GQH-TRF)
Catalog #GK124

Product Description

ScienCell's GeneQuery™ Human Transcription Factors qPCR Array Kit (GQH-TRF) surveys a panel of 88 transcription factors. Transcription factors are proteins that can regulate target gene transcription level by binding to specific regions of genome known as enhancers or silencers. Misregulation of transcription factors can lead to aberrations in signaling transduction and a variety of disorders including autoimmunity, neurological disorders, diabetes, cardiovascular disease and cancer. Brief examples of how genes may be grouped according to their functions are shown below:

- **Stem cell-related:** NANOG, POU5F1, SOX2, EGR1, FOXD3, FOXO1, KLF4, MEF2B, PAX6, SOX18
- **Cancer stem cell-related:** NANOG, POU5F1, SOX2, AR, FOXO3, MYC, NKX3-1, SNAI1, SOX9, TFAP2A, TP53, TWIST1
- **Oxidative stress-related:** ARNT, ETS1/2, IRF1, JUN, NFAT5, NFKB1, NFYA, SMAD1, SRF, STAT3
- **Neuroprotective function-related:** CREB1, ESR1, FOXA1, GATA1/2/3, NFE2L2, NR4A2, PPARA, SP1, TBX3
- **Growth factor-mediated signaling pathways:** CREBBP, ELK1, FOS, HIF1A, ID1, NFAT5, NFATs, STAT1/3/5A
- **Wnt signaling pathway:** CEBPA, CEBPB, GBX2, HNF4A, LEF1, MITF, OLIG1, PITX2, SMAD4, SOX2
- **MAPK signaling pathway:** ATF2/4, ELK1, FOX, JUN, MAX, MEF2A/C, NFKB1, SP1, STAT1/3
- **B/T-cell receptor signaling pathways:** E2F1, ELK1, FOS, GATA3, JUN, MYB, NFATs, RUNX1, STAT6
- **Oncogenes & tumor suppressors:** ABL1, BRCA1, CDKN2A, JUNB, MYCN, NF1, RARA, RB1, TGFB1, TNF

Note: all gene names follow their official symbols by the Human Genome Organization Gene Nomenclature Committee (HGNC).

GeneQuery™ qPCR array kits are qPCR ready in a 96-well plate format, with each well containing one primer set that can specifically recognize and efficiently amplify a target gene's cDNA. The carefully designed primers ensure that: (i) the optimal annealing temperature in qPCR analysis is 65°C (with 2 mM Mg^{2+}, and no DMSO); (ii) the primer set recognizes all known transcript variants of target gene, unless otherwise indicated; and (iii) only one gene is amplified. Each primer set has been validated by qPCR with melt curve analysis, and gel electrophoresis.

GeneQuery™ qPCR Array Kit Controls

Each GeneQuery™ plate contains eight controls (Figure 1).

- Five target housekeeping genes (ACTB, GAPDH, LDHA, NONO, and PPIH), which enable normalization of data.
- The Genomic DNA (gDNA) Control (GDC) detects possible gDNA contamination in the cDNA samples. It contains a primer set targeting a non-transcribed region of the genome.
- Positive PCR Control (PPC) tests whether samples contain inhibitors or other factors that may negatively affect gene expression results. The PPC consists of a predispensed synthetic DNA template and a primer set that can amplify it. The sequence of the DNA template is not present in the human genome, and thus tests the efficiency of the polymerase chain reaction itself.
- The No Template Control (NTC) is strongly recommended, and can be used to monitor the DNA contamination introduced during the workflow such as reagents, tips, and the lab bench.

Kit Components

Component	Cat #	Quantity	Storage
GeneQuery™ array plate with lyophilized primers	GK124	1	4°C or -20°C
Optical PCR plate seal	N/A	1	RT
Nuclease-free H$_2$O	GQ100-1	2	4°C

Additional Materials Required (Materials Not Included in Kit)

Component	Recommended
Reverse transcriptase	First-Strand cDNA Synthesis Master Mix, 4x (ScienCell, Cat #MB6008)
cDNA template	Customers' samples
qPCR master mix	GoldNStart TaqGreen qPCR Master Mix (ScienCell, Cat #MB6018)

Quality Control

All the primer sets are validated by qPCR with melt curve analysis. The PCR products are analyzed by gel electrophoresis. Single band amplification is confirmed for each set of primers.

Product Use

GQH-TRF is for research use only. It is not approved for human or animal use, or for application in clinical or *in vitro* diagnostic procedures.

Shipping and Storage

The product is shipped at ambient temperature. Upon receipt, the plate should be stored at 4°C and is good for up to 12 months. For long-term storage (>1 year), store the plate at -20°C in a manual defrost freezer.

Rev.1

Procedures

Note: The primers in each well are lyophilized.

1. Prior to use, allow plates to warm to room temperature.
2. Briefly centrifuge at 1,500x g for 1 minute before slowly peeling off the seal.
3. Prepare 20 µl PCR reactions for one well as shown in Table 1.

Table 1

cDNA template	0.2 – 250 ng
2x qPCR master mix	10 µl
Nuclease-free H$_2$O	variable
Total volume	*20 µl*

*Important: **Only** use polymerases with hot-start capability to prevent possible primer-dimer formation. **Only** use nuclease-free reagents in PCR amplification.*

4. Add the mixture of 2x qPCR master mix, cDNA template, and nuclease-free H$_2$O to each well containing the lyophilized primers. Seal the plate with the provided optical PCR plate seal.

   Important: In NTC control well, do NOT add cDNA template. Add 2x qPCR master mix and nuclease-free H2O only.

5. Briefly centrifuge the plates at 1,500x g for 1 minute at room temperature. For maximum reliability, replicates are strongly recommended (minimum of 3).

6. For PCR program setup, please refer to the instructions of the master mix of the user's choice. We recommend a typical 3-step qPCR protocol for a 200nt amplicon:

Three-step cycling protocol

Step	Temperature	Time	Number of cycles
Initial denaturation	95°C	10 min	1
Denaturation	95°C	20 sec	
Annealing	65°C	20 sec	40
Extension	72°C	20 sec	
Data acquisition	Plate read		
Recommended	*Melting curve analysis*		1
Hold	4°C	Indefinite	1

7. (Optional) Load the PCR products on 1.5% agarose gel and perform electrophoresis to confirm the single band amplification in each well.
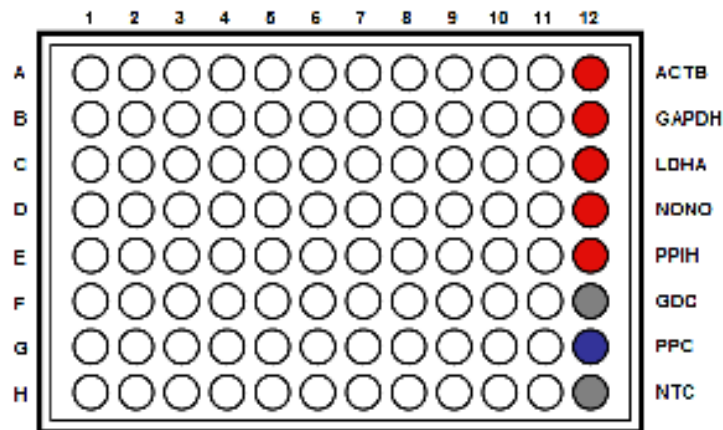
Figure 1. Layout of GeneQuery™ qPCR array kit controls.

Table 2. Interpretation of control results:

Controls	Results	Interpretation	Suggestions
Housekeeping gene controls	Variability of a housekeeping gene's Cq value	The expression of the housekeeping gene is variable in samples; cycling program is incorrect	Choose a constantly expressed target, or analyze expression levels of multiple housekeeping genes; use correct cycling program and make sure that all cycle parameters have been correctly entered
gDNA Control (GDC)	$Cq \geq 35$	No gDNA detected	N/A
	$Cq < 35$	The sample is contaminated with gDNA	Perform DNase digestion during RNA purification step
Positive PCR Control (PPC)	$Cq > 30$; or The Cq variations > 2 between qPCR Arrays.	Poor PCR performance; possible PCR inhibitor in reactions; cycling program incorrect	Eliminate inhibitor by purifying samples; use correct cycling program and make sure that all cycle parameters have been correctly entered
No Template Control (NTC)	Positive	DNA contamination in workflow	Eliminate sources of DNA contamination (reagents, plastics, etc.)

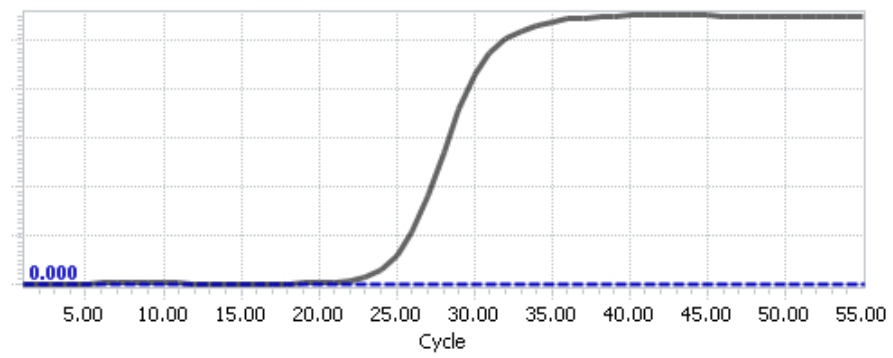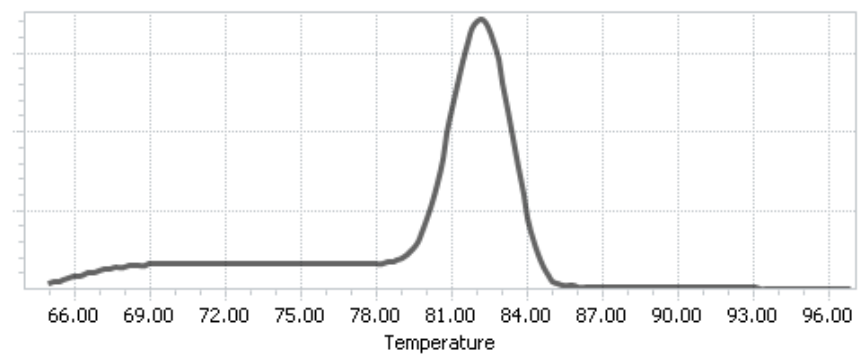Figure 2. A typical amplification curve showing the amplification of a qPCR product.

Figure 3. A typical melting peak of a qPCR product.

Quantification Method: Comparative ΔΔCq (Quantification Cycle Value) Method

1. **Note:** Please refer to your qPCR instrument's data analysis software for data analysis. The method provided here serves as guidance for quick manual calculations.

   You can use one or more housekeeping genes as a reference to normalize samples.

   Important: We highly recommend using all 5 housekeeping genes included in this kit: ACTB, GAPDH, LDHA, NONO, and PPIH.

2. For a single housekeeping gene, ΔCq (ref) is the quantification cycle number change for that housekeeping gene (HKG) between an experimental sample and control sample.

   $$\Delta Cq \text{ (ref)} = Cq \text{ (HKG, experimental sample)} - Cq \text{ (HKG, control sample)}$$

   When using multiple housekeeping genes as a reference, we recommend normalizing using the geometric mean [1] of the expression level change, which is the same as normalizing using the arithmetic mean of ΔCq of the selected housekeeping genes.

   $$\Delta Cq \text{ (ref)} = \text{average } (\Delta Cq \text{ (HKG1)}, \Delta Cq \text{ (HKG2)},......., \Delta Cq \text{ (HKG n)})$$ (n is the number of housekeeping genes selected)

   If using all 5 housekeeping genes included in this kit (ACTB, GAPDH, LDHA, NONO, and PPIH) use the following formula:

   $$\Delta Cq \text{ (ref)} = (\Delta Cq(ACTB)+\Delta Cq(GAPDH)+\Delta Cq(LDHA)+\Delta Cq(NONO)+\Delta Cq(PPIH)) /5$$

   Note: ΔCq (HKG) = Cq (HKG, experimental sample) - Cq (HKG, control sample), and ΔCq (HKG) value can be positive, 0, or negative.

3. For any of your genes of interest (GOI),

   $$\Delta Cq \text{ (GOI)} = Cq \text{ (GOI, experimental sample)} - Cq \text{ (GOI, control sample)}$$

   $$\Delta\Delta Cq = \Delta Cq \text{ (GOI)} - \Delta Cq \text{ (ref)}$$

   $$\text{Normalized GOI expression level fold change} = 2^{-\Delta\Delta Cq}$$

References

[1] Vandesompele J, De Preter K, Pattyn F, Poppe B, Van Roy N, De Paepe A, Speleman F. (2002) "Accurate normalization of real-time quantitative RT-PCR data by geometric averaging of multiple internal control genes." *Genome Biol.* 3(7): 1-12.

Example: Comparative ΔΔCq (Quantification Cycle Value) Method

Table 3. Cq (Quantification Cycle) values of 2 genes-of-interest and 5 housekeeping genes obtained for experimental and control samples.

	Genes of Interest		Housekeeping Genes				
Samples	GOI1	GOI2	*ACTB*	*GAPDH*	*LDHA*	*NONO*	*PPIH*
Experimental	21.61	22.19	17.16	17.84	20.12	19.64	26.40
Control	33.13	26.47	18.20	18.48	20.57	19.50	26.55

$$\Delta Cq \text{ (ref)} = (\Delta Cq(ACTB)+\Delta Cq(GAPDH)+\Delta Cq(LDHA)+\Delta Cq(NONO)+\Delta Cq(PPIH))\ /5$$
$$= ((17.16\text{-}18.20)+(17.84\text{-}18.48)+(20.12\text{-}20.57)+(19.64\text{-}19.50)+(26.40\text{-}26.55))/5$$
$$= -0.43$$

$$\Delta Cq \text{ (GOI1)} = 21.61 - 33.13$$
$$= -11.52$$

$$\Delta Cq \text{ (GOI2)} = 22.19 - 26.47$$
$$= -4.28$$

$$\Delta\Delta Cq \text{ (GOI1)} = \Delta Cq \text{ (GOI1)} - \Delta Cq \text{ (ref)}$$
$$= -11.52 - (-0.43)$$
$$= -11.09$$

$$\Delta\Delta Cq \text{ (GOI2)} = \Delta Cq \text{ (GOI2)} - \Delta Cq \text{ (ref)}$$
$$= -4.28 - (-0.43)$$
$$= -3.85$$

$$\text{Normalized GOI1 expression level fold change} = 2^{-\Delta\Delta Cq \text{ (GOI1)}}$$
$$= 2^{11.09}$$
$$= 2180$$

$$\text{Normalized GOI2 expression level fold change} = 2^{-\Delta\Delta Cq \text{ (GOI2)}}$$
$$= 2^{3.85}$$
$$= 14.4$$

Conclusion: Upon treatment, expression level of GOI1 increased 2,180 fold, and expression level of GOI2 increased 14.4 fold.

ScienCell™
Research Laboratories

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GeneQuery™ Human Transcription Factors qPCR Array Plate Layout*
(**8 controls** in Bold and Italic)

<u>**Note**</u>: all gene names follow their official symbols by HGNC

	1	2	3	4	5	6	7	8	9	10	11	12
A	ABL1	CEBPB	ETS1	GATA2	IRF1	MEF2C	NFATC1	NR4A2	REL	SOX18	STAT6	*ACTB*
B	AR	CREB1	ETS2	GATA3	JUN	MITF	NFATC2	OLIG1	RELA	SOX2	TBX3	*GAPDH*
C	ARNT	CREBBP	FOS	GBX2	JUNB	MYB	NFATC3	PAX6	RUNX1	SOX9	TFAP2A	*LDHA*
D	ATF2	CTNNB1	FOXA1	GLI1	KLF4	MYC	NFATC4	PITX2	SMAD1	SP1	TGFB1	*NONO*
E	ATF4	E2F1	FOXD3	HIF1A	LEF1	MYCN	NFE2L2	POU5F1	SMAD4	SRF	TNF	*PPIH*
F	BRCA1	EGR1	FOXO1	HNF4A	MAX	NANOG	NFKB1	PPARA	SMAD5	STAT1	TP53	*GDC*
G	CDKN2A	ELK1	FOXO3	HSF1	MEF2A	NF1	NFYA	RARA	SMAD9	STAT3	TWIST1	*PPC*
H	CEBPA	ESR1	GATA1	ID1	MEF2B	NFAT5	NKX3-1	RB1	SNAI1	STAT5A	WT1	*NTC*

* gene selection may be updated based on new research and development

Appendix. Plate type choice chart.

Plate type A

Brand	Model	kit catalog #
ABI / Life Tech	ABI 5700	GK124-A
	ABI 7000	GK124-A
	ABI 7300	GK124-A
	ABI 7500	GK124-A
	ABI 7700	GK124-A
	ABI 7900 HT	GK124-A
	QuantStudio	GK124-A
	ViiA 7	GK124-A
Bio-Rad	Chromo4	GK124-A
	iCycler	GK124-A
	iQ5	GK124-A
	MyiQ	GK124-A
	MyiQ2	GK124-A
Eppendorf / Life Tech	Matercycler ep realplex 2	GK124-A
	Matercycler ep realplex 4	GK124-A
Stratagene	MX3000P	GK124-A
	MX3005P	GK124-A

Plate type B

Brand	Model	kit catalog #
ABI / Life Tech	ABI 7500 Fast	GK124-B
	ABI 7900 HT Fast	GK124-B
	QuantStudio Fast	GK124-B
	StepOnePlus	GK124-B
	ViiA 7 Fast	GK124-B
Bio-Rad	CFX Connect	GK124-B
	CFX96	GK124-B
	DNA Engine Opticon 2	GK124-B
Stratagene	MX4000	GK124-B

Plate type C

Brand	Model	kit catalog #
Roche	Lightcycler 96	GK124-C
	Lightcycler 480 (96-well)	GK124-C