

Supplementary Table S5. Differentially expressed gene lists of PD-1^{high} CD39⁺ CD8 TILs according to 4-1BB expression compared to PD-1⁺ CD39⁻ CD8 TILs

Up- or down- regulated genes in PD-1 ^{high} CD39 ⁺ CD8 TILs compared to PD-1 ⁺ CD39 ⁻ CD8 TILs	Up- or down- regulated genes only in 4-1BB ^{neg} PD-1 ^{high} CD39 ⁺ CD8 TILs compared to PD-1 ⁺ CD39 ⁻ CD8 TILs	Up- or down- regulated genes only in 4-1BB ^{pos} PD-1 ^{high} CD39 ⁺ CD8 TILs compared to PD-1 ⁺ CD39 ⁻ CD8 TILs
IL7R	KLRG1	TNFSF4
ENTPDI	DHRS3	LEF1
ITGA5	MKI67	PZP
KLF3	RYR2	SIK1B
ANK3	LYST	PPP1R3B
ETV1	ADAM28	H2AC13
CCR7	GFOD1	RASGRP2
ITGAX	MAST4	RAD51AP1
MYO1E	CLCF1	NEBL
SIPR5	VCL	MPP7
MS4A6A	PHLDB1	GFPT2
TNF	RPL3	SPRY4
VCAM1	B4GALT5	TIPARP
TNS3	PDCD1	POLQ
AKAP5	IL6ST	LY9
PLXND1	PLEKHA1	NEU1
DGKH	SPRY2	PLEKHG3
IKZF4	MTX3	PARK7
ATP8B4	SYT11	PTGER4
SORL1	RAB11FIP5	BRCA1
MAP4K3	NCR1	CCR4
SIPR1	PDE8A	IFIT2
EPHA4	ARHGEF12	PAICS
PELI2	LAT2	GPRASP1
TTN	RPLP0	IL4I1
AUTS2	RPS3	CDCA3
NHS	LONRF2	CDC42EP3
SLCO3A1	RRM2	ADAMTSL4
INPP5F	ARHGAP31	ESCO2
ADRB2	CSF1	WDHD1
GOLIM4	CDK5RAP1	CD69
GLUL	HJURP	SHC4
GNLY	TTC9	HELLS
DPP4	IL23A	PITPNC1
TOX	ARHGEF9	EXO1
SLC4A4	CKAP4	CARMIL3
NHSL2	DZIP3	GINS1
FUT8	UBASH3B	CDCA5
PDE7B	SOGA1	CDC45
NR3C2	TRIB1	KIF14
TRAF5	LIMS1	PPP1R2C
TNFRSF9	KLRC2	POLA1
CD80	ATP10D	CDCA8
SETD7	IER2	PATL2
CCDC141	CD84	HSPA6
CYB561	MPHOSPH9	CLSPN
KLRC1	PTMS	SCML4
ZBTB10	CCL3	CA5B
PIP5K1B	WNT9A	CCNH
GEM	IL18RAP	GGH
SARDH	B3GNT7	C13orf46
SBF2	IKZF3	ZMAT1
TCF7	NECTIN1	H3C7
FOS	PAG1	HECA
SLC4A10	SLC35G2	PER1
P2RY1	NFKBIA	WDR76
PLAUR	KDM1A	H1-5
TSHZ2	FAM102B	HMMR
GPR132	CCRL2	PARP8
A2M	ST8SIA1	NUF2
IL5RA	RBPMS	UBE2T
USP53	EEF1A1	PLAC8
LGR6	TMEM123	NEK2
SNAP47	PTGIS	SH2B3
P2RY8	S100PBP	PLEKHA7
CLNK	CRIM1	MGAT5
YBX3	TP53INP1	DTL
CFH	FEZ1	MYB
FRMD4B	TSPAN5	STIL
ITGA2	GOLGA6L10	MYBL2
AH1	CAND2	GZMB
RBPJ	PELI1	HSPA1B
KCNK5	GOLGA6L9	TICRR
TPRG1	UBE2C	AURKA

MYC	PTPRJ	LHFPL6
GADD45B	LAG3	NLRP3
KLF2	DENND3	CDC25A
SIRPG	LPL	CIP2A
ATP9A	MPST	DNA2
ITGA6	ATP1B1	CNR2
BEND4	CHST2	TNFAIP3
PHEX	PTPRA	FAM222A
NABP1	RGS2	FAM111B
CD200	TJP3	MBP
SIPA1L2	CCL23	FABP5
TMCC3	RDH16	H2AC11
ERN1	RPL13	KIF20A
PLCB1	ASXL2	MT-ND6
RGS1	NAV2	SPON2
BTBD19	HLA-DMA	CENPA
RASGRF2	SERPINB9	FANCI
TOX2	MPP6	BRIP1
GNAO1	CDKL5	MARCKSL1
PTGER2	NPC1	PLK4
PXN	TUBB4B	DNAJB1
CUX1	FBXO2	DUSP1
LYAR	RAB33B	TTK
TC2N	EMP3	FANCA
MID2	SLC25A4	CCDC150
CD200R1	TWISTNB	NCKAP5L
PON2	PLD1	EPB41
BCL9L	SCRN1	ZBED2
FLT1	VPS45	SELPLG
RASA3	NOL4L	PRDX3
NR4A3	PTPN6	ATAD5
GDPD5	NAT9	RDH10
MGAT4A	EML6	STOM
GPD2	ANKRD33B	COL6A2
SVIL	LDOC1	CENPI
FAM3C	DDX21	MCM4
ADGRG1	PKIG	MCM3
DENND5A	TLK1	PFKFB3
PERP	NLGN2	POLD3
SPOCK2	PHTF2	KCNQ5
KLF7	ANKRD10	CENPU
ZC3H12C	MT-ND3	FAM177A1
PLK3	SLC16A1	KIF4A
ASPM	OAS3	RACGAP1
TOB1	NFE2L2	CDC6
GSTO2	CPNE7	C3AR1
KNL1		GPR155
PTPRM		KIF18A
CD300A		CXCL13
TBC1D4		LAIR1
TP53I11		CENPJ
PRRG4		KLF6
CDK14		ADCY3
AGPAT4		KLHDC7B
TYROBP		USP36
CD109		GAPDH
UPP1		ORC6
AQP3		NCR3
GLDC		SERPINB6
FGR		TK1
IFNGR1		POU6F1
NRIP3		FOXP1
SC5D		MX2
SPEF2		HSPA1A
CRYBG1		LRATD2
SH3BGRL2		CD6
CLECL1		DNAJA4
GABBR1		CLINT1
AOAH		GIMAP1
FAM241A		H2BC13
NR5A2		ABCA5
SGPP2		TAMALIN
SLC39A10		AMER1
HAVCR1		CDKN3
SELL		IL4
GPR183		RBBP8
PIK3R1		MMS22L
DKK3		MCM5
TIMP1		BTG1
ITGAE		GAB3
LTB		TTBK1
APBA2		RIMKLB
BTNL8		HOMER1
TGFB1		CCDC97
MYO7A		SNRK

NEO1	FCMR
SALL4	E2F8
LAIR2	EMP1
PLXDC1	CIT
MXI1	H2BC9
DSE	TSC22D3
CHN1	TCF7L2
CHD7	ZWINT
WIPF3	ABHD6
BCL6	C9orf72
C1orf162	ASF1B
SMIM3	HIPK2
NDFIP2	MRPL51
ETV3	DHCR7
TIGIT	SLC12A7
MS4A1	EML4
RASSF2	TFDP1
KIF11	NR4A1
FTH1	CD70
TIAM2	IL15
TRABD2A	H3C3
TLE4	E2F2
ARL3	CCDC34
PBX4	GALNT2
TMEM71	SCCPDH
TUBA4A	RAB27B
AHNAK	PDGFA
CENPF	BRCA2
CARD16	CCNB1
BTG2	KIF18B
TNRC6C	PIF1
SSBP2	GRK3
ZBTB18	SAMHD1
EGR3	FANCD2
NEIL3	FNIP2
MYO1D	SYNGR1
CTRC	DDX11
IGFBP3	FOXM1
ZNF282	XXYL1
ARL4C	CENPH
CAMK4	PRDX5
HECTD2	H2BC11
RNF130	SKI
RTL5	PIM2
CSGALNACT1	TULP2
SLC2A3	CASS4
SOD2	TCF19
TOP2A	CENPW
CCDC50	RFC3
CD44	JMJD6
TSC22D2	PCNA
TTYH2	ZNF683
PSTPIP2	GABARAPL1
KLRD1	CD82
NETO2	TUBB
HPCAL4	PBXIP1
PTPRN2	CCDC167
SMAD7	IRGM
GALNT3	TROAP
RIPOR2	BTN3A1
SYNE1	CTDSP2
ZNF532	CXCL16
SORBS3	BATF
KIF15	HSPH1
LDLRAP1	CDCA7L
SATB1	TMEM198
FER	ZFAND2A
NFIL3	ACYP1
KRT86	YPEL5
PNP	IFRD1
CD63	RNF125
MTMR8	CKS1B
TIAM1	SYDE2
VDR	GOLGA7B
ATN1	DCBLD1
DPF3	EID1
NCK2	EPB4IL4A
BUB1B	H4C8
PABPC1	CAMK2G
AGFG1	FEN1
AREG	DEPDC1
CD55	DHFR
SKIL	GCSAM
NDRG1	CD5
RUNX3	EPHX1

ZFP36L2		FMN1
FKBP1A		SCART1
HOOK1		ATF3
SPART		CTTNBP2NL
CSRNP1		SKA3
SUOX		ZC3HAV1
ZNF165		RBL2
USP6NL		ZGRF1
VSIG10		TTC39A
C1orf61		BLVRA
COL1A1		TMEM106C
FAM102A		IGFBP4
MAFF		SHMT2
BTLA		THBS1
CDKN1A		ID1
KIF23		NSD2
TTYH3		KLHL6
ZCCHC14		RANBP1
E2F7		PIK3IP1
MTUS1		PRKAR2A
KCNA3		ARRB1
PRKCI		PRR11
FZD6		GDPD4
TNFSF10		H2AC21
POU2AF1		PPP1R15A
MIDN		MT-ND5
PMEP1A		IGF1R
CERS6		KIF2C
BAZ2B		TMEM163
PON3		DPEP2
MELK		PLEKHG6
KIR2DL4		SFXN5
PTGDR		REEP2
TANC2		DUSP2
RGS13		SNTA1
TNFRSF10D		RMI2
RERE		SYNGR3
CTH		ARHGAP12
VSIG1		MAGEH1
LMNA		EBI3
ANLN		SKAP2
SSH2		JUND
ZFYVE9		DEK
IL12RB2		SFXN2
CCNB2		E2F1
ENPP5		GINS2
NCAPG2		PVR
RIPK2		CENPO
ECT2		GEN1
ASB2		ADPRH
PIAS2		HMGB2
ITM2A		PGAM1
HASPIN		ITGAM
ZFP36		FBXO43
COL6A3		TTL
SKA1		AGAP1
COL5A2		THOP1
TMPO		ADTRP
TSHZ1		CKS2
TXNIP		PIP4K2A
PLEKHA5		GALNT6
S100B		SLFN11
TNFSF8		C16orf72
TTC21A		SYNE2
RCAN2		ZNF90
SMC2		RBM38
CA2		BCAT1
ZDHHC11B		PTPRK
LSR		BRDT
TMEM178A		SPDL1
HS3ST3B1		ARRDC2
PTCH1		INCENP
RAB27A		LPIN2
DENND2C		RNF149
TRIO		NDRG2
FAM117A		CDC25C
TPX2		ERP27
ADAMTS3		ARHGAP26
TUFT1		DLG5
PATJ		CD48
SMIM10		CAST
MND1		SIK1
TP53BP2		WARS1
DNAJC6		ATM
ZMIZ1		MTFR2

PHLDA1	POLE2
NAALADL1	LEPROTL1
RARA	PKM
MTSS1	GSTM3
BARD1	SLC2A8
RHOU	SYTL2
RAP1GAP2	PKIA
ELL2	IQCN
CD28	WFDC2
VSIR	CATSPERB
PLCL1	NBEAL2
IFFO2	PLCD1
ADRA2B	NCAM1
EZR	FOSL1
ARID5A	CEP152
RNF144A	GPCPD1
VWA2	LIMA1
TMEM88	WHRN
PAM	PIK3R6
NCAPG	ANP32E
N4BP3	SPIRE2
DLGAP5	NATD1
F11R	RALGAPA1
SESN1	OSBPL3
SMC4	CDC14A
NCALD	NSG1
PDZD4	TYMS
DUSP4	BLM
NTN4	TMEM273
CENPE	NFE2L3
FCRL6	SNRNP25
CLU	IDS
APOL3	CDCA7
FOXO3	GSTO1
KDM6B	KIFC1
PTTG1	MBD2
ASTL	ARSB
GRAMD1B	ZNF208
SHROOM3	NME1
PCSK5	MIDEAS
TP73	OASL
UTS2	B4GALT1
SOX13	ME1
SPC24	PRUNE2
RORC	RASA1
CTLA4	H2BC10
PRDM5	FAM163B
SEM1	NUDT1
MT-ND4	PCLAF
MPZL3	DENND11
LIPC	RECQL4
FAM169A	TSPYL2
PDE4B	CISH
TRMO	SPON1
TCP11L2	NCAPD3
STAT4	DEPDC1B
HLA-DRA	TBX21
PITPNM2	FADS3
EGR1	GRIP1
PLAGL1	DOCK9
EHD1	CCNYL1
TAF4B	ZNF395
BEX2	TNFRSF18
SLC2A1	ORC1
TNFSF14	CHAF1B
BARX2	CHMP1B
GNG4	MAD2L1
HBEGF	PNRC1
MYEF2	DOCK5
CKAP2L	C1orf112
ARHGAP11A	MCL1
DBH	CTU2
TMEM63A	NMRK1
JUNB	EPAS1
GCNT1	CAPG
CDCA2	FANCL
AFAP1L2	BTNL9
STMN1	ATP1A1
WNT10B	KCNN1
GTSE1	SLC16A10
PRNP	ATAD2
FAM166B	SAT1
CHEK1	H3C12
LUZP1	NOD2
SMAD3	NAB1

H2AC14	KNSTRN
HDAC7	PLPP1
ZHX2	MALT1
ACVR1C	H2AC12
ZNRF1	SRGAP2C
CEBPD	ZNF711
RREB1	CHEK2
CDK1	DDX24
DUSP6	SMIM14
TULP4	SUPT16H
MT-CO2	ARIH1
ESPL1	GPR171
GK	TNIK
ACSL6	BTBD9
ANXA1	ELOVL5
NFIA	MTBP
PBK	VANGL1
REL	TMEM131L
H2BC7	TSPYL1
KNTC1	ANKEF1
RIN3	MYBL1
RASSF3	DBI
ENC1	GLI1
FKBP11	DNAJB6
TUBB2A	CD53
SOCS3	ABCA12
MATK	CBX5
TPPP	MKNK2
GPM6B	TRAM2
ACP5	GSAP
TENT5C	RBX1
AURKB	WDR62
NFKB1	ZNF367
KLF5	ZDHHC11
PIM1	COQ8A
CCNF	SIRT1
CEP55	MAML2
PLCG2	C11orf21
SMCHD1	MSI2
USP3	SPC25
SIPR4	MT-ATP6
FGFBP2	ABLIM1
ALDH3A2	BIN2
SQLE	ID3
DIAPH3	ZNF331
GPR55	ECM2
LMCD1	UBR7
ATP5PF	CENPN
BIRC5	SRGAP2
DUSP8	ODF2L
FOSB	SESTD1
S100A10	PPP2R5C
BUB1	PCNX1
MT-CO1	BANF1
FAM184A	DMC1
NAF1	CACNA2D2
FCHO2	HSPA2
METTL8	STAC
PHF1	RDX
ANKS1B	H2AZ1
SHCBP1	MAD2L2
FBXO5	MUC3A
SAMD3	SLAMF7
HELB	TRIM22
CXCR4	NOSTRIN
MEGF6	AMIGO1
TMOD2	CREB3L3
EPHA1	TRIM39
MYADM	H2BC17
FOSL2	PPP1CB
GALNT1	SESN2
	MCM6
	TPI1
	FILIP1L
	GLIPR1
	IQSEC1
	PLPP2
	KLF9
	NCS1
	RHOQ
	SMPDL3A
	RPS6KA2
	DYRK2
	CTNNA1
	CD2BP2

		H4C13
		TLR3
		CENPL
		MIA3
		DMXL2
		ELP6
		GMPR2
		MYO6
		PRKAG2
		OFD1
		CTTN
		ITGA9
		HMGB3
		TMED8
		ITGB8
		TMEM108
		ITPKB
		DOT1L
		DMRT2
		H4C5
		NDC80
		KLF13
		EVC
		BCL2L12
		KIF20B
		RFC4
		FHL1
		LFNG
		RGCC
		TRIM8
		CHD2
		TAGAP
		CX3CR1
		C16orf54
		SEC11A
		NEIL1
		TALDO1
		GBP5
		AC013394.1
		MUC5AC
		FGF9
		SERP2
		MADD
		FBXO32
		H2BC4
		MUC5B
		GPX3
		TRANK1
		AUH
		GYG1
		DPYD
		LRIG1
		SAE1
		USP2
		APOBEC3C
		COPRS
		PSMC3
		AMPD3
		AXIN2
		NAALAD2
		NIPAL4
		GCNT4
		TIPIN
		ITPRIP

Genes are listed in the order of the value of \log_2 FoldChange.